Anti-viral properties of *wildeals (Artemisia afra)* and *wynruit (Ruta graveolens)* as combination therapy and its effects on the renal system

Thesis submitted for the fulfillment of the requirements for the degree of

Doctor of Philosophy

North-West University (Mafikeng Campus)

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May 2015

Declaration

I hereby solemnly declare that this thesis presents the work carried out by myself and to the best of my knowledge does not contain any materials written by another person, except where due reference is made. I declare that all the sources used, or quoted in this study are acknowledged in the bibliography. No conflict of interest that the researcher has to declare or was aware of while conducting this research

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David Mphuthi

May 2015

A special word of thanks for the following funders that made this research possible:

Department of Science and Technology (DST), National Research Fund (NRF) and University of South Africa Research Directorate (UNISA).

"*I am an African. I owe my being to the Khoi and the San … I am formed of the migrants who left Europe to find a new home on our native land ... In my veins courses the blood of the Malay slaves who came from the East. … I am the grandchild of the warrior men and women that Hintsa and Sekhukhune led, the patriots that Cetshwayo and Mphephu took to battle, the soldiers Moshoeshoe and Ngungunyane taught never to dishonor the cause of freedom. … I come of those who were transported from India and China … Being part of all these people, and in the knowledge that none dare contest that assertion, I shall claim that I am an African! We are assembled here today to mark their victory in acquiring and exercising their right to formulate their own definition of what it means to be African. The Constitution whose adoption we celebrate constitutes an unequivocal statement that we refuse to accept that our Africanness shall be defined by our race, colour, gender or historical origins." (Mbeki, 1999)*

The potency of a lifelong initiative

This research project is a sub-project of the Seboka research Team. The African academic is firstly the child of mother Africa and secondly the creator of knowledge in the primary context of Africa and secondarily in the global sphere. The configuration of an African scholar's identity necessarily entails accepting a bundle of responsibilities shaped by mother Africa's potent imperatives. Etymologically defined, 'Seboka' denotes a 'group,' a 'team,' a 'community' and a phenomenal 'coming together' of sorts. The term of necessity subsumes one's ephemeral individuality under the value-generating ethos of 'communitarian' solidarity. A signifier of the shared benefits of synergy, the Seboka emblem - depicting a pride of lions on a mission under the supreme guidance of collective vision - is a celebration of the invaluable wealth of sharing and reciprocal engagement which lies at the heart of Africa's philosophy. As such, the Seboka concept was born out of respect for the imperatives of mother Africa, whose breast has availed the milk of human kindness moulding the African children into a team of valiant warriors in legitimate defence of their priceless heritage.

The Seboka logo summons to memory the telling axiom, 'A lion that goes on a hunt by itself, without co-existing in a pride, will always fail to catch even a limping deer.' In the same communitarian spirit, Seboka uses the claypot as a key emblem, symbolising sharing and communal solidarity. The Seboka team perceptively unpacks this definitive element of African life and essence, the profound *Ubuntu* philosophy, potently encapsulated in the dictum 'I am, because we are,' hence placing community and group care above the focus of the self. This Seboka team is a rich confluence of various tributaries, but the Community is their first consideration.

The hallmark of Seboka's invaluable research output has been the endeavour to strike signature partnerships with the community, the very custodians of the forests, mountains and rivers which are the abode of nature's healing essence and strength. Quite enlightening is the Khoi-chief's statement made recently in an open platform, *'The veld is our chemist'* (Kok V, 2013). The wisdom enshrined in this statement is a telling testimony of how conventional medical practice has always tapped into the resourcefulness of medicinal plants and other curative phenomena in Africa's rich forests. Notwithstanding the research on medicinal plants, the Seboka team predominantly re-engineer the broader practices of the African child

Seboka Greeting

The activities of the Seboka project is predominantly funded by the National Research Foundation (RSA); The Department of Science and technology (RSA) and the North-West University (Mafikeng Campus)

Acknowledgements

I would like to acknowledge and thank the following people who stood by me during my years of studies. You were truly a source of inspiration to me:

- The Almighty God Father, who gave me the wisdom and power to sail and jump over the storms and the hurdles of life during my studies.
- Professor Abel J Pienaar, my research promoter, for guidance and support during my studies. "*If you want to know the bush, follow the Bushman".*
- My lovely wife, Jeridah Mphuthi, who has been my pillar of strength during my studies. Without you, this would have not been easier.
- My mother, Sarah Mphuthi, for her continued motherly support and love.
- My children, Leoka and Mathapelo, to whom I would like to dedicate this work.
- The communities at the research sites South Africa (Northern Cape Province) and Lesotho (Maseru), for sharing their information religiously and honestly.
- Mr Leoka Mphuthi, for translating the transcripts from Afrikaans to English.
- Mr Cor Bester, for assisting with the *in vivo* phase and training.
- Mr Simon Rambofheni and colleagues, for the *in vitro* phase assistance.
- Oom Pienaar, Marshall Pienaar and Donovan Smous, for assisting with medicinal plants preparation.
- Ouma Mieta Williams, an elderly of 98 years for her blessings and love.
- Ms Ilja de Boer, for her assistance with the quantitative data analysis.
- Ms Julia Handford, for the language editing.
- Seboka project, for the funding and support from members of their team.
- NRF/DST and UNISA for the provision of funds for the Seboka project.
- Ms Mechelle Britz for timeously making arrangements and coordinating itineraries.
- Mr Owen B. Nene, for his undying encouragement and support.
- Prof Zethu Nkosi, for all the advice and support during my studies.
- Mr Teboho Taaka and Mr. Khauhelo Mahlatsi, for the finalisation of concepts.
- My sisters in mission, 'Me Bock, 'Me Mphana, 'Me Ntseki le 'Me Phoofolo, *"ke ea leboha banabeso".*
- The late Dr John Mfundo Nojaja for mentorship and referral to Prof. A.J. Pienaar for research supervision.
- Lastly, everybody whom I might not have mentioned here, thank you very much.

Summary

Key words: *wildeals*, *wynruit*, *Artemisia afra, Ruta graveolens*, influenza, renal system.

Title: The anti-viral properties of *wildeals (Artemisia afra)* and *wynruit (Ruta graveolens)* as combination therapy and its effects on the renal system.

Globally, approximately 80% of the population is using indigenous medicines. This is because indigenous medicines are less expensive and since the indigenous healers are residing within their communities. The indigenous people trust medicinal plants more than Western medicines, because they have been using them since time immemorial. *Wildeals* (*Artemisia afra*) and *wynruit* (*Ruta graveolens)* are other medicinal plants that have been used by some indigenous people in South Africa to treat several conditions. These have mostly been used as mono therapies, but in the Northern Cape Province, Griqualand-West, South Africa, they are being used as combination therapies also.

A combination of *wildeals* and *wynruit* is a commonly used medicinal decoction in the Northern Cape Province in South Africa. The aims of this research were to confirm scientific knowledge regarding the anti-viral properties of such *wildeals* and *wynruit* decoctions, prepared either as single, or combination therapies, as well as to investigate their effects on the renal system. To achieve these, the anti-viral properties *in vitro* and the effects on the renal system *in vivo* were investigated during this study. The decoctions were tested *in vitro* against the influenza virus (common cold), and *in vivo* for any possible undesirable effects on the renal system, using Sprague-Dawley rats.

This research project had followed a mixed method approach, with a multiphase design. Research phase 1 comprised of the realisation of the qualitative approach, phase two involved a systematic review, while phase 3 consisted of the *in vitro* testing and phase 4 of the *in vivo* experimental procedures. Population and sampling were in accordance with the objectives of each phase. Data was collected and analysed in accordance with the objectives of each phase, since a multiple approach to data collection and analysis was used during this research project. This study comprised of a baseline type of research, where hybrid science was used to generate baseline knowledge.

The decoctions being investigated during this research had been prepared authentically by the rural Griqua community, under pragmatic conditions, and subjected to testing in a western science laboratory. The findings revealed that the combination therapy and the one medicinal plant (*wildeals)* had proven effective against the influenza virus. In vitro medicinal

plant (*wynruit)* had demonstrated some resistance, which may have resulted from possible contamination during uncontrolled preparation by the community member. No undesirable effects on the kidneys and livers of rats were identified.

It was concluded that the tested decoctions, as prepared by the Griqua community from *wildeals* and *wynruit* for this study, had appeared safe and effective for human consumption. This outcome could significantly impact on future health care in South Africa, if co-existence between Indigenous and Western health systems is promoted and achieved.

Opsomming

Sleutelwoorde: *wildeals*, *wynruit*, *Artemisia afra, Ruta graveolens*, griep, niersisteem.

Titel: Anti-virale eienskappe van wildeals *(Artemisia afra)* en wynruit *(Ruta graveolens)* as kombinasie-terapie en die uitwerking daarvan op die niersisteem.

Ongeveer 80% van die wêreldwye bevolking gebruik inheemse medisyne. Dit is omdat inheemse medisyne goedkoper is en inheemse genesers in hulle gemeenskappe woonagtig is. Die inheemse mense vertrou medisinale plante meer as Westerse medisyne, omdat hulle dit al sedert die vroegste tye gebruik. Wildeals (*Artemisia afra*) en wynruit (*Ruta graveolens)* is van die medisinale plante wat deur sommige inheemse mense in Suid-Afrika gebruik word om verskeie toestande te behandel. Hierdie word meestal as mono-terapieë gebruik, maar dit word in die Noord-Kaap Provinsie, Griekwaland-Wes, Suid-Afrika, ook as kombinasie-terapie aangewend.

'n Kombinasie van wildeals en wynruit is 'n algemeen gebruikte medisinale afkooksel in die Noord-Kaap Provinsie in Suid-Afrika. Die doelwitte van hierdie navorsing was om wetenskaplike kennis ten opsigte van die anti-virale eienskappe van sulke wildeals- en wynruit afkooksels te bevestig, voorberei óf as 'n enkele-, óf 'n kombinasie-terapie, asook om die uitwerking daarvan op die niersisteem te ondersoek. Om dit te bereik, is die anti-virale eienskappe *in vitro* en die uitwerking daarvan op die renale stelsel *in vivo* tydens hierdie studie ondersoek. Die afkooksels is *in vitro* teen die griepvirus getoets, en *in vivo* vir enige moontlike ongewenste uitwerkings op die niersisteem, met behulp van Sprague-Dawley rotte.

Hierdie navorsingsprojek het 'n gemengde metode-benadering, met 'n multi-fase ontwerp gevolg. Navorsingsfase 1 het uit die verwesenliking van die kwalitatiewe benadering bestaan, fase 2 het 'n sistematiese oorsig behels, terwyl fase 3 uit die *in vitro* toetsings en fase 4 uit die *in vivo* eksperimentele prosedures bestaan het. Die bevolking en steekproef was in ooreenstemming met die doelwitte van elke fase. Data is in ooreenstemming met die doelwitte van elke fase ingesamel en ontleed, aangesien 'n meervoudige benadering tot data-insameling en analise tydens hierdie navorsing gebruik is. Hierdie studie het uit 'n basislyn-tipe navorsing bestaan, waar hibriede wetenskap gebruik is om basislynkennis te genereer.

Die afkooksels wat tydens hierdie navorsing ondersoek is, was eg tradisioneel deur die landelike Griekwa-gemeenskap, onder ongekontroleerde toestande voorberei, en is dit

daarna aan toetsing in 'n westerse navorsingslaboratorium onderwerp. Die bevindinge het getoon dat die kombinasie-terapie en die een medisinale plant, doeltreffend teen die griepvirus was. Die ander medisinale plant, het ‘n mate van weerstand getoon, wat moontlik ontstaan het as gevolg van kontaminasie tydens die ongekontroleerde voorbereiding deur die gemeenskapslid. Geen ongewenste effekte op die niere en lewers van rotte is geïdentifiseer nie.

Daar is tot die gevolgtrekking gekom dat die getoetste afkooksels, soos deur die Griekwa-gemeenskap vanaf wildeals en wynruit vir hierdie studie voorberei, veilig en effektief vir menslike verbruik voorgekom het. Hierdie uitkomste mag 'n beduidende invloed op toekomstige gesondheidsorg in Suid-Afrika hê, indien mede-bestaan tussen Inheemse en Westerse gesondheidstelsels bevorder en bereik kan word.

Abbreviations used in this Research

AERC	Animal ethics review committee
AIHP	African indigenous health practice
AIS	African Indigenous Science
AKI	Acute kidney injury
AMSTAR	Assessment of multiple systematic reviews
ARF	Acute renal failure
AT	Aspartate aminotransferase
ATN	Acute tubular necrosis
DST	Department of Science and Technology
GGT	Gamma-glutamyl transpeptidase
HIV	Human immune virus
IK	Indigenous knowledge
IKS	Indigenous knowledge systems
IP	Intellectual property
MIC	Minimum inhibitory concentration
MOU	Memorandum of understanding
NHLS	National health laboratories services
NRF	National research fund
NSAIDs	Non-steroidal anti-inflammatory drugs
NWU	North-West University
PCDDP	Pre-clinical drug development platform
PRISMA	Preferred reporting items' systematic reviews meta-analysis
SAAD	South Africans of African Descent
SATMRG	South African traditional medicines research group
SOP	Standard operating procedures
UNISA	University of South Africa
WHO	World Health Organization
WHP	Western health practice
WS	Western science

AFRICAN IDIOM: SEBOKA

Seboka is the name given to the project under which this research is undertaken. This project is funded by National Research Fund and Department of Science and Technology (NRF/DST).

Seboka is a *setswana/sesotho* word meaning unity. The motto of Seboka: "*Tau ga di sena seboka, di siiwa ke none e tlhotsa" meaning;* ***(a lion that goes on hunt single and not co-exist in a pack, it will always fail to catch, even a limping deer)*** This project has produced literature materials of which have been used in this research. Wherever the word *"Seboka*" appears in this research it will be referring to this project.

Project: Indigenous Knowledge Systems (IKS)

Project number: NRF IKP20701130000018563

Part of this work has been presented at the South African Research Chairs Initiative (SARChI) in 2013, 2014 and 2015, under the topic" IKS interface". Funded by NRF/DST hosted by UNISA.

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Chapter 1

Research Overview

"*The art of healing comes from nature and not from the physician. Therefore, the physician must start from nature with an open mind."*

Paracelsus

1.1 Background and introduction

The above statement by Paracelsus (1530) voices the inherent belief system of indigenous people have for many generations and even today relied on natural products to heal the sick, despite the fact that the Western way of healing has become dominant.

This research study forms part of the Indigenous Knowledge Systems (IKS) project under the name “Seboka”. The main purpose of this IKS project is to develop current knowledge around IKS and practice, so as to empower nurses and the African Indigenous Health Practitioners for effective co-existence in an African health system (Seboka, 2010).

According to Durie (2003:510-511), indigenous people instinctively have had a way of treating and looking upon their sick in their communities. The dimensions of health and survival are viewed as being both collective and individual. Health and survival are interpreted on an inter-generational continuum, within a holistic perspective that incorporates four distinctly shared dimensions of life, i.e. spiritual, intellectual, physical and emotional well-being, co-existing in multiple levels of the past, present and future. Shrestra (2002:107) is of the opinion that indigenous knowledge has not been well and easily accepted, as communities and groups who have adhered to indigenous belief systems and who applied local knowledge in health and development practices, have often been misrepresented as being ill-educated, backward, or even uncivilised.

Despite this perception of indigenous people, who are using natural medications, having even been viewed as uncivilised (Shrestra, 2002:107), medicinal plants are still being used by approximately 80% of the South African population/native population. This high usage can be attributed to pharmaceutical drugs being too expensive and unaffordable to most, especially those living in rural areas (Mander *et al*., 2007:54). According to Ohenjo *et al*. (2006:1937-1946), regardless of the high usage of and demand for indigenous medications,

local people are facing substantial challenges in trying to convince policymakers to accept their perspectives in service provision.

In support, Carr *et al*. (2003:5497-5502) agree that indigenous people have an indigenous way of looking after their sick, which differs from the Western ways. Kirmayer (2004:33-48) supports this opinion by contending that indigenous healing practices follow a logical way that starts from a baseline (brain, where a person exercises endogenous pain control) to a higher hierarchy which involves society and environment. Modes of healing include touch, massage and environmental manipulation as well as modes of healing where the aim is to care for political and spiritual environments through acts of activism, which can be achieved by changing the relationship to the environment and spiritual orders (Kirmayer, 2004:33-48).

Wedel (2009:116-120) and Kangwa (2010:3-4) affirm the above views by stating that it is important not to separate body from spirit, as is done by the Western way of healing, which believes in the liberal notion of the individual being some sort of entity that is capable of existing and flourishing on its own, which is contrasting with the indigenous healing system's belief notion (Letseka, 2000:182-184), that I depend on other people to be who I am and we have to look after each other.

According to Durie (2003:510-511), survival and health are viewed as a collective continuum, and it is for this reason that indigenous people believe that when a family member is sick, the whole family should be cleansed. Furthermore, universal elements of healing, including cultural specific features are all viewed as systems of healing, as a theory of illness, as defined roles for the patient and healer, as a restricted place and time for healing rituals, and as specific symbolic actions with healing efficacy and consequent expectations for recovery (Kirmayer, 2004:33-48). As a result, Williams *et al*. (2011:1-32) are of the opinion that in rural South Africa, over 60% of the population still seek health advice and treatment from indigenous healers, before visiting a medical doctor. This practice can be attributed to the healing practice that is taking place in the indigenous healing system, where treatment also involves the family and the community.

Pienaar and Manaka-Mkhwanazi (2004:138) define health as well-being that is cultural and according to the individual's belief system, and which implies respect for the customs and the specific rituals and ceremonies that sustain and create a holistic equilibrium in a person. The above definition supports the World Health Organization (WHO) (2003) that defines health as a complete state of physical, mental and social well-being, and not merely the absence of disease, or infirmity. Similarly, Kubukeli (2000:24) views these definitions as being congruent with the practices of the indigenous healers, who always use holistic

approaches (physical, mental and spiritual), whereas Western medicines heal only the affected parts of the body and is it forever looking at germs or bacteria causing the disease.

Indigenous healing systems consider the social being of the client within the context of family members and sometimes even the village community as a support system to take care of the sick (Steinglass, 2002:32). In addition, Amanze (2011:10) views indigenous medicines as a total combination of knowledge and practices, used in the diagnosis, prevention, or elimination of a physical, mental, or social disease and which may solely depend on previous experiences and observations that had been handed down from one generation to another, either verbally, or in writing. The researcher is a trained nurse under the western sciences, and therefore it is for this reason the study looked at the indigenous knowledge systems, so as to clarify for western scientists. The study also aimed at correcting the misconceptions about indigenous knowledge that it is not science.

According to Jolles and Jolles (2000:230), the knowledge gap that exists between indigenous and Western healing systems gives rise to myths that lead to indigenous healers not being well accepted in the Western world. Despite these differences in healing approaches, Kirmayer (2004:33-48) is of the opinion that all perceptions about healing should form a central part of any medicinal system hence anthropologists writing about a rich array of healing practices being employed in different parts of the world. In addition, the author identifies healing practices and elements that are used by the different indigenous cultures, which include, amongst other methods, the use of medications that are ingested, smoked, injected, taken into the body through other means, whilst methods of removing illness or poisons from the body involve emetics, cathartics (producing a feeling of being purified emotionally, spiritually, or psychologically as a result of an intense emotional experience, or therapeutic technique), purgatives, bloodletting, or surgery, as well as body manipulations and touching of the body with specific materials with specific meaning and purpose (Kirmayer, 2003:282-302).

Struthers *et al*. (2004:141-149) view indigenous healing systems as being of the oldest methods in caring for and treating diseases. Indigenous healers are divided into three categories, i.e. the diviner (*mokoma in Sesotho*), the indigenous herbalist *(ngaka in Sesotho*) and the faith healer *(morapelli in Sesotho*). These indigenous healers are not required to attend any formal schooling, as the knowledge of indigenous healing is considered an ancestral gift that works with spirituality and intuition.

According to Mutwa (as cited by Boon, 1998:20), not everybody qualifies to become a diviner, because the diviner has to be a person with good moral values, and who is well

respected in the community. If a person does not meet these criteria, he is called an *isamfumfu,* which means that the ancestral spirits have not been honoured. The diviner, indigenous healer and the faith healer are the most trusted individuals amongst the indigenous people for helping the sick. It is noteworthy that despite indigenous healing having been around and used by indigenous people, it has never been accepted as a healing practice in the Western healing system.

The researcher is a trained critical care nephrology nurse. Being involved with patients who developed renal failure, it is well known that the deep-rooted Western perception still remains that all African people develop renal failure, due to the usage of indigenous medication. It was for this reason that the commonly used medicinal plants, *wildeals* and *wynruit*, were chosen for this study to demonstrate their effectiveness in treating influenza and to establish their effects on the renal system. It is for this reason that the effects of indigenous medicinal plants on the kidneys were studied.

1.2 Brief literature review

The following paragraphs briefly focus on reported study outcomes, relevant to this research project, to explore current knowledge on indigenous healing systems and approaches, and the current trends and beliefs surrounding this topic.

1.2.1 Trends in the usage of indigenous medicines

African indigenous people, together with their healers, rituals and medicines have been around since time immemorial, and it is estimated that about 80% of the African native population use indigenous medicines to meet their health care needs, whilst in China, indigenous medicines account for about 40% of all health care delivered to the whole population (WHO, 2003). A study, conducted by the South African traditional medicines research group [SATMERG] in 2006, revealed that the use of medicinal plants as indigenous medicine by indigenous people in South Africa comprises approximately 70% of the total South African population of between 49 and 51 million people. This high usage level could be attributed to pharmaceutical drugs being too expensive and unaffordable to most people, especially those in rural areas [SATMERG, 2006].

It was also noted during the study by Mander *et al.* (2007:54) that, the demand for indigenous medicines has increased faster than ever before. The increased demand could have been attributed to the Human Immune Virus (HIV) pandemic, as well as high levels of

unemployment. McKean (2007, 1-3) believes that the high demand could have been as a result of easy accessibility and affordability of indigenous medicines.

1.2.2 Indigenous people and their beliefs

According to Semali and Kincheloe (1999:20-21), Western science has become the dominant global knowledge system and it has notably also shown intolerance towards other persuasions. This intolerance has adversely affected the recognition of the indigenous knowledge system as a science of healing, by for example being labelled as witchcraft by Western scientists. These negative perceptions, however, had not stopped indigenous people from using the healing system they know best. This was confirmed by a study conducted in Canada amongst Ghanaians regarding their views on the usage of indigenous medicines. This study revealed that nearly 73% of all Ghanaians still used indigenous medicines, rather than Western medicines, regardless of them inhabiting a Western country (Barima & Van Teijlingen, 2008:1-4).

Building from the aforesaid, by demonstrating the high usage of and demand for indigenous medicines, Mawere (2010:209-221) views the invasion of the Western system from Europe into Africa as the beginning of the most nefarious image. In addition, this African invasion by Europeans saw Africa being no longer able to serve the interests of its own people. Furthermore, the author concludes that this invasion despised the African traditions, customs and knowledge, which had resulted in many respects to the African people struggling to control their own identity, society and destination, due to cultural onslaught by spreading the Western religious traditions and scientific worldviews as being superior.

In trying to rebuild Africans with their African worldview, a call to return to the native land was made by Masolo (2005) in 1995. Mawere (2010:209-221) supports this view in saying that ’rather than being passive assimilators of European modernity, Africans should take an active role in the selection and at times, fusion of what they got from Europe and what they already had as people’. However, this surviving strategy is failing in many African societies, due to the impact of Western science and modernism forces that despise African traditions and knowledge systems as diabolic, backward and superstitious.

1.2.3 Comparison of the indigenous and Western healing systems

In a study to bring about an understanding between the two healing systems, Broome and Broome (2007:161-173) compared the indigenous and western healing systems, as

summarised in table 1.1 below. These authors also investigated the focus of each healing practice, the Western focus being on pathology, while indigenous medicines focus on the community. Accordingly, in the Western healing system, the physician is in authority, while the indigenous healer is the health counsellor and advisor. These authors conclude that Western medicine health history focuses on the patient and family, while the indigenous health history includes the environment.

Table 1.1: Characteristics of Western and indigenous medicines

Western medicines	**Indigenous medicines (native American)**
Focus on pathology and on curing disease.	Focus on health and healing the person and community.
Reductionist: Diseases are biological.	*Complex:* Diseases do not have a simple explanation.
Treatment should produce measurable outcomes.	The results are not always measurable.
Adversarial medicine: How can I destroy disease?	Teleological medicine: What can the disease teach the patient? Is there a message or story in the disease?
Investigate disease, mainly focusing on the physical, with an approach of dividing and conquering of causes and effects of a disease.	Looks at the "bigger picture", i.e. within the context of the emotional, environmental, social and spiritual.
Health history focuses on an individual patient and his/her family.	Health history includes the environment.
Intellect and evidence from the primary point of departure.	Intuition is the primary point of departure and healing is based on spiritual truths.
Physician is in authority.	Healer is a health counselor and advisor.

(Broome & Broome, 2007:161-173)

Table 1.1 summarises the major differences between indigenous and Western healing systems. These differences demonstrate that indigenous healers have their own science when compared to the Western way of healing. In looking at what influences the differences between the Western and indigenous healing systems, Kangwa (2010:1-15) concludes that the major influence is in how each worldview approaches healing, meaning that the approach and understanding of sickness and healing are viewed differently by each approach. The approach to healing by the indigenous view is holistic, while the Western approach is more specific and has a specific focus point, and it is hence prepared for the area to be treated.

1.2.4 Preparation and administration of indigenous medicines

A study done by Mukinda and Syce (2007:138-144) revealed that indigenous medicines can be prepared in different ways, in accordance with what is being treated and what form of administration would be the most appropriate for therapy. Indigenous medicines can be prepared and administered as **enemas**, i.e. aqueous, or oily solutions, or suspensions that are administered rectally, as a **decoction**, i.e. a plant extract obtained from boiling, as an **infusion**, which is the extract obtained by soaking the crude plant for a short period of time in cold or boiling water and these are taken by mouth, or as **snuffs**, which are prepared from a dried medicinal plant and ground into a powder that can be drawn up into the nostrils through inhalation. Other preparations include inhalants, powders for licking, under the skin implants, bath mixtures, poultices, balms, internal cleansing solutions and lotions intended either for bathing with, for rubbing into incisions, for anointing, for inhaling as a smoke, for licking, for applying to the skin, or for nibbling on (Mukinda & Syce, 2007:138-144; Van Wyk, 2008:44). These administration routes are still being employed to this day. Unfortunately, the use of indigenous medicines has been associated with causing, or aggravating some conditions, such as renal failure, as discussed below.

It must also be noted that traditional medicines and indigenous medicines are used interchangeably in most cases (Traditional Health Practitioners act, 22 of 2007). In this study the researcher prefers using indigenous medicines as it refers to local medicines while traditional medicines could have an outdated connotation.

1.2.5 Causes of renal failure

According to Daugirdas *et al*. (2001:3), globally, the leading causes of renal failure have been identified as diabetes mellitus, hypertension, trauma, non-steroidal anti-inflammatory drugs (NSAIDs), as well as *muthi* (a *Zulu* name for African herbal preparation used to treat illness; *pitsa* in Sesotho). Renal failure is further divided into acute and chronic phases. Acute renal failure is described as a rapid reduction of the glomerular filtration rate, resulting in the retention of waste products, such as urea, creatinine and other uremic toxins, whilst it may be accompanied by oliguria (Barratt *et al*., 2009:3-4; Daugirdas *et al*., 2001:3) and it can be reversible.

If acute renal failure cannot be reversed, it progresses into the chronic phase. The chronic phase is defined as a state whereby the kidney has lost more than 60% of its function and has the glomerular filtration rate been less than 60 mL/min/1.73 m^2 for more than three months (Thomas, 2008:55; Smeltzer & Bare, 2000:1146-1151). Given the above, the

researcher proposed to undertake research that aimed at exploring that *wildeals* (*Artemisia afra Jacq. Ex Willd*) and *wynruit (Ruta graveolens L.)*, thereafter referred to as wildeals and wynruit respectively as the most commonly used indigenous medicinal plants, would not result in any adverse effects on the renal system.

Both *wildeals* and *wynruit* have been used as a remedy and cure for flu by the indigenous people, since time immemorial. However, neither their medicinal properties as combination therapy for flu have to date of this study been established, nor the effects of this combination therapy on the renal system. The researcher, as an experienced, medical-surgical nurse believes that these medicinal plants are used to treat and improve the immune system that prevents a person from easily contracting flu. It is for this purpose that the researcher envisaged to undertake this research to establish the properties of these two medicinal plants and their effects on the renal system, by focussing on the following problem statement.

1.3 Problem statement

A combination of *wildeals* (*Artemisia afra Jacq. Ex Willd*) and *wynruit* (*Ruta graveolens L.)* is a commonly used medicinal decoction by the indigenous people of Griqualand-West in the Northern Cape province of South Africa. Despite the common usage of the *wildeals* and *wynruit* decoction, the anti-viral medicinal properties of this combination therapy have not been tested in vitro. Furthermore, since the decoctions prepared from these plants are used to treat common colds, the effects on the renal system as mono-, or combination therapy have not yet been established in vivo. The researcher therefore proposed to test the anti-viral properties of the combination therapy of *wildeals* and *wynruit* against the influenza virus. In addition, the researcher sought to test the effects of decoctions prepared either as mono-, or combination therapy on the renal system. From the problem statement the below research question was posed.

1.4 Research question

What are the anti-viral properties of combination therapy decoctions prepared from *wildeals* and *wynruit* in vitro*,* and what are the effects that either of the mono therapies (*wildeals* or *wynruit*), or the combination therapy would have on the renal system and the liver of rats?

1.5 Aims and objectives of the study

1.5.1 Main aim of the study

The main aim of the study was to generate baseline scientific knowledge regarding the anti-viral properties of the mono- and combination therapy decoctions prepared from *wildeals* and *wynruit,* as well as their effects on the renal system and liver of rats.

1.5.2 Objectives

In answering the research question, this study endeavoured on the following objectives:

1.5.2.1 Primary objectives

The primary objectives of this study were to:

- Explore and describe current African indigenous health practices with regards to the use of *wildeals* and *wynruit* for medicinal purposes. This objective is addressed in chapter 3.
- Conduct a systematic review to determine knowledge regarding the use of *wildeals* and *wynruit* as mono therapy. This objective is addressed in chapter 4.
- Investigate the anti-viral properties of decoctions prepared from *wildeals* and *wynruit* as either mono-, or combination therapy for the treatment of common colds, caused by the influenza virus (*in vitro*). This objective is addressed in chapter 5 (phase 3).
- Establish the effects of all mono- and combination therapy decoctions prepared from *wildeals* and *wynruit* on the renal system and liver (*in vivo*) using rats. This objective is addressed in chapter 5 (phase 4).

These objectives are based on the umbrella objectives of the Seboka project as outlined in section 1.14.

1.5.2.2 Secondary objectives

The secondary objective was to report the research outcomes back to the community and knowledge holders in the Northern Cape, South Africa (Griqualand-West) for community confirmation and researcher validation and knowledge exchange in a mutually beneficial relationship regarding the established anti-viral properties of *wildeals* and *wynruit*, either as mono-, or combination therapy and their effects on the renal system. This objective is addressed in chapter 6.

This research aimed at establishing the anti-viral properties of *wildeals* and *wynruit* in vitro, as well as the effects on the renal system and liver of the decoctions prepared from these medicinal plants. In light of the defined aims and objectives of the study, the following central theoretical argument was developed, as outlined next.

1.6 Central theoretical argument

The central theoretical argument of this research was that the exploration for medicinal purpose of the decoctions, as described by the Griqua community as mono- and combination therapies, by making use of *makgotla* (singular, *lekgotla*) as data collection method, would furnish the required knowledge on how the community prepares the decoctions. The gained knowledge would enable the researcher to comprehend and prepare the decoctions in a similar manner as the community. These decoctions would be used for investigating the anti-viral properties of each during phase 3 and their effects on the renal system in phase 4. The use of the decoctions, similar to those prepared by the indigenous people, would improve knowledge regarding their anti-viral properties and their effects on the renal system, which, in turn, would be used to confirm what is already known by the community.

1.7 Hypothesis

The researcher propose the following null hypotheses for this study, because indigenous community have used these decoctions since time immemorial, without any influence of these plants on each other when used in combination, nor has any reported effects in the community:

- The decoction prepared as either mono-, or combination therapy from *wildeals* and *wynruit* has no influence on the treatment of common cold. Hypothesis is partially rejected as one of the decoctions showed no MIC (Chapter 5; phase 3).

- The decoctions prepared from *wildeals* and *wynruit* as either mono-, or combination therapies has shown no significant changes on the renal and hepatic systems of the rats. Hypothesis is accepted. (Chapter 5; phase 4).

1.8 Paradigmatic perspectives

A paradigmatic perspective is a worldview framework needed for thinking about how philosophy fits into the design of a mixed methods study, as described by Creswell and Plano Clark (2011:38-39). There are four worldviews that research can be based upon, i.e. those of the post-positivist, constructivist, participatory and pragmatist (Creswell & Plano Clark, 2011:40-41). The latter worldview is typically associated with mixed methods research, whereby multiple methods are used for data collection. This research study followed the pragmatism worldview, based upon the philosophical and epistemological grounding, as discussed next.

1.8.1 A worldview of the philosophical understanding of pragmatism

According to Creswell (2009:231), pragmatism arises from actions, situations and consequences, rather than from antecedent conditions. In addition, pragmatism is also concerned with applications of what works and with solutions to problems. The researcher aimed at applying all approaches available to understand the problem and to make recommendations, as described by Creswell (2009:231). The philosophical believe and understanding of pragmatism is that there can be a singular and multiple realities out there. It is also believed that these realities can be achieved, because researchers can test hypotheses and provide multiple perspectives about a problem under investigation (Creswell & Plano Clark, 2011:42-43). This study followed a mixed methods methodology in which multiple data collection strategies were used and the hypotheses tested.

1.8.2 Epistemological grounding

During this study, the researcher strove towards being as practical as possible when collecting data by what would work to address the research question, as described by Creswell and Plano Clark (2011:42). In achieving this objective of what works, the researcher stayed with the community to observe how they prepared and administered both *wildeals* and *wynyruit* either as mono-, or combined therapy. In doing so, the researcher tried to be as close to reality as possible, and to use whatever works for the community to answer

the research question. During data collection, the researcher consulted with the community about what works for them and aimed at confirming those findings with their knowledge.

1.8.3 Meta-theoretical assumptions

The researcher's worldview and humanity were based upon the African philosophy of *ubuntu* and included its views about man, family, community and healing. *Ubuntu* (a *Nguni* word meaning humanity; *botho* in Sesotho) encompasses morality, humanness, sharing and interactiveness between family and community (Boon, 1998:1-34). As a matter of fact, *ubuntu* is viewed as the root of African philosophy, in that it has a kind of philosophical affinity and kinship among and between the indigenous people of Africa, i.e. '*I am because you are, you are because I am, and therefore we are*' (Ramose, 2005:35-36). The spirit of *ubuntu* therefore forms the basis of how Africans view the world. This philosophy had been with the African people since forever, and the written versions have been around since at least 1846, in which *ubuntu* was defined as *the human quality* (Gade, 2012:485-503).

The emphasis of *ubuntu* as a morality and sharing amongst the community (Boon, 1998:1-34) is also emphasised by the transpersonal caring theory of Watson (George, 2002:411), which is defined as human-to-human connectedness, occurring in a nurse-patient encounter, during which each is touched by the human centre of the other. This theory suggests that there is no one truth, rather that there are multiple constructed realities, as per the pragmatism worldview (Creswell & Plano Clark, 2011:42). In addition, this theory is also open to multiple interpretations, stories, narratives, text and search for meaning and wholeness (George, 2002:405-407). This theory is supported by Pienaar and Manaka-Mkhwanazi (2004:130), who view health as well-being that is cultural and according to the individual's belief system. This implies respecting the customs, rituals and ceremonies, which sustains and creates a holistic equilibrium in a person.

According to Steinglass (2003:32), indigenous healing systems take into consideration the social being of the client by including the family members and sometimes even the village community. Inclusion of the family and the community is well supported by Watson's transpersonal caring theory (George, 2002:411). The researcher assumed that the inclusion of the family and community would make patients feel cared for by people around them.

Roederer and Mollendorf (2004:441) view *ubuntu* as holding a stem from and being deeply rooted in African indigenous cultures, and representing notions of universal inter-dependence, solidarity and communication, which can be traced to small-scale communities in pre-colonial Africa, and which underlines virtually every indigenous African culture. From

the above it is therefore evident that *ubuntu* has been with the indigenous people and has been used by them since long before it was recorded as a philosophy. It can therefore be linked to the indigenous people as their own philosophy.

According to Gade (2012:485-503), in a study done in South Africa regarding the views of the South Africans of African descent (SAADs), two clusters of answers were identified. The first cluster defined *ubuntu* as a moral quality of a person, while the second viewed it as a phenomenon (philosophy, an ethic, African humanism), according to which persons are inter-connected. In addition, the study outcomes also revealed *ubuntu* as a kind of divine. During this study, in the researcher's central theoretical assumption, where multiple approaches were used in collecting the data, the philosophy of *ubuntu* was used to guide the study. Eze (2001:1-8) furthermore believes that philosophy is a reflection of activity that happens when a person takes a look at the world around him. This was indeed observed amongst the community where this study was undertaken, since the researcher had felt welcomed and accepted by the community.

In order to support the *ubuntu* philosophy being applied during this research, the researcher adopted the following worldviews, as defined in the Seboka document (2010:5-7) (hereinafter referred to as Seboka), as the foundation of the worldview of this study, as discussed below.

1.8.3.1 Person

A person is viewed as a holistic human being, meaning that the body, mind, emotions and spiritual human being are embedded within an indigenous social structure and culture. Additionally, the human being is in a constant interaction and relationship with other human beings, with nature and the cosmos (Ohenjo *et al*., 2006:1938). Watson as cited by George (2002:411) furthermore defines a person as a being having a human experience, and not as human beings having a spiritual experience. This person, by being in relationship and interaction with other human beings, promotes and uplifts the philosophy of *ubuntu.*

1.8.3.2 Health

According to Cocks and Moller (2002:387, as cited by Seboka, 2010), in an African view, good health does not only require a healthy body. It is therefore important to understand that in an African view good health refers to a harmony between the body, mind, emotions and the spirit, as well as a distinctive maintenance of culture (Ohenjo *et al.,* 2006:1938). The same view is shared by Roger (2002:412), stating that health refers to unity and harmony

within mind, body, and soul. This is also maintained through harmonious interaction with other human beings and the cosmos.

1.8.3.3 Illness

According to George (2002:412), Watson's theory defines illness as a subjective turmoil, or disharmony within the spheres of the person, like in the mind, body, and soul, either consciously, or unconsciously. In an African perspective, illness is viewed as disharmony between the physical, mind and spirit of the human being, as well as the ill interaction and relationship with others, with nature and the cosmos, as described in Seboka (2010:6). Furthermore, illness is viewed as being caused by either contact with pollutants, craft of darkness and/or punishment from the ancestors, or from natural or super-natural powers (Liddell *et al*., 2005:693; Mphuthi, 2010:68).

1.8.3.4 Community

According to Seboka (2010:6), community is viewed as persons within groups in interaction and relationship with each other, their land, or nature and the environment, or cosmos, who share the communal beliefs and values.

1.8.3.5 Nursing

According to Ohenjo *et al*. (2006:1944), nursing is a comprehensive, community-based, culturally appropriate care that is rooted in knowledge translation that aims at advocating, restoring, maintaining and promoting harmony between body, mind, emotions and spirit of the human being. This care is aimed at promoting interaction and relationship with the community, nature and the cosmos. In addition, nursing is also viewed as a caring profession practised by a person registered under section 31, which supports, cares for and treats a health care user to achieve or maintain health and where this is not possible, cares for a health care user so that he or she lives in comfort and with dignity until death [SANC, 2005].

1.8.3.6 Knowledge

As per Seboka (2010:7), knowledge is viewed as what we have learnt through observations, experience, learning from others and literature. Such knowledge is furthermore divided into the following categories:

Common knowledge: This is the knowledge that is known by everybody within the community. This type of knowledge has no secrecy but can also be sacred.

Shared knowledge: This is the type of knowledge shared by a particular group of people in the community, like a family, or a group sharing the same age. This type of knowledge has some form of secrecy, which is not necessarily freely shared with anybody outside of this group as it may also be sacred to people out of the group.

Specialised knowledge: This is the knowledge known only by specific people in the community, like indigenous healers and/or rain makers (Seboka, 2010:6). This form of knowledge is only shared when a person has undergone and passed some rituals. This form of knowledge is highly sacred and also has high levels of secrecy.

1.8.3.7 Healing

Healing is a holistic practice, art and science of assisting the sick, or ill person to restore optimal health, mental, physical, spiritual and emotional well-being in relationships and also harmony with other human beings, the environment and the cosmos (Pienaar & Manaka-Mkhwanazi, 2004:130; Seboka, 2010:7).

1.8.3.8 Indigenous knowledge (IK)

Mapara (2009:139-155) views indigenous knowledge as that form of knowledge, which the people of the formerly colonised countries had survived on, before the advent of colonialism, and had it manifested itself through different dimensions, such as agriculture, medicine, security, botany, zoology, craft and linguistics. Such knowledge is, however, defined differently by various scholars. For the purpose of this research, the definition that was used stems from Seboka (2010:6), which refers to *Indigenous knowledge* as the unique knowledge, innovations and practices of local communities, developed from experience within specific conditions gained over time, and adopted to local culture and environment of a particular geographical area.

1.9 Theoretical assumptions

According to George (2002:569), a theory is described as a creative and systematic way of looking at the world, or an aspect of it to describe, explain, predict or control it. For the purpose of this study, the researcher adopted and applied Watson's (George, 2002:411)

transpersonal caring and indigenous way of caring and healing to describe the worldview. This theory was combined with *ubuntu* as an African philosophy that looks at the inter-connectedness amongst people (Gade, 2012:485-503).

1.10 Definition of concepts

1.10.1 Effects

Reaction produced by a cause or an agent results (Collins Concise Dictionary, 2004).

Effects in this study refer to any changes that can be attributed to the administration of *wildeals wynruit*, or a combination of these medicinal plants on the renal system.

1.10.2 *Wildeals*

According to Van Wyk *et al*. (1997:142), *wildeals (Artemisia afra)* is one of the oldest and best known medicinal plants, which is still used effectively today in South Africa by people of all cultures. It is an erect growing, shrubby, woody, perennial plant, growing up to 2 m tall, having a leafy and hairy stem. Its leaves grow up to 8 cm long and 4 cm wide and the leaf shape is narrowly ovate, bi-pinnatipartite, feathery and finely divided. In this study, *wildeals* refers to the indigenous plant used by the Khoisan community in the Northern Cape Province of South Africa (Griqualand-West) for medicinal purposes, independently, or in combination with *wynruit*.

Figure 1.1: Image of a green plant of *wildeals*. Picture from Northern Cape, South Africa: 2014 and used with permission from community (Mphuthi, 2014)

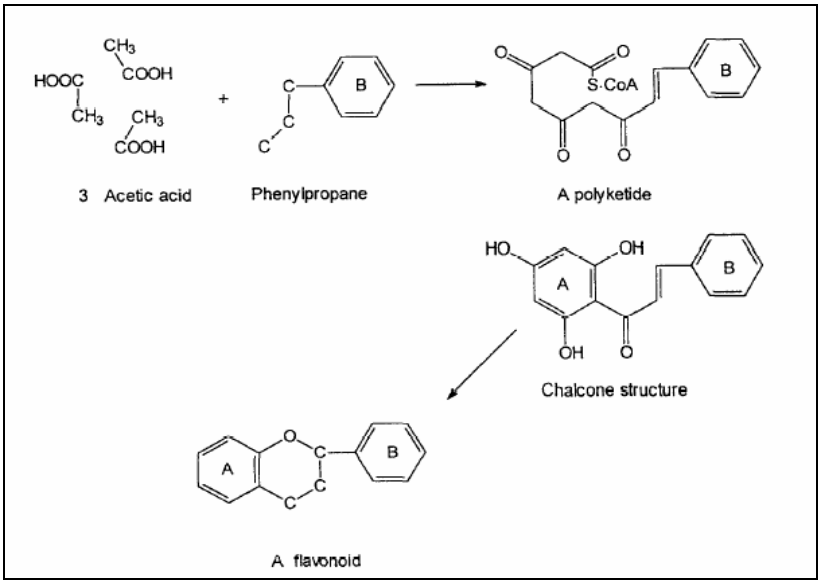

Figure 1.2: Schematic representation of the biosynthesis of the flavonoids of *wildeals* (adapted from Di Carlo, Mascolo, Izzo & Capasso, 1999)

The botanical classification and morphology of *wildeals* is as follows:

Kingdom:	Plantae - Plants
Division:	Magnoliophyta - flowering plants
Class:	Magnoliopsida - Dicotyledons
Sub-class:	Asteridae
Order:	Asterales
Family:	Asteraceae
Genus:	*Artemisia*
Species:	*Artemisia afra* (Van Wyk *et al*. 1997).

1.10.3 *Wynruit*

According to Van Wyk *et al*. (2009:250-251), this indigenous plant is a small, evergreen sub-shrub, or semi-woody perennial, which is about 0.6 - 0.9 m tall and almost as wide. The stem becomes woody near the base, but remains herbaceous towards the tips. It has long leaves that are dissected pinnately into oblong or spoon shaped segments of about 7.6 - 12.7 cm. These leaves are fleshy and usually covered with a powdery bloom on top. In this study, *wynruit* refers to the indigenous plant used by the Khoisan community in the Northern Cape province of South Africa (Griqualand-West) for medicinal purposes, independently, or in combination with *wildeals.*

Figure 1.3: Image of a green plant of *wynruit*. Picture from Northern Cape, South Africa: 2014 and used with permission from community (Mphuthi, 2014)

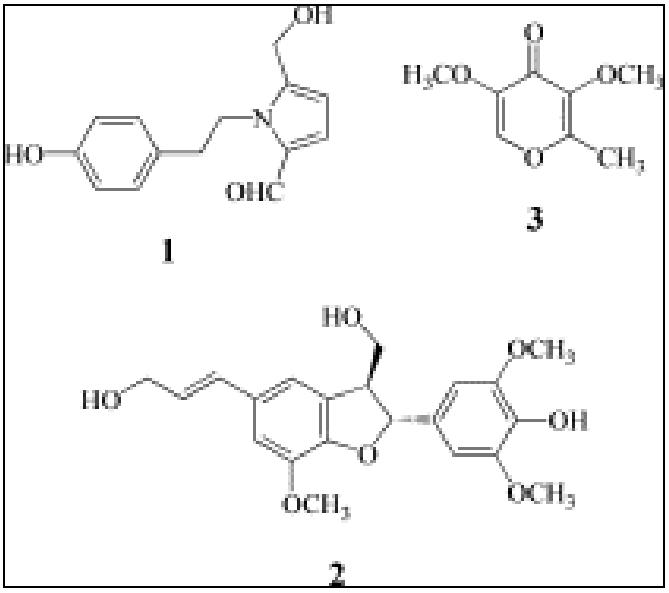

Figure 1.4: Schematic representation of the phytochemical structure of *wynruit* (adapted from Mulholland & Drewes 2004)

The botanical classification and morphology of *wynruit* is as follows:

Kingdom:	Plantae - Plants
Division:	Magnoliophyta - flowering plants
Class:	Magnoliopsida - Dicotyledons
Sub-class:	Rosidae
Order:	Sapindales
Family:	Rutaceae - Rue family
Genus:	*Ruta L. - Rue*
Species:	*Ruta graveolens L*. common Rue (Van Wyk et al, 2009)

1.10.4 Renal system

The renal system consists of two kidneys, two ureters, the bladder and urethra (Marieb and Howhn, 2010:961) and is it responsible for urine formation and waste removal in the body. In this study, renal system refers to the functional unit of the kidney, called the nephron, as described by Marieb and Howhn (2010:964).

1.10.5 Anti-viral properties

According to Bergner (2005:1-12), anti-viral is a term that is commonly applied by practitioners to medicinal plants used for viral infections. In addition, many are known in indigenous traditions to be effective for various viral infections, either as treatment, or as prevention therapy. Furthermore, properties are viewed as the universal activities that the herb has against the prevention, or treatment of an infection. It must be noted that anti-viral drugs are only effective against the influenza virus as described by centers for disease control and prevention [CDC, 2004].

In this study, anti-viral properties are regarded as the activity that a combination decoction of *wildeals* and *wynruit* has in treating, or preventing influenza.

1.10.5 Virus

According to Seth *et al*. (2006:141-147) and Bergner (2005:1-12), a virus is a highly infectious pathogen of a genetic material, packaged in various ways, and is it dependent upon host cellular machinery for survival and replication. In addition, a virus has a simple acellular organisation, with a protein coat and a nucleic acid genome (Willey *et al*., 2011:617-618). The below definitions were adopted for this study.

1.10.6 Influenza

This is a highly contagious viral infection of the respiratory passages, causing fever, severe aching and phlegm (Centers for disease control and prevention, 2004). This meaning was adopted as is for this study and was applied in the same context.

1.10.7 Combination therapy

Combination therapy is defined as administering two or more drugs/medications at the same time for treatment of a condition (Baddour *et al*., 2004:440-444). In this study, combination therapy refers to the mixing of *wildeals* and *wynruit* in a decoction for the treatment of influenza as done in this indigenous context.

1.11 Methodological assumptions

The methodological assumption of this study was based upon pragmatic views, which also recognised the simultaneity paradigm. The pragmatic view is explained by Creswell (2009:10-11), as not being committed to any one system of philosophy and reality. According to George (2002:416-417), simultaneity paradigm is the view where the patient and family are engaged for the purpose of identifying meaningful aspects of the situation. In this view, when indigenous healing takes place, the patient and the family, as well as the community are engaged in helping the patient to heal.

1.12 Brief research methodology

The research methodology involves the processes, techniques, procedures, or a plan for conducting the specific steps of a study (Burns & Grove, 2009:719; Lichtman, 2013:324). Creswell (2009:230) defines mixed methods research as an approach to inquiry that combines, or associates both qualitative and quantitative forms of research, by involving philosophical assumptions, and mixing both approaches in the same study. Sharing the same view, Creswell and Plano Clark (2011:5) add that when using this method, the mixing of data of many phases can happen at any level. This research study followed the mixed methods approach techniques, whereby different strategies were used to realise the objectives of the study. These processes, techniques, procedures and plans were applied during data collection, analysis and during the convergence of the results. The process is briefly explained in the next paragraphs, whilst the methodology is explained in full in chapter 2.

1.12.1 Research design

Burns and Grove (2005:195) define a research design as 'a blueprint for conducting a study with maximum control over factors that may interfere with the validity of the findings'. In addition, Polit, Beck and Hungler (2001:167) define a research design as 'the researcher's overall approach for answering the research question, or for testing the research hypothesis'. In this study, research design refers to the blueprint plan that was followed to ensure that the findings of the study were valid, following the multiphase design (Creswell, 2009:216), as explained in chapter 2.

The research procedure followed during this study involved a mixed method approach, with a multiphase design and transformative strategies, as described by Creswell (2009:216). In addition, this approach was divided into a four-phase, mixed method with a multiphase design, whereby the first two phases followed a sequential transformative strategy, whilst the last two phases followed a concurrent transformative strategy, as described by Creswell (2009:209-216), and by Creswell and Plano Clark (2011:68-73).

This research comprised of four phases of which method mixing assisted in gaining more insight into the research problem. In addition, Klingner and Boardman (2011:208-218) view mixed methods as being able to lead to insights about possible challenges to implementation and the circumstances, and are they also able to address many types of research questions, whereby each method used can address a specific type of a question.

In this research, therefore, the mixed methods approach with multiphase design was used, because the researcher aimed at using a qualitative approach, a systematic review, as well as *in vitro* and *in vivo* testing to answer the research questions. In addressing the research questions, the use of a transformative strategy during this research was further proposed, because the community where the research was undertaken was regarded as marginalised (Ohenjo *et al*., 2006:1937-1946). For this reason a transformative design was therefore used, so as to be able to advocate the healing practices amongst the Khoi community.

The trustworthiness in this research is discussed in chapter 2 as applied in chapter 3 and four (phases one and two). Validity and reliability are discussed in chapter 2 as applied in chapter 5 (phases 3 and 4).

1.13 Ethical considerations

The ethical considerations being employed during this research, as stipulated by Creswell (2009:87-92), and applicable to this research where human participants were used, included

permission to perform the research by North West University, Animal Research Ethics as well as the Royal Griqualand West house, informed consent by the participants, the right to self-determination, the right to privacy and confidentiality, as well as the principle of beneficence. In addition, where animals were used as research participants, the following additional ethics were considered, i.e. replacement, reduction and refinement, as stated by the Animal ethics review committee in the Act (Act, 71 of 1962). Full explanations on animal ethical consideration are discussed in chapter 2. Annexure A (Ethical clearance certificate), Annexure K (Memorandum of understanding and agreement) and Annexure L (Memorandum of agreement). The memorandum of agreement and understanding were reached with the Khoisan Commissioner and the community.

1.14 Summary

This chapter outlined the research overview, whereby the background, introduction to the study, the problem statement, the objectives, the researcher's assumptions and theoretical assumptions, and the research methodology and design being followed during this research, were discussed. A brief literature review introduced and compared the healing approaches of the Western and Indigenous communities. The ethics that were considered during the conduct of this study have also been mentioned.

The use of indigenous medicines has been part of African communities for many centuries. This form of treatment has, however, never gained any recognition from other communities. The researcher employed a mixed methods approach to identify the effects of two of the oldest medicinal plants (*wildeals* and *wynruit*), used by indigenous people to treat the sick. The phases of the study aimed at looking at the problem and to propose recommendations.

Western science claims that acute renal failure is, or can be attributed to the use of indigenous medication. For this reason, the researcher identified the two long and widely used medicinal plants, *wildeals* and *wynruit*, to test their effects on the renal system. It was anticipated that this research would benefit the indigenous communities in that the findings would be reported back to the community, together with scientific recommendations.

The ethical considerations of the participants (Khoi-San community and authors of the publications used) and the subjects (rats) were taken into consideration while conducting the research. It is also important for the community health nurses to understand and respect the norms and values of the community. Give advices but not criticise what is the norm of the community they are serving.

Although this research forms part Seboka project, it was undertaken as an independent research by researcher in answering objectives one to three of the main project (Seboka, 2010) that are to:

- Explore and describe the current African Indigenous health systems and practice (Chapter 3; phase 1).
- Conduct systematic review of previous research done on African Indigenous Knowledge Systems to promote evidence-based practice (Chapter 4; phase 2).
- Identify a commonly used indigenous medicine plant and test it for potential health effects (Chapter 5; phases 3 and 4).

The findings of these phases are then summarised in chapter 6 of this study.

1.15 Chapter outline

Chapter 1: Research Overview
Chapter 2: Research Methodology
Chapter 3: Realisation of the Qualitative Phase (Phase 1)
Chapter 4: Systematic Review (Phase 2)
Chapter 5: Clinical Experiments (Phases 3 and 4)
Chapter 6: Convergence of the Findings and Recommendations

Chapter 2

Research Methodology

"For the most part, if they are non-indigenous to the state and they`re not endangered or threatened, they`re not regulated. Most of it is going to fall between the cracks. If it`s not indigenous to the state, then it`s up to the country or the city to invoke ordinances."

Jack Baker

2.1 Introduction

Taking from the above statement, it is important for the community to protect and regulate what belongs to them. The previous chapter presented an overview of this research project and a brief literature review. The review revealed that no current literature to date of this research had reported on the effects of *wildeals* and *wynruit* on the renal system, neither as a single-, nor combined indigenous medication, hence the importance of undertaking this research. The main aim of this research was to establish the anti-viral properties of decoctions prepared from *wildeals* and *wynruit* as combination therapies, and their effects on the renal system, by employing *in vitro* and *in vivo* testing methods. In order to address the effects of *wildeals* and *wynruit*, this research followed a mixed methods approach.

This chapter explains the research methodology being utilised during this research. The design, data collection and data analysis methods, as well as the target population and the sampling methods are presented in the below discussions. This research project was divided into phases, as discussed in the next paragraphs.

2.2 Research design and method

This research comprised of an assessment that included the identification, gathering, categorisation and evaluation of data, but was not limited with regards to the data identification methods used, the gathering of neither the data, nor the categorisation and analysis of the obtained data (Burns & Grove, 2005:50; Mouton, 2008:55). This approach is also supported by Welman *et al*. (2011:52) and by De Vos *et al*. (2008:268), who view research design as all of the methods and the plan used by the researcher to obtain research participants and to collect information from them, and to organise and to evaluate

the available data. Furthermore, these authors believe that in research design, the researcher has to say what the participants did, so as to reach conclusions about the research problem. Lichtman (2013:325) views research design as a plan to conduct research, by following the appropriate research approach.

2.3 Research methodology

The research methodology being used involves the processes, techniques and procedures, or a plan for conducting the specific steps of the research (Burns & Grove, 2009:719; Lichtman, 2013:324). This research followed a mixed methods approach, whereby different strategies of inquiry and research designs were employed.

2.4 Research design

This study followed a mixed methods approach with a multiphase design and transformative strategies, as described by Creswell (2009:216). The proposed approach is represented in figure 2.1.

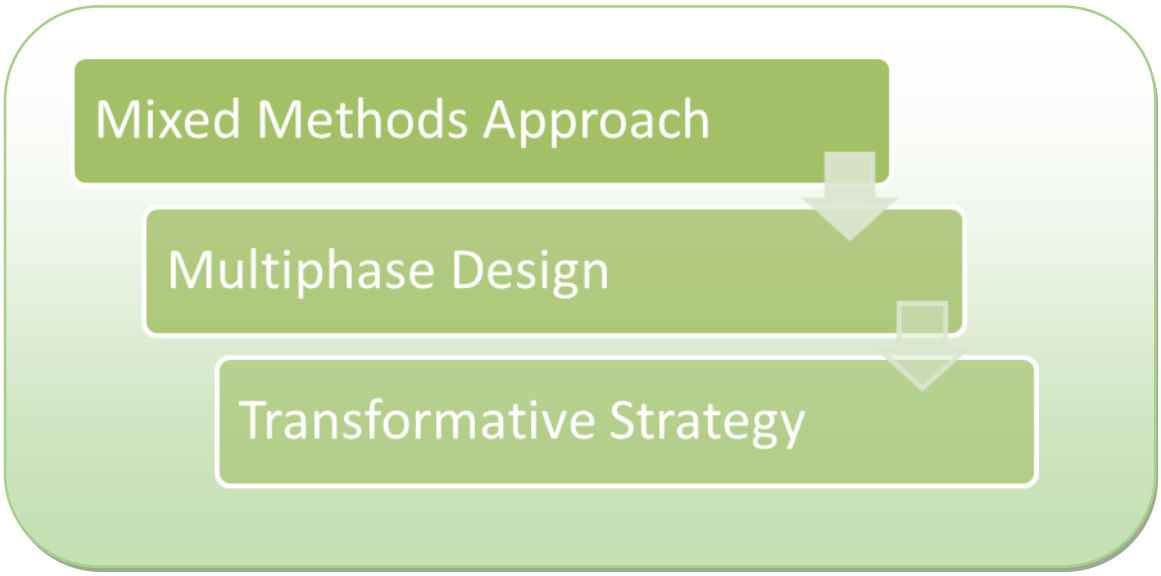

Figure 2.1: Diagrammatic representation of the research design used during this study (Creswell & Plano Clark, 2011; Creswell, 2009)

2.5 Research method

The research method being employed during this study involved a four phase, mixed methods approach with a multiphase design, whereby the first two phases followed a sequential, transformative strategy, whilst the last two phases comprised of a concurrent transformative strategy, as described by Creswell (2009:209-216) and Creswell and Plano Clark (2011:68-73).

According to Kettles *et al*. (2011:535-542), mixed methods research only began as a discreet methodology in the 1980s. It is now, however, viewed as the third methodological movement. The researcher decided upon this method also, as it had been recommended by these authors as having become the most used method that helps with understanding complex research problems. The researcher used this method to learn to understand the complexity of the anti-viral properties and the effects of decoctions prepared from *wildeals* and *wynruit* on the renal system. It is noteworthy, however, that the authors also acknowledge that there still is no consensus with regards to the definition, since the terms multiple- and mixed methods are used interchangeably. For the purpose of this research, the researcher adopted and used the term *mixed methods* to denote the meaning, as described by Creswell (2009:230).

Creswell (2009:230) defines mixed methods research as an approach to inquiry that combines, or associates both qualitative and quantitative forms of research, by involving philosophical assumptions and by mixing both approaches in the same research. Sharing the same view, Creswell and Plano Clark (2011:5) add that this method can be used to mix data during many phases of the research methods and at any level. This research comprised of four phases, during which data was mixed so as to gain more insight into the research problem.

Data from phases one and two was triangulated, while phases 3 and 4 were in progress. Final data convergence took place when all phases were completed for the final understanding of the problem being investigated. In addition, Klingner and Boardman (2011:208-218) view mixed methods as being able to lead to insights about possible challenges to implementation, as well as the circumstances, and can such methodology also address many types of research questions.

During this research, therefore, the mixed methods approach, with a multiphase design were used, because the researcher used *makgotla* and participatory observations to gather information during the qualitative and the *in vivo* phases, as well as a systematic review, and *in vitro* and *in vivo* tests to answer the research question. As discussed by Russell Bernard

(2011:256-258), participatory observation involves getting close to people and making them feel comfortable enough with your presence, so that you can observe and record information about their lives. In addition, it involves taking field notes about what the researcher observes and hears in a natural setting, as well as taking photographs and making audio recordings and videos of people telling folk stories, preparing food and doing the daily chores in an open-ended interview. Applied to this research, the researcher used this approach to listen, to observe, to audio tape and to take pictures. The pictures were mostly taken in relation to the preparation of the medicinal plants.

The use of a transformative strategy in this research was proposed, because the community in which the research was undertaken is regarded as marginalised (Ohenjo *et al*., 2006:1937-1946). Transformative design was therefore used, so as to be able to advocate for the healing practices used amongst the Khoi (Griqua) community in the Northern Cape (Griqualand–West, South Africa).

2.6 Multiphase design

The multiphase design that was followed during this research was a form of a mixed methods design that exceeded the basic designs, as described by Creswell and Plano Clark (2011:100). Such design could also be used when research involves an individual, or a team of researchers investigating a problem, or topic through an iteration of connected quantitative and qualitative studies that are sequentially aligned. In addition, each new strategy builds on what was learned in the previous, in order to address the programme/research objective (Creswell & Plano Clark, 2011:72-73). The multiphase design in this research comprised of two strategies, i.e. sequential and concurrent, which were further divided into four phases, as illustrated by figure 2.2 below.

The following paragraphs discuss the two designs, as well as the phases followed by the researcher during this study.

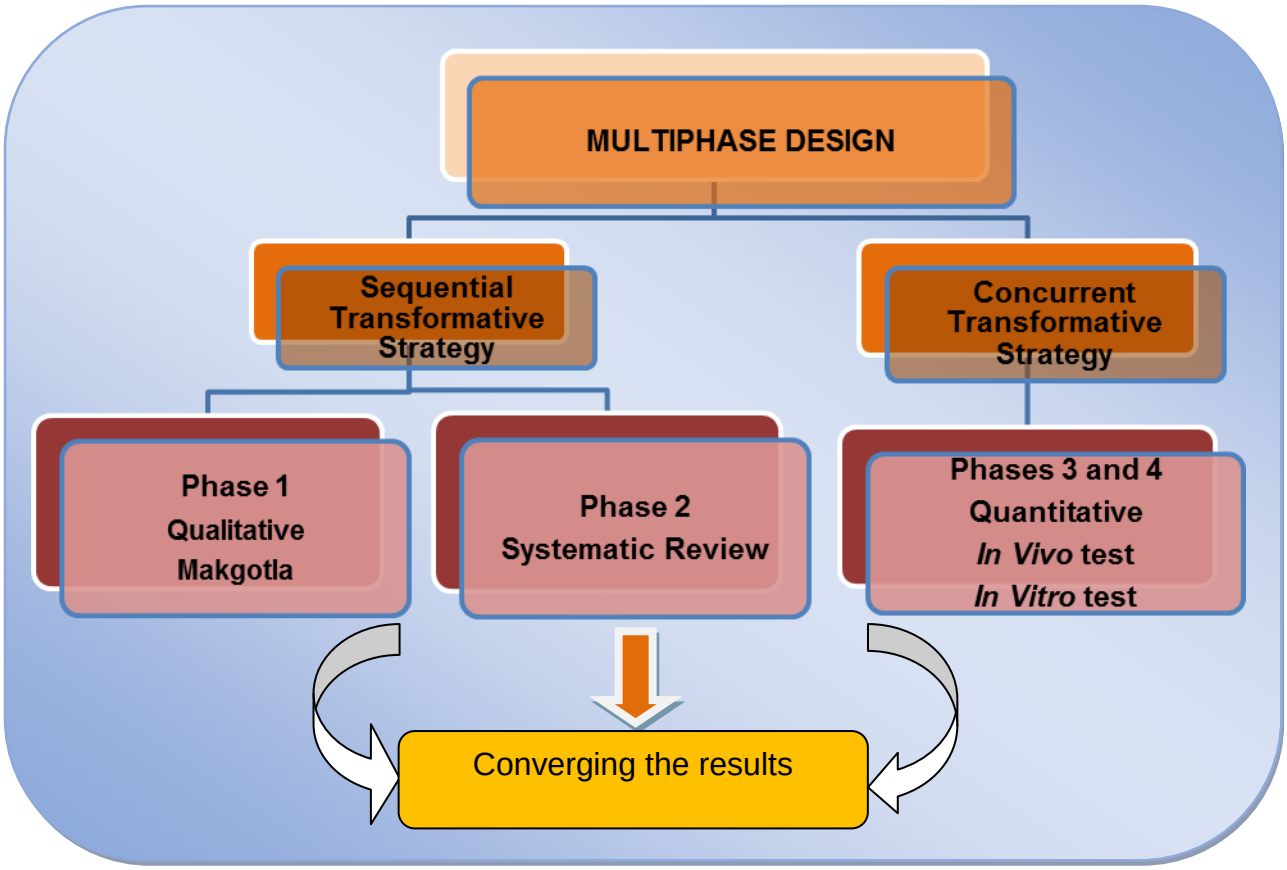

Figure 2.2: Diagrammatic representation of the multiphase research design (Creswell & Plano Clark, 2011:72-73)

2.7 Sequential transformative strategy (phases 1 and 2

A transformative strategy was employed during phases one and two, with phase 1 being conducted first, followed by phase two. The sequential transformative strategy was used for the purpose of this research, because the researcher aimed at advocating (Creswell and Plano Clark, 2011:127-130) for the healing practices used amongst the Khoi community, as the indigenous people in South Africa (Ohenjo *et al*., 2006:1937-1946). In this research, the notation weight was equally distributed.

According to Creswell and Plano Clark (2011:127-130), this design is used in situations where research is done amongst vulnerable groups, or marginalised participants, where advocacy, or addressing of any injustices towards participants is expected. This design being used during this research was based on the fact that the Khoi community is a

marginalised community (Ohenjo *et al*., 2006:1937-1946). In using this strategy, *makgotla*, as described by Pienaar (2004:24-25), was conducted during phase 1.

2.7.1 Phase 1: Qualitative phase

Phase 1 followed a qualitative approach, aimed at understanding the human nature (the way of doing things) and in doing so, the researcher would be able to get close to the participants (Bassett, 2004:4-5). This phase further aimed at gaining information from participants' perspectives and lived experiences (De Vos *et al*., 2008:267-268) by exploring and understanding the meaning that an individual or a group attaches to a social, or human problem. Participatory observation, as described by Creswell (2009:181), was also applied, during which the researcher observed the behaviour and activities of the participants. Applied to this research, the researcher aimed at understanding the nature of the research community in applying their indigenous knowledge system of using medicinal plants, with specific focus on the use of *wildeals* and *wynruit.*

Data was collected by using multiple data collection approaches, whereby data collection was done in the participants' natural setting, followed by an inductive analysis of the data, by building from particulars to general themes, and by interpreting the data (Creswell, 2009:232). In this phase, *makgotla* and participatory observation were used to explore and describe how the community prepares, administers and stores decoctions prepared from *wildeals* and *wynruit.* Observations were made to observe the attitudes and activities of the community (Creswell, 2009:181), to learn and be able to participate in the activities that would enable data collection amongst the population being identified and chosen by the researcher.

2.7.1.1 Population and sampling

According to De Vos *et al*. (2008:193), research population is defined as the people, or objects that possess certain characteristics from which the sample for research is determined. In addition, population is described as a group, or cases from which the sample in a research project is selected (Liamputtong, 2009:340). During this research, the population from which the sample was determined was in the Northern Cape (Griqualand-West, South Africa), specifically the Khoi community, and the basotho indigenous healers who utilises *wildeals* and *wynruit* for medicinal purposes. This communities possesses the required knowledge that would aid the researcher in understanding the research problem and in answering the research question.

Phase 1 will take place in the Northern Cape Province (Griqualand West) of South Africa amongst the Khoi community. According to Besten (2011:175-191) the Khoi-San community are classified as the first nations (indigenous) in the Southern Africa. Furthermore they live close to the nature, and are phenotypically different from others and continue to practice their ancestral traditions. This community was identified and chosen for this research because of being the most popular community using both *wildeals* and *wynruit* for treatment of common colds.

These communities were identified for conducting *makgotla* (Pienaar, 2004:24-25), to explore and describe ways in which to prepare the natural decoctions from *wildeals* and *wynruit*. Both men and women were included in the research, participants had to be over the age of 18 and needed to have knowledge about the preparation and administration of both *wildeals* and *wynruit*, as either mono-, or combination therapy. Participation in the research was on a voluntary basis and the participants were informed about their right to withdraw from the study at any stage. The primary community of focus was the Campbell community while the Basotho was used only to identify the common practices like preparations and administration for the convergence purposes.

De Vos *et al*. (2008:193) describe research sample as the portion of the total population that is representative of the total research population. For the purpose of this research, it was difficult to determine the sample beforehand, since *makgotla* is an open forum, during which everybody from the community is welcome to attend (Pienaar, 2004:24-25), and would everybody present hence be part of the *makgotla* sample. Despite *makgotla* being an open forum, not everybody would attend at the same time; hence the attendees would constitute the sample. The researcher further aimed at consulting with knowledge holders (as identified by the community, '*Melesi,* gathering) with regards to the preparation and administration of medicinal plants, with specific focus on *wildeas* and *wynruit*.

2.7.1.2 Data collection methods

According to Burns and Grove (2005:733), data collection is defined as the precise and systematic gathering of the information that is needed to address the research problem. The following paragraphs describe the methods and systems that were used to gather the information during this research. In collecting information, the researcher followed the *makgotla* approach, as described by (Pienaar, 2004:25-26). In a follow-up information collection process, a participative observation methodological framework that utilises a qualitative research form, whereby extensive observation and participation is made to obtain

an insider's, or knowledge holder's understanding of the phenomenon being investigated, was used, as described by Stahler and Cohen (2000:1-8).

These extensive observations were used in the natural setting of the participants (Creswell, 2009:229; De Vos *et al*., 2008:271-272), whilst an observation schedule was developed after the *makgotla* to collect further data. The researcher planned to observe how indigenous medicines are prepared, administered and stored by the community, with the main focus being the decoctions prepared from both *wildeals* and *wynruit* as either mono-, or combination therapy. The paragraphs below explain the data collection approach as implemented during this research.

a. Contextualising the meaning of makgotla (singular, lekgotla)

Makgotla is the plural form of *lekgotla*, which is a Sesotho word that, when directly translated, means council meeting, gathering, or an assembly (Schapera, 1953 as cited by Pienaar, 2004:25). In addition, *lekgotla* can also be described as the chiefs' court, during which a wide range of community disputes and offences are dealt with (Schapera, 1957:150-162), and are certain procedures followed, whereby the chief/headman (hereinafter the chief) directs the proceedings of the meeting (Pienaar, 2004:25-26). However, when applied to the context of this research, these gatherings aimed at collecting research data instead.

According to Pienaar (2004:25-26), *lekgotla* follows a specific process, whereby the chief becomes aware of the matter to be discussed, as the matter is brought to the chief's attention informally, privately and confidentially. Subsequently, the chief informs his advisors, who normally are his paternal uncles, or people with in-depth knowledge about the issue, or members of the community itself. Applied to this research, the researcher followed this approach by consulting with the chief first by sharing the information in private, before any *lekgotla* would be called. In this context, therefore, *makgotla* gatherings were used as data collection method. The researcher had also arranged for a pre-meeting with the chief, before data collection could start.

The aim of the pre-meeting was to show the necessary respect to the chief as leader of the community and to seek his buy-in and approval first, by informing and allowing for the chief to determine the safety and the risks of the envisaged research to his community. The meeting further aimed at empowering the chief with regards to the proposed research by discussing the research problem and by negotiating on appropriate timing for the gatherings. The chief therefore agreed to conduct *lekgotla*, because he had been consulted with and empowered first, which resulted in the community also feeling at ease and protected from

humiliation and intimidation, due to the approval by their highly respected headman. During the *lekgotla*, the researcher observed by listening and witnessing what the community members were saying and doing. Pictures were taken with the permission of community members. During lekgotla the community stressed the importance of being spiritually connected to the medicinal plants as well as the earth.

Data was validated by the community in anonymous agreement with the statement said. In the case of a disagreement, the chief/chief healer would call for consensus (Pienaar: 2014:56-61).

Figure 2.3: *Lekgotla* facilitated in Campbell (picture used with permission from the community) (Mphuthi, 2014)

b. Using makgotla / lekgotla as data collection method

Lekgotla and participative observation were used as data collection methods in this phase. The researcher met with the *lekgotla* facilitator and discussed the final questions to be asked. The researcher was present as an observer and also participated by asking some clarity questions to make sure that the discussions are focussed. During these gatherings the non-verbal communication of participants were observed by researcher who also made field notes, as well as to aid the chief when he needed assistance during the process and during the interaction.

The number of *makgotla* to be conducted would be determined by the emergence of new information from the previous *lekgotla* held. As soon as no new information would emerge, it

would be indicative that data saturation was reached and would no further *makgotla* be held. Two *makgotla* gatherings were held independently of one another. One *lekgotla* in *'Melesi,* Maseru (Lesotho) and the other in Campbell (Griqualand West) Northern Province in South Africa. Then the face to face discussion was also held with the chief of Campbell (Griqualand West). Full description of these gatherings is in chapter 3 as well as annexures D, E and F. The two places are about 500 km apart from each other, and the reason was to identify how the medicinal plants are prepared by these two communities see chapter 3, table 3.2.

The following paragraphs discuss the process of *lekgotla* being followed during this research for the purpose of data collection, as described by Pienaar (2004:25-26).

For the purpose of this research, *lekgotla* commenced on approval by the chief/chief healer for the proposed research to be conducted in this community, when he called for a public community meeting, after having been consulted with and empowered during the pre-meeting, and after having had the necessary time to assess the risks and benefits of the proposed research to his people. Before a community meeting, the chief would call for a council/advisors' meeting to discuss the issue at hand and to possibly reach consensus, without disclosing the issue to the broad community.

The *lekgotla* meeting was open to everybody, as there was no limit to the number of participants, or to who should attend the meeting. Normally, the friends of the headman/chief and their families, and everybody else from the community attended, as it is regarded disrespectful not to attend the chief's calling. The *lekgotla* facilitator opened the meeting by informing the community about the purpose of the gathering, but without disclosing any prior decisions that may have been taken by the smaller meeting with his advisors/council. The researcher reminded the facilitator about the aim of this research as a form of empowerment, before each gathering, and the chief subsequently directed the proceedings so as to make participants feel at ease when addressed by him.

The community was given the time to debate the matter, and was there minimal, or no interference, as community members enjoy freedom of speech. After some debate, the chief made a decision, which could be disputed until an agreement was reached. The researcher observed and respected the cultural practices of the community during the process of *lekgotla*.

The researcher was part of the *lekgotla* members, but only as an observer and was he asked only to clarity questions, through the chairperson, who was the chief. The possible use of audio visual equipment had been discussed with the chief, who in turn informed the

community about the purpose of the meeting and the use of audio visual tools. The researcher captured and audio taped the proceedings, until the gathering was adjourned by the chief. The researcher thanked the chief, before leaving the place of the gathering.

The information gathered during *makgotla* was kept in a safe place and prepared for analysis. Whenever an element of uncertainty by the researcher arose, the community and/or knowledge holders were consulted with to provide clarity.

2.7.1.3 Data analysis methods

Data analysis is described as reducing, organising and giving meaning to the collected data (Burns & Grove, 2007:41). The researcher similarly reduced, organised and gave meaning to the data having been collected during *makgotla*. In an attempt to give meaning, the researcher also followed De Vos *et al*. (2008:333) in viewing data analysis as the process of bringing order, structure and meaning to the mass of collected data.

a. Qualitative data analysis approach

In analysing the data, the researcher followed Henning's (2007:102) approach in analysing the qualitative data, as the researcher planned to deal with the raw data conventionally and straightforward, by coding and categorising it. Henning (2007:102) furthermore views this approach as dividing the data into small units of meaning, which are each systematically named (coded according to what a unit of meaning signifies to the researcher) and then grouped together in categories containing related codes. In application to this study, data was analysed by taking apart words, sentences and paragraphs, as an important act during the research project to make sense of, interpret and theorise the collected data (Henning, 2007:127). In order to make logical sense out of the collected data, the researcher also followed the process being described below (De Vos *et al*., 2008:334-339) with regards to the data having been collected from *makgotla* and observations. The full description of data analysis approach is discussed fully in chapter 3 (Section 3.6.3) .Information was recorded and preliminary analysis was done, it was also organised for easy following. Additionally, memos were read, that lead to the development of themes and patterns (De Vos *et al.*, 2008:336-338).

2.7.1.4 Crystallisation of phase 1 findings

As viewed by Cugno and Thomas (2009:111-115), crystallisation is a post-modern, qualitative research approach that features in-depth, multiple genre descriptions as a way to generate themes and patterns of life experiences. In addition, Maree (2009:81) views

crystallisation as providing a complex and deeper understanding of the phenomenon. The author is also of the opinion that in providing a complex and deeper understanding, crystallisation further offers a credible reality to the readers of the analysed data, as they would be able to identify the emerging pattern, which would also add to trustworthiness of the research outcomes.

When applied to this research, crystallisation was used to generate patterns of life experiences amongst the research population, as well as to ensure that the phase 1 findings were not viewed as fixed or rigid, but as being flexible and applicable to other relevant situations (Maree, 2009:81).

On completion of phase 1, the findings from *makgotla* and participative observations were analysed in order to reach an overall interpretation and an understanding of the phase 1 outcomes (Creswell & Plano Clark, 2011:77). The combined findings of this phase were crystallised, as advised by Tracy (2010:837-851), who views crystallisation as the term used when data collection involves more than one approach to provide a valid, singular truth. In crystallising the findings, the researcher searched for any disconfirming or confirming evidence from the collected data. The combined findings of this phase were kept safe, while the other phases were in progress.

2.7.1.5 Current thinking about validity in qualitative research

According to Lichtman (2013:302-303), increasingly more interest in the general topic of quality in qualitative research has arisen since the 21st century, about ensuring validity in qualitative research. In traditional thinking, validity used to be called a transactional approach, during which the researcher would utilise techniques, such as member checking, bracketing, or triangulation.

In current thinking, Lichtman (2013:324) is of the opinion that validity is more radical and transformational, as it is concerned with value-laden within a social context. As such, validity within a modern approach is therefore achieved, as the research promotes actions and ensures that the practice is transformed. It is for this reason that the researcher aimed at advocating for the use of *wildeals* and *wynruit* in the context of research, as he believed that this would benefit the community in which the research was undertaken.

Creswell and Plano-Clark (2011:211-212) argue that it can be difficult to know which approach to adopt in ensuring qualitative validity. However, they have suggested ways for ensuring validity in qualitative research, such as member-checking (the investigator communicates summarised findings with key participants to confirm with them whether the

outcomes represent an accurate reflection of their experiences) and triangulation (drawing of data from several sources, or from several individuals). The researcher envisaged using a member checking approach during this research, whereby the findings would be communicated back with key participants in the community for validation and verification.

2.7.1.6 Thick descriptions

According to Lichtman (2013:22-23), a thick description is viewed as a detailed description of a culture in order to identify underlying meanings and understandings. This involves the way in which the research was conducted, the settings within which the research was conducted, how the participants looked and how they responded to the research experience. This research was conducted within the natural settings of a Griqua community as the primary population of focus, and their cultural believes and behaviour were respected so as to ensure full and free participation of the participants. Data collection notes, including field notes were used to ensure a thick description of the information, as per Lichtman (2013:22).

2.7.2 Phase 2: Systematic review

This phase comprised of a systematic review as the approach through which to understand the research problem and to answer the research question. A systematic review is a way of identifying and analysing any published and unpublished literature relating to the topic being investigated, by assessing the quality of each research project, and by synthesising the findings and making interpretations of the findings (Hemingway & Brereton, 2009:1-8; Cronin *et al*., 2008:38-43). The focus in this phase was to investigate how the Griqua community uses, prepares, administers and stores *wildeals* and *wynruit* as medicinal plants and to establish their toxicity. The study investigated each plant individually as a means of therapy.

As advised by Crowther *et al*. (2010:3140-3146), before any research is included in a systematic review approach, it must be assessed for its quality and relevance to the research being undertaken. In the process of assessing the studies to be included in the systematic review of this study, the researcher proposed to follow the following five steps, as described by Khan *et al*. (2003:118-121).

2.7.2.1 Step 1: Framing the question for review

The question to be answered by the systematic review during this study was clear, specific and unambiguous. The question pertained to how *wildeals* and *wynruit* are used and what

ailments are being treated by these medicinal plants. This phase further aimed at establishing any recorded toxic effects of these medicinal plants.

2.7.2.2 Step 2: Identification of relevant work

The researcher extensively researched scientific computer search engines for relevant articles that would assist in answering the research question. Although the searched articles were restricted to those published between 2007 and 2012, older articles were also considered, based on relevance. Both qualitative and quantitative studies were included in the search. The inclusion and exclusion criteria of articles were based on their contribution, or not, to this project.

2.7.2.3 Step 3: Assessing the quality of studies

This step was based upon steps 1 and 2 above. This included answering the research question, the method being followed during this research, the research population and the conclusions made from the study outcomes. Furthermore, studies were included for this research, based upon the methodology being followed, their data collection methods, their data analysis techniques and findings, as described by Cronin *et al*. (2008:38-43), and by Hemingway and Brereton (2009:1-8). This step therefore aimed at ensuring that conclusions were made from quality and relevant studies.

2.7.2..4 Step 4: Summarising the evidence

Data was synthesised, or analysed, by following the research characteristics, quality, effects and the use of statistical methods, or by exploring differences between studies and by combining their effects. The heterogeneity of studies were also explored during this step. Findings from different studies were combined in preparation for an interpretation of the findings of this research.

2.7.2.5 Step 5: Interpreting the findings

In interpreting the findings, the researcher also explored the risks of publication bias and researcher related biases. The recommendations were made with reference to the weaknesses and/or strengths of the obtained evidence. Each research source was given the same status in this study, and was the data interpreted without any influence from researcher bias.

2.7.2.6 Data extraction method

Data extraction management was carried out by the researcher and a reviewer, to ensure that articles were included based upon pre-agreed criteria. Any articles having been included for this research that caused disagreement were resolved through consensus (McDaid *et al*., 2008:5) between the researcher, the reviewer and the research supervisor. Qualitative and quantitative, as well as mixed method articles were used to extract data for this research.

Computer based scientific search engines, like PubMed Clinical Queries, Science Direct, Scopus, Medline, EbscoHost, ANNA and CINAHL were used to extract articles for this research. Most importantly, articles to be included for this research were required to be significantly relevant to the topic being investigated to aid in answering the research question. The following key words were used to search for relevant articles: indigenous, artemisia afra, *wildeals* ruta graveolens, *wynruit*, medicinal herbs, anti-viral properties and nephro-toxicity.

The abstracts of all relevant articles were extracted, read and the decision made whether or not to extract the complete research article. In cases where the abstract was inconclusive, the whole article was extracted and read and the decision made about inclusion, or not.

Data extraction followed the **PICOT** mnemonic, as described by Hoffmann *et al*. (2010:22-23), with the following meanings attached: (**P**) Population (which population used these herbs?), (**I**) Intervention (what were these herbs used for?) (**C**) Comparison (were any other interventions used by this population?) and (**O**) Outcomes (what outcomes were achieved by these interventions?). In this research, the letter (**T**) was used for toxicity so as to evaluate any toxic effects by these medicinal plants. In addition, the letter (**M**) replaced the letter (**C**) in this study, as the (**M**) was used to evaluate the methodology being employed. As a result, the mnemonic used for this research was **PIMOT**, as comprehensively discussed in chapter 4. All extracted data was recorded on a formulated data extraction form (Hemingway & Brereton, 2009:1-8).

2.7.2.7 Data analysis

Data was analysed by following the approach by Cronin *et al*. (2008:38-43), who view meta-synthesis as a non-statistical technique used to integrate, evaluate and interpret the findings of multiple qualitative studies, while meta-analysis is viewed as a statistical technique that is used to evaluate findings of quantitative studies. According to Hemingway and Brereton (2009:1-8), the process of separating selected articles according to a chosen methodology, is known as evidence synthesis. In this research, evidence synthesis was applied, since the

included articles were evaluated based on their employed methodology, while the findings were merged to find a common interpretation.

According to McDaid *et al*. (2008:5), narratives can also be used as a form of analysing those articles being included in the research, as these narratives are being described, organised, explored and the research findings coded at the same time. The researcher, with the assistance of the co-coder identified the themes and codes for the coding process. The coding was done independently in the initial phase, whereas a combined coding was employed for validation of the findings. On completion of the data analysis, the findings from phase 2 were recorded and converged with the crystallised qualitative first phase findings.

2.7.2.8 Trustworthiness

In ensuring the trustworthiness of these phases 1 and 2 of research, the researcher followed a process of transparency, where data was gathered for the purpose of research, while also searching for multiple perspectives, and changing practices to ensure that results would matter (Lichtman, 2013:292). According to Creswell and Plano Clark (2011:14-15), in ensuring trustworthiness, it is important for researchers to understand the essential issues of persuasiveness in qualitative research, including credibility, trustworthiness and common validation strategies. In order to ensure trustworthiness during this research, the model of Lincoln and Guba (1995 as cited by Creswell, 2009 and Liamputtong, 2011:20-23) was employed. The model focuses on four items, i.e. credibility, transferability, dependability and confirmability, as discussed and applied in chapters three and four. In ensuring that the above criteria were met, an attempt was made by the researcher to ensure that the research topic was well defined to ensure theoretical validity.

Lichtman (2013:299) advises that in ensuring that research findings are trusted, the population in which the research is conducted should possess credible knowledge to answer the research question. For the purpose of this research, the Khoi community in Campbell (Northern Cape) was identified as the primary participants to answer the research question, since they possess the required knowledge regarding the use of indigenous medicinal herbs, specifically *wildeals* and *wynruit*. Data was collected and analysed with the assistance of an experienced qualitative researcher, who acted as a co-coder of the initial coder, as described by Lincoln and Guba (1995:297). Full application of trustworthiness for chapters three and four is in chapter 4.

2.8 Concurrent transformative strategy (phases 3 and 4)

Phases 3 and 4 both took place in the laboratory concurrently. This was possible, because none of these two phases depended upon the findings of the other. Creswell and Plano Clark (2011:127-128) view the use of this design as being guided by the researcher's use of a specific theoretical perspective, as well as the concurrent collection of both quantitative and qualitative data. In addition, like the sequential transformative design, the theoretical perspective can be based on ideologies, such as critical theory, advocacy, or participatory research. The perspective of this research was based on advocating and validating for the healing practices of indigenous people, specifically of the Khoi (Griqua) community in the Northern Cape province of South Africa.

During this research, the notational weights of both phases 3 and 4 were equal to QUAN=QUAN (Creswell & Plano Clark, 2011:127-128). Both these phases investigated the decoctions prepared from *wildeals* and *wynruit*, as either mono-, or combination therapy. Testing of the effect on the renal system of the decoctions being prepared from *wildeals* and *wynruit in vivo* (on rats in phase 4) as either mono-, or combination therapy, occurred simultaneously, by testing the combination decoctions *in vitro (*phase 3*)* in relation to the influenza virus*.* Phases 3 and 4 are discussed in detail in the paragraphs that follow.

2.8.1 Phase 3: *In vitro* testing

According to Gallo (2002:1-2), *in vitro* testing refers to the test that is done in the laboratory, so as to elicit the medicinal properties, or sensitivity of the organism towards the medication being tested. In addition, this test does not involve any living animal, as it is either done in test tubes, or in petri dishes, by using a culture medium and the organism being tested, together with the researched medication.

During this study, *in vitro* testing was performed to test the medicinal properties of combination therapies of *wildeals* and *wynruit* against the influenza virus. These medicinal plants are commonly used as mono therapy to treat common colds, whilst their anti-viral medicinal properties as combination therapy were still unknown at the time of this study. This phase aimed at eliciting the anti-viral properties of these medicinal plants as combination therapy.

2.8.1.1 Process to be followed when conducting in vitro testing

The researcher utilised the laboratory technologist's expertise to guide the process for conducting the *in vitro* testing. The technologist provided the necessary guidance with regards to the number of petri dishes to be used, as well as the suitable culture medium. The process being followed in determining the anti-viral properties is described in the paragraph below.

The decoction was prepared in the same way as by the Khoi community. The preparation method was established during the prior consultation sessions with the knowledge holders, by following the *makgotla* data collection approach within the KhoiSan community in the Northern Cape province. The prepared decoction was then taken to the laboratory where the sensitivity of the influenza virus to the prepared decoction was tested *in vitro.* The influenza virus was grown on a medium in a petri dish, after which the decoction was introduced. The sensitivity, or resistance of the virus to the decoction was checked at 18 hours, 24 hours and 48 hours. The researcher familiarised himself with the indigenous measurement units used by the community, especially when preparing the combination decoction. Sensitivity was determined by the way that the virus reacted or behaved to the decoction.

During testing, care was taken to prevent any contamination, as any form of contamination would affect the results. The laboratory technician offered guidance with regards to the procedure to be followed to prevent contamination, and on how to read the results at the said intervals. The results were determined from both mono- and combination decoctions. The combination therapy served as the experimental reading, while the mono therapies of *wildeals* and *wynruit* served as the controls.

2.8.1.2 Data collection

In this phase, data was collected by assessing the activity of the virus in the presence of the mono- and combination decoctions of *wildeals* and *wynruit*. The *in vitro* data was collected by evaluating the activity of the influenza virus in the petri dish containing the combination decoction, and compared with those of the mono decoctions. Evaluations occurred at regular intervals, as recommended by the laboratory technologist, who had offered guidance regarding the frequency of inspecting the petri dishes for any viral activity.

2.8.1.3 Data analysis

Data was analysed by reading and comparing the viral responses to the decoctions, by taking the reading in centimetres from the area of source, compared to the control petri

dishes. The experimental petri dish was placed under the microscope and with the assistance of the microbiologist, the viral activity was determined. This analysis gave an indication of any possible synergism in terms of the anti-viral properties demonstrated by the combination decoction towards the influenza virus, compared to the mono decoctions.

2.8.2 Phase 4: *In vivo* testing

According to Gallo (2002:1-2), *in vivo* testing is defined as research being carried out on live animals in the laboratory, with rats being the most often used for this purpose. Rats were also the animal species of choice for this research, as they are commonly used due to their size, the accumulated knowledge regarding this species, the costs involved, as well as the close similarity of their metabolism to that of humans (Timbrell, 2002:163-179). *In vivo* testing took place under the supervision of a qualified vivarium biomedical technologist.

The main aim of this phase was to test the acute and sub-chronic effects of both *wildeals* and *wynruit* on rats both as mono- and combination therapies. The researcher strived at preparing the decoctions similarly to those prepared by the Khoi community. Care was taken to avoid contamination during the preparation. To understand the effects of *wildeals* and *wynruit* decoctions on the renal system of rats, the weight of the rats, as well as the strength of the decoctions had to be taken into account.

This phase was divided into three mini-phases, with each phase lasting 7 days. The dose of the decoction was adjusted, based upon the outcomes of the previous group. The blood samples taken at the end of the experiment also helped with the determination of the cumulative effects of the decoctions prepared from both *wildeals* and *wynruit.* Each mini-phase comprised of three experimental test groups and one control group. The first group represented the testing of the effects of *wildeals* on rats, the second group tested the effects of *wynruit*, the third group tested the effects of the combination decoction on rats, whilst the fourth group represented the control group that was not subjected to any of the decoctions. The groups being subjected to the decoctions were clearly marked, so as to avoid possible contamination. In adherence to research ethics, this phase only commenced after the animal ethics clearance certificate for the use of animals had been issued.

2.8.2.1 Research population

In phase 4, the population comprised of male Sprague Dawley rats that were given both *wildeals* and *wynruit* as mono-, or combination therapies, as well as a control group.

2.8.2.2 Researcher training

The researcher had undergone prior training, comprising of theoretical and practical sessions, in preparation for commencing with the *in vivo* tests. The training aimed at orientating the researcher and assistant with regards to the handling, blood sampling and urine collection from rats. Full details of the training are discussed in chapter 5.

2.8.2.3 Process to be followed when conducting in vivo testing

The test animals (rats) had been allowed to adjust to the experimental conditions by keeping them for at least 3 - 7 days before commencement of the test, in accordance with the requirement of animal ethics, to reduce the stress of animals to be used for research purposes. The researcher also received training on how to handle the animals, and on how to give them water in the same way that was envisaged for the administration of the *wildeals* and *wynruit* decoctions. The behaviour of the animals was observed during orientation and was documented. During this period, the animals were also coded and weighed.

The environment was controlled with regards to macro- and micro noise levels, as well as vibrations, as these could cause the rodents to stress and release hormones that may influence the test outcomes. The lighting was further controlled, as specified by the technologist, in order for the animals to have day time and night time for them to rest. Ventilation and temperature were set according to the recommendations of the laboratory technologist.

The animals were given plain water and food so as to minimise contamination of the results. Pre-testing of the renal functions of the rats was done during the orientation phase, so as to generate baseline data for comparison with the experimental findings later during the research. The animals were tested for acute and sub-chronic effects of *wildeals* and *wynruit* decoctions on their renal systems, for both mono- and combination therapies.

During testing, rats were given a constant dose of *wildeals* and *wynruit* as mono- and combination therapies, according to the body weight of each rat. Blood and urine samples were tested at least once or twice per week, or as advised by the laboratory technologist. In the event that any of the animals died during testing, it would be dissected for examination of the macro- and micro structures of the kidneys and nephrons for the identification of any abnormalities, visually and under the microscope. The researcher had negotiated with the Animal Ethics Committee for permission to sacrifice all animals and to dissect randomly selected animals at the end of the testing. Dissections focused on the kidneys and nephrons, aimed at examining the macro- and micro structures, so as to identify any abnormalities.

2.8.2.4 In vivo test data collection method

Spraque-Dawley rats (males) over 250 g were used to test the renal function after administration of *wildeals* and *wynruit* both as mono- and as combination therapies. The preparation of the decoctions was as close as possible to the way that they are prepared by the Khoi community. Rats were divided into four groups per compound applied. Ten rats each were subjected to the *wildeals* decoction, to *wynruit* and to the combination decoction. Each control group consisted of 5 rats per compound, as advised by the animal research department. Each decoction was given at 1 ml, twice a day for the duration of one week. Urine was collected daily for the duration of 6 days, heart bloods were taken once on the day of sacrificing the animals to test for the presence and elevation of liver enzymes, as well as the kidneys and livers were also taken at the same time for histopathology. The urine samples were taken as a 24 hours specimen from each rat. The blood results were captured on a spreadsheet. The combination group was assessed for serum urea and creatinine, so as to determine whether or not the combination decoction had any effects on the renal system of the rats. The mean renal function was also calculated with the assistance of the statistician. This was done for all groups of rats. After each test, the rats being used were sacrificed. Dissections were done on any rats that had died during the experiment and at the end of the test, with specific focus on any changes on the kidney and liver structures. No rats died during the experiment and all were sacrificed at the end of the experiment.

Both blood and urine samples were taken from the experimental and control groups. The blood and urine test results were kept in a safe place, until completion of the research.

2.8.2.5 In vivo data analysis

Accurate records of both blood and urine samples were kept by the researcher for analysis. The results from the analyses were captured on an Excel spreadsheet, including the biopsy results. These results were captured per rat code. The data was double captured and cleaned for any errors and was also verified. Once all of the results had been captured, the statistician analysed the results. The urine test results were also analysed. The researcher used the results to compare and contrast the findings at different time intervals. The mean clearance and peak levels were calculated at the end of 21 days for acute toxicity and again at the end of the testing. Again, any animal that had died for any reason was dissected and the kidney and nephron structures examined visually and under the microscope. The analysis of the results included urine output volumes over the period of 24 hours, urine test results, blood test results, as well as outcomes from the visual and microscopic examinations of the kidneys and nephrons.

2.8.2.6 Good clinical practice

This research was conducted observing the principles of Good Clinical Practice (GCLP). As defined by Vijayananthan *et al*. (2008:1-4) and Dongen (2001:213-216) GCP is an international ethical and scientific quality standard for the design, conduct, performance, monitoring and verifying the clinical trial and studies being performed. It is also aimed at protecting the rights, integrity, confidentiality and privacy of the clinical trial or study participants. This research adhered to the principles of GCP which are also based on ethical considerations. These principles are respect for persons, beneficence and justice. These principles are discussed well under the ethical considerations (Section 2.8.3) below.

2.8.2.7 Convergent approach to the test results

The findings from all of the four phases were converged at this level so as to obtain complementary data for the topic under investigation and to understand the research problem better (Creswell & Plano Clark, 2011:77). The researcher further synthesised complementary quantitative and qualitative results to develop a more complete understanding of the phenomenon being investigated, and to compare multiple levels within a system. The use of convergent design occurs when the researcher collects and analyses both quantitative and qualitative data during the same phase of the research process and then merges the two sets of results into an overall interpretation (Creswell & Plano Clark, 2011:77). The researcher followed the same approach during this research, whereby the findings were analysed and merged, so as to identify the medicinal properties of the combination therapy of *wildeals* and *wynruit*, as well as their effects on the renal system, as either mono-, or combination therapy.

2.8.2.8 Validity and reliability

a. Validity

As viewed by De Vos *et al*. (2008:182), validity refers to the extent to which an instrument can accurately reflect the concept being measured. In order to ensure validity of the findings, the blood samples, the b and urine specimens were analysed in the laboratory by an experienced laboratory technician. All the results were captured on spreadsheet and given to the statistician for analysis. Greef and Holtzkamp (2007:189-200) conclude that content validity is established on the basis of judgement, that is, if the researchers, or experts are of the opinion that the instrument/data collection method in use had covered the full range of meanings of the variable being measured, content validity has been established. The

researcher made use of an accredited laboratory to perform both phases 3 and 4. This was also a measure to ensure validity of the findings.

b. Reliability

Burns and Grove (2007:365) believe that reliability is primarily concerned with how well an instrument measures what it is supposed to measure, meaning that, reliability is the consistency of measurement. The equipment used for generating the results ensured reliability of the findings during this study, because they were specifically designed to accurately measure the blood and urine samples. The machines were calibrated for accuracy and reliability of the results. Data was also later validated through the community and literature, to ensure reliability. Both validity and reliability are discussed fully in chapter 5 (phases 3 and 4).

2.8.3 Ethical considerations

The following paragraphs discuss the ethical issues that were taken into consideration when undertaking the research.

2.8.3.1 Permission to conduct

Permission to conduct this research was obtained beforehand from the Ethics and Research Committee of the University of North-West and from the head of the Griqua community in which the research was conducted as well as the chief healer of the *'Melesi* indigenous healers. Permission to conduct this study was furthermore obtained from the South African Veterinary Council, the South African Medical Research Council, as well as from the Animal Ethics Review Committee with regards to the use of the rats (vertebrate animals).

2.8.3.2 Informed consent

The researcher informed the participants with regards to the purpose of the study, the objectives to be achieved and the planned duration thereof. The information was first shared with the chief so as to empower him. The headman communicated the information to the community and emphasised that participation was voluntary. The researcher assisted in clarifying and answering questions where needed.

The researcher ensured that participants understood the research study, the purpose thereof, that participation was voluntary and that each participant would be free to withdraw

from the research at any time (Lichtman, 2013:53-54), without any penalty being imposed on him/her.

The researcher also ensured that each person completed and returned the consent form, before commencement of the observations. Participants were informed that they could request to end participating at any time during the observation.

2.8.3.3 Right to self-determination or autonomy

According to Burns and Grove (2007:204), autonomy is viewed as the capability of a person to control his or her destiny, and to have the freedom to conduct his or her life, without any force, or control. To reiterate, the researcher provided participants with the necessary information, by holding pre-research meetings with the community in which the study was undertaken, including the chief, as a way of sharing the purpose and the way in which the research would be conducted. During these meetings, the community was given the choice to decide whether, or not, they wanted to be part of the research, before the research commenced.

2.8.3.4 Right to privacy

According to De Vos *et al*. (2008:61), privacy is defined as, that which is not intended for others to observe or analyse. In addition, it is the individual's right to decide when, where, to whom and to what extend his or her attitudes, beliefs and behaviour would be revealed. The privacy to information provided by the participants would be held confidential and would only be used for research purposes. In the case where participants would not like the researcher to reveal, nor to even observe some of the activities, the researcher completely respected that. The values, morals and belief systems of the community were respected by the researcher.

2.8.3.5 Right to confidentiality

According to Burns and Grove (2007:212), confidentiality is the protection and management of the information by the researcher, as it is provided by participants, and must this information be protected at all times and be made available only to the research team and solely for research purposes. The researcher did his utmost to treat all of the gathered information from participants as confidential, by not writing any names, nor the name of the place where the information was collected from.

2.8.3.6 Principle of beneficence

According to Terre Blanche *et al*. (2007:557), beneficence is the ethical principle that underlines the ethical obligation to do well, or to generate benefits for the participants of the research. The researcher ensured that the possible benefits arising from the research would outweigh any undesired effects. The participants were not exposed to any physical, psychological, spiritual, or even social trauma. The researcher protected the participants from any form of trauma, even though no anticipated form of trauma existed.

In phase 2, all authors of the articles being included in this study were fully acknowledged and referenced. The researcher objectively documented the information truthfully as it is, according to the reported study, without any prejudice and researcher bias.

The ethical considerations are discussed in detail in phase 1 of this research.

2.8.3.7 South African Veterinary Council

In South Africa, the use of animals during research is controlled and all vertebrate animals are protected by law. The South African government, in conjunction with the Animal Ethics Review Committee (AERC) established the recommendations, protection, guidelines and the responsibilities that every researcher must take into account when using animals for research purposes, and is any contravention of these recommendations punishable by law, as stated in the Animal Protection Act (Act, 71 of 1962).

According to the Animal Protection Act (Act, 71 of 1962), it is stated that if animals have to be used in research, the AERC has to make sure that the use of these animals is justified. Accordingly, the researcher ensured that the committee was convinced that the use of animals (rats) was justified. Furthermore, the researcher ensured that the animals were optimally cared for, that their welfare was observed, that the number of animals needed was kept to the minimum, and that the methods and procedures were refined to minimise and to avoid pain and distress in the animals during the research.

The researcher also aimed at satisfying the four **R** principles, as stated in the Animal Protection Act (Act, 71 of 62), i.e. responsibilities, replacement, reduction and refinement.

2.8.3.8 *Responsibility*

It is stated in the Act that it is the responsibility of the researcher(s) that use animals in their research to make sure that the animals are not unnecessarily put under stress. The animals

should be made as comfortable as possible. It is also stated that animals are used strictly for research purposes and nothing else.

2.8.3.9 Replacement

The researcher ensured that any techniques or models that could replace using animals were investigated and used, as stated in the Act. This was in compliance with the requirements of the Act of replacing animals with any other available technique.

2.8.3.10 Reduction

The researcher ensured that valid results were obtained by using the minimum number of animals. Only animals required for the research were exposed to repeated procedures for the sake of the project, and if any live animals had to be killed, the researcher tried to keep the number to an absolute minimum.

2.8.3.11 Refinement

As stated in the Animal Protection Act, the researcher refined animal sourcing, animal care and procedures by minimising, or eliminating any physical or psychological distress that could be imposed on the animals by the research requirements. This was achieved by making sure that the animals were pain free and by allowing for them to acclimatise and adjust to the research environment, before commencement of the study. The animals were treated with a sense of humour/respect and any other situation/experience that these rats were exposed to during the course of this research, was made as stress free as possible by also making use of an animal research scientist.

2.9 Summary

This chapter focused on the phases comprising this research study. The methods and design being used during this study was also discussed comprehensively. The approach to each phase was described, as well as the way in which the results would be handled during each phase. The following chapter focuses on the realisation of the qualitative phase in which *makgotla* was being utilised to answer the research question.

Chapter 3

Realisation of the Qualitative Phase (Phase 1)

> "*The veld is our chemist; therefore we live and get healed from the earth."*
>
> Kok (2013)

3.1 Introduction

The previous chapter outlined the research methodology being employed during this research. The four phases of this methodology were discussed, with reference to the available literature and contextualised to this study by explaining how each methodology would be carried out. The phases include the realisation of the qualitative phase (phase 1), the systematic review (phase 2), and the *in vitro* and *in vivo* phases (phases 3 and 4). The research design framework, and the data collection and analytical methods were also presented. Lastly, chapter 2 addressed the ways in which trustworthiness during the research project would be ensured, as well as the applicable ethical considerations for conducting this research, with specific reference to research ethics pertaining to animals.

This chapter addresses the process that was followed in realising the qualitative phase of this research. The qualitative data collection process is discussed step by step, together with the analytical work being conducted and the findings stemming from this phase. The information arising from this phase was used in undertaking both the *in vitro* (phase 3) and *in vivo* (phase 4) phases.

The participants during this phase were both men and women, who were able to make it to the gathering when called by the chief/leader. Such *makgotla* occurred in Lesotho and in Campbell. The number of participants in Lesotho was about 20, while 34 community members participated in the Campbell *lekgotla*. These two gatherings generated adequate information and was information saturation therefore reached.

3.2 Main aim of this phase

The main aim of this phase was to gather the required knowledge from participants about the importance, preparation and indications/uses of medicinal plants being utilised by these communities, as either mono-, or combination therapy. The information regarding the preparation of the natural decoctions was later in the study used to test the anti-viral properties of *wildeals* and *wynruit* and the effects of these decoctions on the renal system of rats. This study specifically focused on the two medicinal plants, *wildeals* and *wynruit*,

3.3 Objectives of this phase

The objectives of this phase were to:

- Prepare the medicinal plant decoctions as close as possible to the way in which the Khoi community would prepare them, whilst also adhering to the laboratory policies and guidelines.
- To ensure that the prepared decoctions were administered to the rats through the same routes used by the community.

3.4 Methodology and design

The purpose of this chapter is to inform the reader about the methodology and design being followed in realising this qualitative phase. The process that was followed during this research is outlined step by step.

During this phase, a qualitative approach was followed, aimed at understanding the human nature (the way of doing things) and in doing so, the researchers (the researcher and the co-researcher) were able to get close to the participants (Bassett, 2004:4-5). The focus was to gain an understanding of the Griqua community in Campbell, i.e. one of the few remaining KhoiSan communities in South Africa, specifically with regards to how they prepare and administer the medicinal plants, as well as the conditions being treated. This approach enabled the researcher to build a good rapport with and to gain the trust of the community. In addition, this phase also aimed at gaining data from participants' perspectives and lived experiences (De Vos *et al.,* 2008:267-268), by exploring and understanding the meaning that an individual or a group attaches to a social, or human problem. The researcher focused on understanding the nature of this community being studied, as its members to this day still apply indigenous knowledge regarding the utilisation of medicinal herbs. This study mainly

focused on *wildeals* and *wynruit* as the commonly used medicinal plants amongst the research population.

This approach furthermore involved the collection of data in the participants' setting, by analysing the data inductively, i.e. by building from particulars to general themes, and by interpreting the collected data (Creswell, 2009:232). This research made use of *makgotla* to explore and understand the preparation and uses of *wildeals* and *wynruit* decoctions. The following paragraphs discuss how *makgotla* was applied during this study as data collection approach.

3.5 Population and sampling

For the purpose of this research, the population comprised of those people or objects that possessed certain characteristics from which the sample for the research would be determined, as defined by De Vos *et al*. (2008:193). The population that had been identified for inclusion in this study was a community in the Northern Cape (Griqualand-West, South Africa), specifically the Khoi community, who had been using *wildeals* and *wynruit* for medicinal purposes since time immemorial, to this date. This community therefore had the required knowledge and had all of the characteristics that would help the researcher in answering the research question.

This community was used for conducting *makgotla*, so as to explore and describe the uses of the said medicinal plants. Men and women over the age of 18, with the necessary knowledge on how to prepare and administer *wildeals* and *wynruit* for medicinal uses, were included in the study. They were further required to willingly participate in this research.

De Vos *et al*. (2008:193) describe research sample as the portion of the total population that would represent the total population of the study. As *makgotla* is an open forum, everybody from the community is welcome to attend (Pienaar, 2004:24-25), and was an all-inclusive sample for *makgotla* used as a result, since the whole community would be invited to attend. Non-probability purposive sampling was employed during personal, individual interaction with the community's knowledge holders. In addition, both men and women who had voluntarily agreed to participate would be included in the study. The knowledge holders included anybody that had been recognised by the community as being knowledgeable with regards to the use and preparation of medicinal plants. These knowledge holders would help in gaining an in-depth understanding of how the KhoiSan community prepares and utilises the two chosen medicinal plants.

3.6 Data collection approaches

As defined by Burns and Grove (2005:733), data collection is the precise and systematic gathering of the information that is needed to address the research problem. The following paragraphs address the methods and systems that were used to collect the required data for this research. In collecting data, the researcher followed the *makgotla* approach, as described by Pienaar (2004:25-26). In a follow-up data collection method, an ethnographic methodological framework that utilises a qualitative research form, whereby extensive observation is made to obtain an insider's, or knowledge holder's understanding of the phenomenon being investigated, was used, as described by Stahler and Cohen (2000:1-8). These extensive observations were used in the natural setting of the participants (Creswell, 2009:229; De Vos *et al*., 2008:271-272), and was the observation schedule developed after the initial data collection method through *makgotla.* The researcher observed how indigenous medicines were prepared, administered and stored by the community, with the main focus on decoctions prepared from both *wildeals* and *wynruit*, for mono- and combination therapies. The community also mentioned and emphasised the importance of who can collect the medicinal plants. It was agreed that an elderly woman, a young girl or a man. They also said that if you going to collect the medicinal plant, you have to leave something in the ground. The paragraphs below explain each method as it was implemented during this study-098.

3.6.1 *Makgotla* and a participative observation approach to data collection

Makgotla is the plural form of *lekgotla*, a Sesotho word, which, when directly translated, means council meeting, gathering, or an assembly (Schapera, 1953 as cited by Pienaar, 2004:25). In addition, *lekgotla* is also described as a chiefs' court, during which a wide range of community disputes and offences are dealt with (Schapera, 1957:150-162). According to Pienaar (2004:25-26), *lekgotla* follows a specific process, whereby the chief becomes aware of the matter to be discussed, as the matter is brought to his attention informally, privately and confidentially. The chief would then inform his advisors, who normally are his paternal uncles, or people with in-depth knowledge about the issue, or even the community itself. Applied to this research, the researcher followed this approach by consulting with the chief/headman first by sharing the information in private, before the *lekgotla* would be called. A more detailed discussion of a *lekgotla* is found in chapter 2.

On the day of the scheduled *lekgotla* in Campbell, the researcher had a private meeting with the chief beforehand, so as to verify the required information to be shared with the

community. This private meeting at the chief's house gave the researcher an opportunity to interview the chief, as one of the knowledge holders. This meeting also ensured that the chief was aware of the information being required by the researcher. After the interview, the chief and researcher left for the community centre, where the community was readily waiting.

Figure 3.1: Some of the community members who attended *lekgotla* in a relaxing environment (*community consented for the picture usage*) Mahlatsi (2014)

The first *lekgotla* was held in Campbell, in the Northern Cape province of South Africa, where the researcher met with the community after having met with the chief. The main aim of this meeting was to build the necessary rapport with the community. This became the successful endeavour, although not much data was collected during this *lekgotla per se*.

The following *lekgotla* for the purpose of this study was held in 'Melesi, in the Maseru district in Lesotho and was it attended by the indigenous healers. The same approach was followed as in Campbell, in that the chief indigenous healer was given the information prior to the main gathering. This *lekgotla* was facilitated by the chief indigenous healer, and was the researcher merely an observer. Although many healers were present, there was no free flow of information and was a lot of probing necessary.

The last *lekgotla* was facilitated in Campbell, and was it regarded as the primary population of this study. In view of the community being comfortable with the researcher, the information flowed freely under facilitation of the chief, and was the community eager to participate in the discussion.

As mentioned, *lekgotla* is an open forum, during which everybody from the community is welcome to attend. All *makgotla* being held for the purposes of this study were conducted in the presence of the researcher and other Seboka (the project name) team members. The researcher acted as an observer and took field notes and made recordings. The information was captured by using a video and digital camera, whereas field notes were taken by the researcher while observing the non-verbal communications of participants. These recorders were used with the necessary permission of the chief, who had subsequently also obtained prior consent from the community. The taking and use of photographs were granted by the community.

Although the participants called each other by their names, these names were not disclosed, so as to maintain the principle of protection of identity and confidentiality.

In order to obtain the required information that would help answer the research question, the researcher and his promoter agreed upon posing the following two main questions to participants:

What is the importance of medical plants in this community?

What is the importance of wildeals and wynruit in this community?

These questions where then followed by probing questions, such as:

How do you prepare these medicinal plants?

What do you use them for?

What measurements do you use when preparing and administering these decoctions?

These questions were asked in the local language (mother tongue) of the participants. In Lesotho, the local name that is used for both medicinal plants is *lengana* and do the local people differentiate between them by their appearance and colour. In the Northern Cape, the terms *wildeals* and *wynruit* are commonly used and were they adopted for the purpose of this research, as the Griqua community constituted the primary research population of this study. The commonly used medicinal plants were written down by the researcher by using the indigenous names used by each community. Although some other medicinal plants were commonly used by both communities, this study only focused on the two selected *wildeals* and *wynruit* plants.

Among the medicinal plants being mentioned by the two communities during *makgotla*, five were used by both. The medicinal plants that were identified at these gatherings are summarised in table 3.1 below.

Table 3.1: Selective medicinal plants commonly used by the indigenous Campbell and Lesotho communities (local names used)

Campbell (Griqualand-West, SA)	'Melesi (Maseru district, Lesotho)	Common medicinal plants in 'Melesi and Campbell
Wildeals	*Lengana*	*Wildeals/Lengana*
Wynruit	*Lengana*	*Wynruit/Lengana*
Wildekeer	*Poho tshehla*	--
Rooistorm/Mint	*Koena*	*Mint/Koena*
Grashout	*Phate ya ngaka*	--
Bloubos	*Lero la tlholeho*	--
Mooimeisie	--	--
Rondepisbos	*Matekoane*	--
Aalwyn	*Lekgala*	*Aalwyn/Lekgala*
Marijuana/Dagga	*Matekoane*	*Dagga/Matekoane*

The plant names in the above table 3.1, are those used by the respective communities. These medicinal plants are used to treat common ailments in the community, such as the common cold.

3.6.2 Reaching of data saturation by using *makgotla*

As mentioned, *makgotla* is the plural form of *lekgotla* in Sesotho, generally referring to a meeting, or gathering (Schapera, 1953 as cited by Pienaar, 2004:25). *Lekgotla* is an open forum and is everyone in the community invited and allowed to voice their opinion in a respectable way (Pienaar, 2004:25).

Such open forum allows for much inter-personal communication and for exchanging ideas, until no new ideas emerge. At such point, the *lekgotla* facilitator would ask whether the topic

could be concluded, and if yes, it is summarised and finalised. Both *makgotla* being held for the purpose of this study followed the same approach. Since the same information was voiced during the second Campbell gathering, as in the first, it was indicative of data saturation having been reached. Information saturation would be reached faster when using *makgotla*, than during conventional focus groups, or in-depth interviews, because of its nature as being an open forum that accommodates as many people as possible, without any restrictions on what and how things are said.

3.6.3 Data analysis methods

Data analysis is described as reducing, organising and giving meaning to the collected data (Burns & Grove, 2007:41). The researcher accordingly reduced, organised and gave meaning to the data that had been collected during the *makgotla* and from observing. In an attempt to give meaning, the researcher also followed De Vos *et al*. (2008:333) in viewing data analysis as the process of bringing order, structure and meaning to the mass of collected data.

Table 3.2: Most commonly used medicinal plants by Campbell and Lesotho communities and routes of administration

Campbell and Lesotho	Boiling of leaves	Application of raw leaves	Smoking	Drinking	Mono therapy	Combination therapy	Uses/Indications
Wildeals	✓	✓	✓	✓	✓	✓	**Flu**
Wynruit	✓	✓	✓	✓	✓	✓	**Flu**
Wildekeer	✓	✓	--	✓	✓	✓	**Flu**
Rooistorm	✓	--	--	✓	✓	--	--
Mooimeisie	✓	--	--	✓	✓	✓	--
Bloubos	✓	--	--	✓	✓	--	--
Makoemiesho (Powder)	✓	--	--	✓	✓	✓	**Multiple conditions**
Rondepisbos	✓	--	--	✓	✓	--	--
Mint	✓	✓	✓	✓	✓	✓	--
Hloenya	✓	--	--	✓	✓	--	--
Poho tshehla	✓	--	--	✓	✓	--	--

3.6.4 Qualitative data analysis approach

The researcher also followed Henning's (2007:102) view of analysing qualitative data, as the researcher dealt with raw data by going the conventional, straightforward way of coding and categorising it. The researcher then divided the data into small units of meaning, which were each systematically named (coded according to what a unit of meaning signified to the researcher), after which different units with related codes were grouped together in categories. Data was analysed by means of taking apart words, sentences and paragraphs, which constituted an important act during this research project, in order to make sense of, interpret and theorise the collected data (Henning, 2007:127). To make logical sense from the data having been collected during the *makgotla* and ethnography, the researcher followed the qualitative data analysis strategy, as described below (De Vos *et al.,* 2008:334-339).

3.6.4.1 Planning for recording of the data

For this part, the researcher observed the natural setting and the day-to-day activities of the community when treating ailments, using *wildeals* and *wynruit.* Planning was completed before commencement of the data collection, by visiting the chief/headman, so as to share information about the purpose of the research, the methods of data collection and the planned strategy of reporting back to the community. The researcher further ensured that writing pads were available for making field notes, that the audio-visual camera to video tape all activities, and the audio tape to record all of the conversations engaged in during the *makgotla* gatherings and during the in-depth interviews, were ready and operational, as well as that the observation schedule was available for reporting on the observations made (Pienaar, 2004:25). The researcher labelled all of the audiotapes as they were changed, so as to accurately follow the sequence of events. The labels included the dates of the recordings, the number of participants present during *makgotla* and the setting where the discussions were held. The researcher further ensured that the dates on the field notes and on the audiotapes corresponded for accurate recordings. Finally, collected data was safely kept, to avoid data from getting lost, or misplaced and becoming available to unauthorised people.

3.6.4.2 Data collection and preliminary analyses: the twofold approach

As viewed by De Vos *et al*. (2008:335), data analysis in qualitative research inquiry necessitates a twofold approach, i.e. initial data analysis at the research site during data collection, while the second approach involves data analysis afterwards, away from the

research site. Accordingly, the researcher initially analysed the data at the research site, and afterwards away from the site. Data was classified according to Patton (as citied by De Vos *et al.,* 2008:335), according to whom data should be classified during analysis under different sections, or headings, or grouped into clusters, according to emerging themes. De Vos *et al*. (2008:335) are of the opinion that in traditional research, data collection is always separated from data analysis, contrary to the above view. This author is of the opinion also that qualitative research involves an inseparable relationship between data collection and data analysis. Congruently, the researcher followed a strategy of developing an inseparable relationship between data collection and analysis, by applying them simultaneously (Erlandson *et al.* as cited by De Vos *et al.,* 2008:335), so as to allow for the fine-tuning of the collected data, as well as for continuous adjustment to the analytical approach to help ensure that the researcher reached coherent interpretations that made sense of the emerging data in the field.

3.6.4.3 Managing (organising) the data

Creswell (2007:143) alludes that, besides organising the files, researchers have to convert these files into appropriate text units, like a word, a sentence, or even an entire story, for the purpose of analysis, by using a computer word processing package, or writing by hand, as the first stage of data management. The researcher compiled an inventory of the collected data (De Vos *et al.,* 2008:336-337) to know what forms of data were available. In listing the data, the following aspects regarding the available data were checked:

- Are the field notes complete?
- Were any sections left to be written later that were never finished?
- Are there any gaps in the data that could still be filled by collecting additional data before commencing with the analysis?
- Are all of the data media properly labelled with a notation system that would make future retrieval manageable (dates, places and times)?
- Are all interview transcripts complete?

By following the above inventory guide, the researcher ensured that data analysis was manageable.

3.6.4.4 Reading and writing memos

The researcher read the transcripts repeatedly, so as to make sense of the responses of the participants. The transcripts were read, prior to breaking the information into parts, as

advised by Creswell (as cited by De Vos *et al.,* 2008:337). As the reading was repeated, the researcher made notes on the side to become familiar with the information and to facilitate the incorporation of the literature during the final writing of the participants' responses. The data was cleaned up during the re-reading thereof (Patton, 2002). Moreover, the data was coded with the assistance of an experienced qualitative researcher, who acted as the moderator. The memos were written in the margins of the field notes and next to the photographs (Creswell, 1998 in De Vos *et al.,* 2008:337).

3.6.4.5 Generating categories, themes and patterns

In order for the data to be functional and easy to interpret, the researcher arranged it into categories and sub-categories in accordance with the emerging patterns (De Vos *et al.,* 2008:338). As advised by De Vos *et al*. (2008:338), the process of categorisation was followed by noting any irregularities being observed in the setting, or among the participants. As the categories of meaning emerged, the researcher searched for those that had internal convergence and external divergence (De Vos *et al.,* 2008:338). This meant that the categories had to have internal consistency, while also being distinct from each other. In addition, this involved identification of salient, grounded categories of meaning, as held by the participants in their natural setting.

3.6.4.6 Data coding

Data can be coded by either using different colours, indexing cards, self-adhesive stickers, or writing in the margins of field notes (Burns & Grove, 2007:82). In this study, data was coded by writing in the margins of the notes, which successfully facilitated the retrieval of data by coding the categories.

3.6.4.7 Testing emergent understandings

Data was tested by searching through the data and by challenging the understanding of the data (De Vos *et al.,* 2008:338). Furthermore, the author encouraged the researcher to search for negative instances in the emerging patterns and to incorporate them into larger constructs, as it became necessary. The data was further evaluated for its usefulness and centrality in relation to the phenomenon being investigated (De Vos *et al.,* 2008:339). No negative instances were identified during this research.

3.6.4.8 Searching for alternative explanations

As advised by De Vos *et al.* (2008:339), the researcher had to be aware of alternative explanations and meanings that would exist when attaching meaning to the data. In addition, the researcher searched for, identified and described these meanings and also demonstrated why a given explanation was regarded as the most plausible one. The researcher further searched for possible meanings being attached to categories, and were they later verified by the community as representing the best possible meanings.

3.6.5 Data analysis method and findings

In reading and re-reading the raw data obtained during the two *makgotla,* and during the personal interviews with the chief and the chief indigenous healer, the main themes started to emerge, and are they discussed in the next paragraphs.

The first *lekgotla* was held in 'Melesi in Lesotho with the indigenous healers and was facilitated by the chief indigenous healer. The second *lekgotla* was held in Campbell, with the chief acting as the facilitator. The face to face interview was held with the chief prior to *lekgotla* discussions in Campbell. The following paragraphs describe the context within which the *makgotla* discussions occurred, as well as the procedures that were followed.

3.6.5.1 Lekgotla held in 'Melesi in Lesotho

Context: The *lekgotla* was negotiated for in terms of standard indigenous protocol, whereby the researcher and the co-researcher had negotiated with the different chiefs first, during which the chiefs were informed of the intent and nature of the proposed *lekgotla*. The chiefs then called upon the head of the traditional (indigenous) healers in Lesotho, who in turn called for a meeting of all of the indigenous healers in and around 'Melesi and Maseru to discuss the intended *lekgotla.*

During the negotiations, the researcher discussed the aims of the *lekgotla*, i.e. to obtain answers to the following two questions:

"How important are medicinal herbs in this community and what are they used for?"

"How do you prepare these medicinal herbs and which ones do you use frequently?"

The *lekgotla* being held with the invited indigenous healers was facilitated by the chief healer. Before the meeting, the researcher and the chief indigenous healer had met, with the main focus being to remind the chief healer about what needed to be discussed during the *lekgotla* proceedings. Both parties agreed that the shared information was in agreement with what had been planned.

The researchers (main researcher and co-researcher) introduced themselves to the invited community healers and did they also introduce the Seboka team members present. The chief indigenous healer conducted the *lekgotla.* The chief healer made some introductions and thanked the Seboka team for the invitation. There were 66 community members present in the *lekgotla*, including the Seboka team members.

3.6.5.2 Personal interview with the chief of Campbell

Context: The researcher and co-researcher arrived at the chief's house in Campbell and were welcomed by the chief's wife, as he was busy with arrangements for the planned *lekgotla* of the community. When the chief arrived, he welcomed the researchers into the house. The researcher had a personal interview with the chief, while the co-researcher was present. After the greetings and the introductions, the chief informed the researcher that he was ready for the interview to start.

The researcher thanked the chief for making the time to speak with them, before commencement of the *lekgotla* at the community service hall. The researcher and the chief agreed on the planned proceedings of the main *lekgotla* in the community hall. The interview was then initiated with the following questions:

"How important are medicinal plants in this community?"

"How do people use the medicinal plants in this community?"

The chief answered these questions and discussed the methods of preparation and administration, as well as the uses of medicinal plants to the community. The chief also explained how measurements are being made by the community. After the interview, the researchers and chief left for the community hall to meet with the community.

3.6.5.3 Campbell community lekgotla

Context: The town of Campbell is about 100 km from Kimberley towards Griquastad, in the Northern Cape. This town is quiet and humble and on arrival, one could hear a cock crowing

and see goats running across the field. The running of the goats and the ants scurrying on the ground, according to community members were early signs of imminent rain, along with the thunder clouds collecting in the distance. At the house of one of the community elders, a big pot of food was busy cooking over an open fire, spilling the appetising aroma, whilst ladies were busy kneeing dough for *roosterbrood* (a type of bread in the form of small buns that are placed on an open wire grid directly above warm coals and left to bake). The whole of the community was in preparation of the feast to be held after the *lekgotla.* As mentioned, the Campbell community constituted the main population for this research.

This community is highly religious, because every gathering that was attended by the Seboka team (of which the researcher formed part), was opened with a hymn, and with a prayer by the local priest. The community still shares and believes in the *ubuntu* principles in that, when food is prepared, it is prepared even for those who may arrive uninvited. When somebody takes up a task, there always are more people willing to offer help. *Ubuntu* is therefore about sharing and showing the humanity spirit, as is so well practiced by the Campbell residents.

Lekgotla took place after the researcher had negotiated the proceedings with the chief of Campbell. Negotiations for the *lekgotla* took place in the humble residence of chief and his wife. On arrival of the research team at their house, the researchers enjoyed the view of the hills and the soccer field on which a few goats were grasing. The researchers were awaiting the arrival of the chief, as he was at the community centre, making sure that everything would be ready for the research team. While waiting for the chief, the researchers enjoyed a conversation with mama Corrie on the porch.

On arrival of the chief, the researchers were invited into his house (a welcome cool relieve from the humidity and heat outside). After introductions and being offered a cool drink, the researchers and the chief discussed the aims of the *lekgotla* and what the researchers wished to discuss with the community.

Chief agreed to lead all proceedings, which would take place in the Campbell community centre, and gave the necessary permission for the *lekgotla* to be captured through video recording and was permission also granted to take pictures of the proceedings. Chief requested that the material be made available to him and that the material captured be used for the purpose of this research only and not for any commercial purposes. The researchers agreed to this requests.

3.6.5.4 Proceedings during lekgotla in Campbell

The Griqua tribe is a religious community, as they opened the *lekgotla* with the singing of a hymn and a prayer by the pastor, requesting that the eyes, ears and thoughts of the members of the *lekgotla* be opened. The pastor then blessed the members of the research team and the participants in the name of Jesus Christ, and thanked God that the members had arrived safely and that the researchers and research assistants would have a safe return journey. Figure 3.2 shows the place where the *lekgotla* and pre-*lekgotla* meetings took place. The researcher and the Seboka team had to ensure that they visited the community several times before *lekgotla* could be convened, so as to build a trusting relationship.

Figure 3.2: Campbell youth centre where gatherings were held.

The *lekgotla* proceedings took place in the Campbell youth centre. The day was hot and the sun was very bright, but later in the afternoon during the *lekgotla* proceedings, the rain started forming. Loud roars of thunder were heard and the rain was imminent. The fall of rain during *lekgotla* was interpreted as blessings from God.

The proceedings of *lekgotla* allowed for members of the community to enter and leave during the proceedings. As each participant entered, he/she was welcomed by the rest of the community. A total of 35 members attended the *lekgotla.*

Chief spoke about the use of indigenous medicines and the role of the university in determining the efficacy of indigenous medicines. He emphasised that the purpose of the

research was not to make *gxeigas* (healers) out of the community, but to shed more light on the medicines that the community had been using for so long, by exploring how the community uses and prepares these medicines.

The chief introduced the Seboka project leader to the participants, so that he could introduce the researcher as well as members of the Seboka team present. Once all of the introductions were complete, the community acknowledged the Seboka team, after which the project's principal investigator left the stage for the chief to lead the proceedings.

The chief had laid the platform by stating that the medicinal plants had been used by their community for many years and had they enjoyed excellent results. The chief then started the discussion by asking the following questions to the community:

"How important are these plants, this medicine, for us as a community? How important is it?"

These questions were discussed at length and did the discussions lead to further questions. All discussions are listed in Annexures D, E and F.

Analysis of the discussions later led to the identification of the following themes and sub-themes, as discussed in the next paragraphs.

Table 3.3: Themes and sub-themes identified from the *lekgotla* discussions

Themes	**A**	**B**
	Heritage and relationship of the community with medicinal plants	**Usage and preparation processes of medicinal plants**
Sub-themes	Prolonged engagement with medicinal plants (years). Impact and value of medicinal plants (importance). Trust and relative usage (indigenous system *versus* Western system, reliance on the field (nature).	Appropriate usage (use it as directed). Indications for usage (reasons for use). Process of preparation (methods, e.g. boiling). Measurement of preparation (adult and children). Unprepared and prepared medicinal plants measuring (unique African ways).

3.7 Discussion of the themes and sub-themes

3.7.1 Theme A: Heritage and relationship of the community with medicinal plants

This theme emerged as a result of the participants discussing the relationship and heritage that they have shared with medicinal plants over generations. The participants also discussed the impact and value of their long term trust in indigenous medicines, and the relative usage of the indigenous system, compared to the Western system.

3.7.1.1 Sub-theme A-1: Prolonged engagement with medicinal plants

Struthers *et al*. (2004:141) are of the opinion that even though the indigenous healing system has become so marginalised today, as a result of modern science, it has been with the people since time immemorial and had it been widely used, without any complication. The authors also believe that during the pre-colonialisation era, the indigenous people had faith in what they were using, and was it the same faith that had formed the foundation of indigenous healing. The authors further aver that people had believed more in this healing system, as it had been with them long before the Western healing system came during post-colonialisation, and is traditional healing based upon the respected *ubuntu* philosophy.

Indigenous people have always had a way of treating and looking upon the sick in their communities, and has the concept of health and survival always been viewed as a collective and individual, inter-generational continuum, encompassing a holistic perspective, by incorporating four distinctly shared dimensions of life. These dimensions include the spiritual, intellectual, physical and emotional well-being that are being viewed as co-existing at multiple levels, i.e. the past, present and future (Durie, 2003:510-511).

> *"It makes the man clean, his kidneys, his back and his whole body. It keeps you healthy".*

Taking from the above statement, this brings to light the value of the relationship that indigenous people attach to medicinal plants. The indigenous community has had a long history of trust in medicinal plants, as evidenced by the following statements by the participants:

"The medicinal plants in this country are very important, because we believe in them and these plants, they make us healthy and in most of the cases we use them in mixtures. They are important also for healing and cleansing".

In supporting the above statement, Chinyama (2009:33-34) claims that herbs and plants had been used as the very first medicinal therapies known to man, and with time, the indigenous people of an area had gained knowledge with regards to the plants that they could use for treating certain diseases, or for certain states of illnesses, and by so doing, they had also gained knowledge as to which plants were hazardous, or poisonous and which ones were safe for human use. The above statements hence confirmed the relationship that man had had with nature and its resources.

3.7.1.2 Sub-theme A-2: Impact and value of medicinal plants

Plants once were the primary source of all medicines in the world and do they still continue to provide mankind with new remedies. Natural products and their derivatives represent more than 50% of all drugs in clinical use in the world (Van Wyk *et al*., 2009:8). In support of the importance and value of medicinal plants, Kirmayer (2004:33-48) states that the notion of healing forms the central theme of any medicinal system and has this led to anthropologists writing about a rich array of healing practices being employed in different parts of the world. According to Stewart *et al*. (2008:181-189), during the pre-European contact era, the indigenous tribes had maintained a constant level of balanced, holistic health. Later contact with Europeans then created an upset with regards to the three aspects of community, family, and individual life among all of these First Nations. One of the indigenous healers had this to say about the value and importance of medicinal plants as reinforcement of the previous statement:

"The medicinal plants in this country are very important, because we believe in them and these plants, they make us healthy and in most of the cases we use them in mixtures. They are important also for healing and cleansing".

"It makes the man clean, his kidneys, his back and his whole body. It keeps you healthy".

The common healing practices and elements that are being employed by the different indigenous cultures, include, amongst other methods, the use of medications that are drunk, smoked, injected, or otherwise taken into the body, whilst methods of removing things or poisons from the body involve emetics, cathartics (producing a feeling of being purified

emotionally, spiritually, or psychologically as a result of an intense emotional experience, or therapeutic technique), purgatives, bloodletting, or surgery, as well as body manipulations and touches with specific materials (Kirmayer, 2003:282-302). It can be concluded that medicinal plants had and still have a big impact and value in the lives of people.

3.7.1.3 Sub-theme A-3: Trust and of usage (indigenous system versus Western system)

This theme emerged from participants expressing their trust in using medicinal medicines and in the valuable relationship that has always and still exist between the indigenous people and medicinal plants. The trusting relationship that indigenous people have with medicinal plants was well expressed by Kok (2013), in stating that the "veld" (field) is their chemist and that they live from the bush.

The use of medicinal plants as a means of remedy by the indigenous people in Southern Africa comprises approximately 80% of the total South African/indigenous population and can such high usage be attributed to pharmaceutical drugs being too expensive and unaffordable by most people, especially to those living in rural areas (Mander *et al*., 2007:54). This is how some of the participants expressed their trust in medicinal plants:

> *"Now I can understand, because if the man has jumped around every now and then, you can use these plants".*

From the above statement, it is clear that the majority of the indigenous population had always used and trusted medicinal plants for the treatment of ailments. One of the indigenous healers expressed his trust in medicinal plants as follows:

> *"When somebody has common cold, we put the green leaves in the nostrils or under the pillow".*

In support of the different ways of preparing medicinal plants, other than through cooking, Heilmeyer (2007:88) states that medicinal plants have been ascribed to magical powers, as they came into use as medication and tinctures for illnesses and also for bites by poisonous beasts. From the above expression by participants, it was concluded that the indigenous people trust that contact with the leaves of medicinal plants would cure chest problems. To demonstrate the trust and the relative usage of indigenous medicinal plants by a broad spectrum of indigenous people, one of the members had this to say:

> *"We use these plants for common cold, treating of the intestinal worms (manyowa), so we do deworming (re bolaya manyowa ka tsona), menstrual*

pains (bohloko ba ho ea kgweding), malaria, killing of germs (di bolaya dikokwana-hloko). These plants, they also help the drivers and people doing sedentary type of work with their kidneys (re phekola mafu a diphio)".

"We also use these plants against witchcraft (boloi)".

"Wynruit", "wildekeer", "wildeals" and "vaalbos" are for flu and fevers and you can also cook them and drink them for well-being within the chest. If you didn't receive any cough syrup or pills from the clinic, then you can use it to get rid of the flu conquering your body. The "bloue distel's" roots you can also use for tooth ache. You can use the plants' roots for a tooth pain".

From the above statements, it was concluded that indigenous people use medicinal plants for a very wide range of ailments and conditions. It is therefore less surprising that according to the World Health Organization (WHO) (2003), an estimated 80% of the African population use indigenous medicines to meet their health care needs, while an estimated 40% of all health care in China constitutes administering natural medicines. Such usage occurs despite the negativity surrounding the indigenous healing system and despite the marginalisation of indigenous people. In a study conducted by Mander *et al*. (2007:189-200) among two African countries, i.e. South Africa and Ethiopia, it was revealed that in South Africa about 157 g of plant material had been used per year per consumer, while in Ethiopia it was about 267 g. The same study further revealed that on average about 72% of black South Africans had been using indigenous medicines, compared to the 68% of Ethiopians. This study also demonstrated that even though South Africa is being regarded as one of the more developed African countries, and Ethiopia as less developed, the use of indigenous medicines appeared to have been a firmly entrenched cultural practice among Africans, and had a country's level of development and urbanisation not shown any negative impact on such African healing practices.

Their trust in and relative usage of medicinal plants were also emphasised by the participants, especially with regards to cases were Western medicines were unavailable, or not believed to be capable of effectively treating a condition. Participants also pointed out that the Western practices often failed to deliver, but that the "veld" is always there and would one not be disappointed by nature. These views were evident from what these participants said:

"Now, if you do not receive the pills there by the clinic, there is always an option to go to the veld. That is the reason why our plants are so important to us. In the case that we cannot receive the medication we need, we can always go to the veld and get something there…".

The trust and the relative wide usage of medicinal plants by this community can therefore not be underestimated. These plants are either used raw, or boiled in the form of a decoction/tea.

3.7.2 Theme B: Usage and preparation processes of medicinal plants

With regards to this theme, the information that had been shared by the participants included the appropriate use and indications for the usage of medicinal plants. The uniquely indigenous way of measurement, the preparation processes, as well as the tests for readiness of the prepared treatments are discussed in the next sections.

3.7.2.1 Sub-theme B-1: Appropriate usage

According to Chinyama (2009:33-34), herbs and plants had been used as the very first medicinal therapies known to man, and with time, the indigenous people of an area had gained knowledge as to which plants could be used for certain diseases, or for different states of illnesses, and by so doing, they had also gained the necessary knowledge regarding plants that were hazardous, or poisonous and about those being safe for human use. Knowledge about the use and preparation of plants as remedies for diseases had for long been treated as a closely guarded secret and had such knowledge been withheld from the public domain (Masika *et al*., 2000:87-91).

African indigenous healers have a unique way of measuring medicinal plants and their preparations, and are such measurements individualised. The process of preparing indigenous medicines is well understood by indigenous scientists. Indigenous medicinal plants must be used, as directed by the person offering or administering the medication. Some of the preparation processes and indications for usage, as shared by participants are summarised below:

"Normally, we boil them, we sometimes use green leaves and put them on the painful part. When somebody has common cold we put the green leaves in the

nostrils, or under the pillow. Some people will even smoke the dried leaves single as lengana, or mixed with kwena leaves".

"They cook the plants as the most common method".

Congruent with the above information, Mukinda (2005:15-16) is of the opinion that the preparation of indigenous medicines can be a very critical point, since most of the time it deals either with the fresh, or dry form of the plant, and can the length that is taken to boil or partially burn the plant to extract the odour, not be accurately measured. Most of the time, two main aims of preparation exist, i.e. to extract most of the aqueous extract from the plant, or to neutralise some toxins which might be active in the plant. Additionally, the plant can be boiled until the required colour is attained.

"Taste how bitter it becomes while cooking it, understand? The bitterer it becomes, the more value it will have. ...we also look at the colour of the medicine".

The most common methods of administering indigenous medicines are found to be orally, sublingually, rectally, topically, nasally, and through smoking, steaming and bathing. Preparation will therefore either involve boiling, or heating, or using the leaves raw as is (Mukinda & Syce, 2007:138-144; Kramer, 2005:196). In agreement, Normann *et al*. (1996:72) explain that most often more than one plant are used and may the plants be cooked with other preparations used for medicinal purposes, before use.

3.7.2.2 Sub-theme B-2: Indications for usage

Indigenous medications have a broad spectrum of uses, which forms the central thinking of healing. According to Kirmayer (2004:33-48), the notion of healing is central in any medicinal system and has this led to anthropologists writing about a rich array of healing practices being employed in different parts of the world. Such anthropologists are of the opinion that universal elements of healing, as well as cultural specific features are regarded as constituting all systems of healing, offering a theory of affliction, defined roles for the patient and healer, a circumscribed place and time for healing rituals, specific symbolic actions with healing efficacy, and consequent expectations for recovery. In addition, the author identifies the common healing practices and elements that are being used by different indigenous cultures, such as the use of medications that are drunk, smoked, injected, or otherwise taken into the body, whilst methods of removing things or poisons from the body involve emetics, cathartics (producing a feeling of being purified emotionally, spiritually, or psychologically as

a result of an intense emotional experience, or therapeutic technique), purgatives, bloodletting, or surgery, as well as body manipulations and touches with specific materials (Kirmayer, 2003:282-302). In support of the broad usage of indigenous medication, the participants had these to say:

> *"We use these plants for common cold, treating of the intestinal worms (manyowa), so we do deworming (re bolaya manyowa ka tsona), menstrual pains (bohloko ba ho ea kgweding), malaria, killing of germs (di bolaya dikokwana-hloko). These plants, they also help the drivers and people doing sedentary type of work with their kidneys (re phekola mafu a diphio)".*
>
> *"We also use these plants against witchcraft (boloi)".*

In confirming the above statements, the other participants from the other *lekgotla* had this to say:

> *"Wynruit", "wildekeer", "wildeals" and "vaalbos" are for flu and fevers and you can also cook them and drink them for well-being within the chest. If you didn't receive any cough syrup or pills from the clinic, then you can use it to get rid of the flu conquering your body. The "bloue distel's" roots you can also use for tooth ache. You can use the plants' roots for a tooth pain".*

The above statements by the participants, as well as those by Kirmayer (2003:282-302) confirm the wide range of conditions and illness that can be healed by using indigenous medications. This wide usage can also be attributed to the trust that indigenous people have in using medicinal plants for the treatment of medical conditions.

3.7.2.3 Sub-theme B-3: Preparation process

Indigenous medicinal plants can either be used raw and fresh, or they can be boiled/cooked into a decoction, or tea. Similarly, different parts of the medicinal plant can be used. As mentioned, the common healing practices being identified and the elements that are being used by different indigenous cultures include methods, such as the use of medications that are drunk (decoctions), smoked, injected, or otherwise taken into the body, whilst methods of removing things or poisons from the body involve emetics, cathartics (producing a feeling of being purified emotionally, spiritually, or psychologically as a result of an intense emotional experience, or therapeutic technique), purgatives, bloodletting, or surgery, as well as body manipulations and touches with specific materials (Kirmayer, 2003:282-302). The

participants during *makgotla* had this to say about the way that they prepare medicinal plants:

> *"Normally we boil them, we sometimes use green leaves and put them on the painful part. When somebody has common cold we put the green leaves in the nostrils, or under the pillow. Some people will even smoke the dried leaves single as lengana, or mixed with kwena leaves".*

The chief also confirmed the preparation process during the interview in saying:

> *"They cook the plants as the most common method…and yes…they then drink the juice (sap) that comes from the cooking".*
>
> *"The other manner that I know precisely, they cook and they also mix both the "wildeals" and the "wynruit" together whilst the cooking is happening; thereafter they then drink the juice".*
>
> *"According to me it is much more effective when they are both mixed together, because then they have a quicker outcome".*

Community members also commented as follows:

> *"You take the "bloue distels" and then you take the "rooistorm" and then you take "wildekeer" and then you take "wit vergeet" and then you throw it in and you cook it".*

The above statements testify that indigenous medicinal plants can be used in any other form, whether in the raw form of the leaves, or boiled, and can these medicinal plants also be used as a mixture. Congruently, Normann *et al*. (1996:72) report that often, more than one plant are used in a remedy by the *inyanga (an indigenous healer),* and may these medicinal plants be cooked with meat, beans, or various portions of wild animals, or insects. In addition, there is a definite ritual that has to be strictly adhered to for the treatment to be effective.

Mukinda (2005:15-16) and Van Wyk (2008:342-355) also claim that the indigenous way of preparing medicinal plants include enemas (aqueous, or oily solutions, or suspensions), decoctions (a plant extract obtained from boiling) and infusions (the extract obtained by macerating the crude plant for a short period of time in cold or boiling water).

3.7.2.4 Sub-theme B-4: Preparation measurement (unprepared and prepared medicinal plants)

The way in which African indigenous healers measure medicinal plants, whether in the prepared, or unprepared forms, is very unique. This involves the emotions attached to the medicinal plant, as well as an intuition assessment. These are unique and individualised measurements that can only be understood and interpreted by the person doing the measurement. The science of measure is within the one, who prepares the medicinal plant decoction.

Roberts (1990:226-228) and Dube (2006:1) give examples of measurements/doses that are commonly used by indigenous healers, such as a quarter cup, or double handful of either wet or dried leaves for infusion as a tea. Such non-specific direction of measurement may lead to different doses per preparation. In addition, dose variation may also be attributed to the different cup sizes and hand sizes. The use of wet leaves in the dosage preparations may furthermore result in poor product quality, as the presence of moisture may encourage microbial growth (Dube, 2006:1). During *makgotla* and the interviews with the chief, the participants had these to say when asked about the measurements of the medicinal plants:

> *"We use the fingers to measure how much we need (demonstrating by show of fingers). Sometimes we make use of a full hand or half-a-hand, once the decoction is prepared the measurement is done with teaspoon, tablespoon and/or cups. These medicinal plants should not be used more than a week for the same condition".*

In an interview with the chief, when asked about how the community measures the strength of medicinal plants, he responded as follows:

> *"Look, they take the leaves of the plant and use a handful of this and a handful of that, as long as it is evenly divided ("Handvol blaartjies van een plant hier en ook 'n handvol daar") (even numbers) in measurements as well, then they mix it like that".*
>
> *"("Ons drink maar bekers man"). We drink them out of mugs (said in a humorous manner, laughter graces the room, then a slight pause)…".*

"You know, some people do not like the bitterness, but there are also those who happen to enjoy the bitter taste of the juice, and you can therefore drink a mug or a half glass just any way you feel comfortable".

During *lekgotla*, when asked the same question, the participants commented as follows:

"You take with the measurement of your finger length (illustrating with her own fingers as example). If it has small leaves, then you can just take those leaves if you are really sick. For the child you make it a weaker mixture to the one the adult would drink, but for the adult, you would make it strong. Take the sticks as well as the leaves and cook the leaves separate from the stem sticks of the plant".

The unit of measurement for indigenous medicinal plants, as stated by Roberts (1990:226-228) and Dube (2006), was hence exactly how the community would measure their doses. These doses are unique and individualised and fall within the indigenous scientific way of doing things.

3.8 Interpretation of the findings from phases 1 and 2

Phase 1 represented the realisation of the qualitative data collection method. This phase occurred in 'Melesi, in the form of a *lekgotla* with Basotho indigenous healers, during a personal interview with chief of the Campbell community, as well as during a *lekgotla* with the Campbell community. The 'Melesi *lekgotla* was facilitated by the chief indigenous healer. The interview with the Campbell chief was facilitated by the researcher, with the assistance of the co-researcher, whereas the Campbell *lekgotla* was facilitated by chief, in his capacity as the community leader.

Phase 2 comprised of a systematic review, whereby published and unpublished literature were searched for information regarding the two medicinal plants being studied. Although most of the literature reported on the common usage of the two selected medicinal plants, *wildeals* and *wynruit*, there was no mention of both being used in a combination therapy, as had been the tradition within the Campbell community. A difference was also identified among the literature and the outcomes of this study, with regards to the measurements being applied to medicinal plants. The Campbell community explained their way of using an individualised, uniquely community based measurement system. Since these measurements are well known to the community, it could be referred to as common knowledge among the

KhoiSan people. Contrary, the literature mostly refers to the metric measurement system. Another difference being noted was that the community insisted on using the whole medicinal plant extract, while the literature refers to the active ingredient of the medicinal plant only.

Agreement among some information in the available literature, and the information that was shared by the indigenous community members during the *makgotla* were found, such as information regarding the preparation, administration routes and indications for usage. The most commonly reported method of preparation of medicinal plants was boiling. While Van Wyk *et al*. (2009:48, 250) allude that teas and decoctions are made from these medicinal plants, the community had this to say about the preparation:

> *"Normally we boil them, we sometimes use green leaves and put them on the painful part".*

3.9 Trustworthiness

In ensuring the trustworthiness of these phases 1 and 2 of research, the researcher followed a process of transparency, where data was gathered for the purpose of research, while also searching for multiple perspectives, and changing practices to ensure that results would matter (Lichtman, 2013:292). According to Creswell and Plano Clark (2011:14-15), in ensuring trustworthiness, it is important for researchers to understand the essential issues of persuasiveness in qualitative research, including credibility, trustworthiness and common validation strategies. In order to ensure trustworthiness during this research, the model of Lincoln and Guba (1995 as cited by Creswell, 2009 and Liamputtong, 2011:20-23) was employed. The model focuses on four items, i.e. credibility, transferability, dependability and confirmability, as discussed and applied in chapters three and four. In ensuring that the above criteria were met, an attempt was made by the researcher to ensure that the research topic was well defined to ensure theoretical validity. The discussion below on trustworthiness includes both phases 1 and 2.

- *Credibility*

As described by Lincoln and Guba (1995) in De Vos *et al.,* (2008:346), this is to demonstrate that the inquiry was conducted in a manner to ensure that the participants/subjects are accurately identified and described (Lichtman, 2013:299). Applied in this research, the participants were accurately identified as the as the users of the two medicinal plants and have a wealth of knowledge regarding indigenous use of medicinal plants (phase 1). The

participants in all *makgotla* have used these two medicinal plants and had faith and trust in them. Respondents were over the age of 18 years as they could answer questions independently. The younger generation used this as a platform to learn more about medicinal plants.

In phase 2, credibility was ensured by making every effort that the process of selecting the articles was well defined. All the articles that were included in this phase were screened thoroughly using the AMSTAR approach (O'Mathúna, 2010:414-418). All articles contained the information as set out in the inclusion criterion.

- *Transferability*

This criterion as described by Lincoln and Guba (1995) in De Vos *et al* (2008:346), refers to the generalisation of the findings. The findings in of phases 1 and 2 of this research, seemed to be linking well it is still hard to can generalise as some communities might use these medicinal plants for other conditions. However, it must be noted that the preparation and mode of administration of medicinal plants can be generalised. The preparation methods found during *makgotla* ('Melesi and Campbell) were the same as those in phase 2 of this research. Although there can be other methods of preparing the medicinal plants, boiling and making tea extracts were the most common generalisable method.

- *Dependability*

Dependability as viewed by Lincoln and Guba (1995) in De Vos *et al* (2008:346-347) refers to the researcher's attempt to account for the changing conditions of the phenomenon chosen for the study as well as the changes in the design so as to understand the setting. The researcher made every effort to make sure that the setting design is conducive and acceptable for the participants. The researcher made use of the positivist notion of reliability of assuming an unchanged universe where inquiry could logically be replicated. This was evidenced by realising that the preparation and administration as well as application of indigenous medicines was the same in 'Melesi, Campbell (phase 1) as well as what was found in the literature in phase 2.

- *Conformability*

This construct is stressed by Lincoln and Guba (1995) in De Vos *et al* (2008:347) as focussing on the objectivity of the study and whether can they be confirmed by another. It was for this reason this research used *makgotla* and participative observations in different

areas to demonstrate the objectivity of the findings. The information on preparation and administration of indigenous medicines was found to be the same in both phases. The indications or reasons for the usage of the two medicinal plants were also found to be the same (table 3.1). The *makgotla* were conducted by the chief indigenous healer and the chief of the Campbell community in the presence of researcher. The researcher's own knowledge was bracketed and only asked clarity questions.

Lichtman (2013:299) advises that in ensuring that research findings are trusted, the population in which the research is conducted should possess credible knowledge to answer the research question. For the purpose of this research, the Khoi community in Campbell (Northern Cape) was identified as the primary participants to answer the research question, since they possess the required knowledge regarding the use of indigenous medicinal herbs, specifically *wildeals* and *wynruit*. Data was collected and analysed with the assistance of an experienced qualitative researcher, who acted as a co-coder of the initial coder, as described by Lincoln and Guba (1995:297).

3.10 Intellectual property rights

Intellectual property, as defined by the Act (Act 51, 2008), refers to any creation of the mind that is capable of being protected by law from use by any other person, whether in terms of the South African law, or foreign intellectual property law, and includes any rights in such creation, but excludes copyrighted works, such as a thesis, dissertation, article, handbook, or any other publication, which, in the ordinary course of business, is associated with conventional academic work.

Intellectual property rights, as applicable to this study, were taken into consideration, as advised by Thring and Weitz (2006:261-275). These authors advise that there are political and very important considerations when utilising indigenous knowledge, especially for medicinal discovery. In addition, they acknowledge the efforts of both the National Research Foundation (NRF) and South Africa as a country, in protecting the intellectual property rights of communities, where information is obtained from.

Although theses and dissertations are excluded in terms of the said Act, the memorandum of understanding, as agreed upon by the researcher and the community, states that findings of this research remains the property of the community of Campbell. This community, as defined in the Act (Act 51), is therefore regarded as the intellectual property creator. Based on these study outcomes, the planned for publication will be to the benefit of the community as well.

3.11 Conclusion

This chapter focused on the realisation of the qualitative phase by discussing the methodology, design, and data collection methods used during the *makgotla* being held in ‘Melesi and Campbell. Further data collection during the personal interview with the Campbell chief, as the knowledge holder of the community, was also described.

The collected data during this research and the available literature revealed that indigenous medicinal plants can be used to treat a variety of conditions, and can these medicinal plants also be mixed. Both the literature and the research population indicated that the most common ways of using medicinal plants is to boil/cook them, and/or to use the raw plants as is. Further details are discussed in chapter 6. The trustworthiness for this chapter is discussed in chapter 4.

Chapter 4

Systematic Review

(Phase 2)

"Although we are in different boats, you in your boat and we in our canoe, we share the same river of life".

Ancient proverbs

4.1 Introduction

The previous chapter the researcher discussed the realisation of the qualitative phase of this study, whereby *makgotla* were used to collect data on how the community the community prepares, administers and stores *wildeals* and *wynruit* decoctions. The information assisted the researcher in comprehending the utilisation, indications and contra-indications of these medicinal plants.

In this chapter the researcher will report on the systematic review that was conducted to explore in depth, the existing knowledge, trends and development related to the field of the use of medicinal plants by communities in general with particular focus on *wildeals* and *wynruit*. For the purpose of this study, the systematic review was viewed as a systematic, explicit and reproducible method of identifying, evaluating and synthesising the existing body of knowledge, as reported on by researchers, scholars and practitioners (Okoli & Schabram, 2010:1-10). These evaluated articles were further analysed to draw meaning from the gathered information. All articles included during this phase were assessed, based upon the formulated inclusion criteria and relevance. The process of assessing literature will be reported on in detail below.

4.2 Objective and purpose of this phase

The objective of this phase was to establish the existing knowledge on the use of *wildeals* and *wynruit* as mono therapies, the populations that were utilising these medicinal plants, the indications for usage, the methods that were followed, the outcomes and any reference to experienced toxicity, as reported in the available literature. In determining the use of these

medicinal plants, the systematic review was conducted by using the following key words in the literature searches: *indigenous*, *traditional*, *artemisia afra*, *African wormwood*, *wildeals ruta graveolens*, *rue*, *wynruit*, *medicinal herbs*, *traditional medicine and toxicity, medicinal plants*.

4.3 Design and method and search strategy

This phase followed the design, as outlined in the paragraphs below. As described by Creswell (2009:233), a design is a plan and/or procedures to be followed in detail when applying methods, data collection and data analysis and does it also involve the strategies of inquiry and specific methods to be followed in research. During this research, the design involved the method of data extraction, article appraisal, evidence synthesis and consolidation of the findings, so as to make conclusions with regards to the available information.

The following criteria were used to select articles for inclusion in this research:

- Articles on the preparation of *wildeals* and *wynruit* each as mono therapy.
- Articles on the administration and indications for the use of either, or both these medicinal plants (*wildeals* and *wynruit*).
- Studies that reported on population, indications, methodology, outcomes and toxicity.
- Studies in the fields mentioned above that followed either a quantitative or qualitative methodology, so as to be able to include a broader scope of information, whereas the population of the study, the data collection and analytical methods were also taken into account.
- Primary studies that showed originality in the field of the research.
- Studies conducted between mainly 2000 and 2012 and reported in English. Any relevant information published after 2012 was considered.

The key words that were used during the literature searches (electronic and hard copies) were: *indigenous, traditional, artemisia afra, African wormwood, wildeals ruta graveolens, rue, wynruit, medicinal herbs, traditional medicine and toxicity.* In the study, these medicinal plants were referred to by using the names that are commonly used in the community, i.e. *wildeals* (Artemisia afra) and *wynruit* (Ruta graveolens). The main aim of using these names

was to build and maintain a trusting relationship with the community that the information had not been changed. These medicinal plants had been used and are still being used by indigenous people and had all of the reported studies been conducted on the individual plants. Most of the studies cited their use as mono therapy. Because the research community had indicated that these medicinal plants could be used together as a combination therapy, the literature search also focused on their uses in combination.

Since these medicinal plants are closely related (table 4.1), it was important to establish from the search, whether these medicinal plants are being used to treat the same conditions. Although these medicinal plants were reviewed under the same objective and at the same time, the literature reviews were kept independent, to ensure that the researcher's biases were bracketed.

4.4 Data extraction

Data was extracted by using scientific search engines for articles, as well as books on medicinal plants. Articles for assessment were extracted from the following computer based scientific search engines, i.e. PubMed Clinical Queries, Science Direct, Scopus, Medline, EbscoHost and CINAHL. Inclusion of the literature complied with the inclusion criteria mentioned before (Refer to discussion under item 4.1). The outcome of the literature search, processing and selection therefore are illustrated in figure 4.1 below.

Figure 4.1 below illustrates the process that was followed in selecting the articles for inclusion in this study. In total, the initial search revealed 641 articles, whilst an additional 16 books and other unpublished literature were consulted, giving a total of 657 records. From this total, 214 records were removed, either as a result of a duplication of information, or because they had not met the inclusion criteria. The remaining numbers of records/articles were 416, from which 241 were further screened for eligibility. A further 202 articles were removed after the abstracts were read and found not to contain relevant information. After having read the full text articles, some more were excluded, based on the PIMOT criteria, whereby others did not have two or more sets of information relating to the inclusion criteria. Ultimately, only 13 articles were used for the purpose this study, of which six related to *wildeals* and seven to *wynruit*. Since these articles included both *in vitro* and *in vivo* study outcomes, they would be able to report on toxicity, one of the focus points of this research.

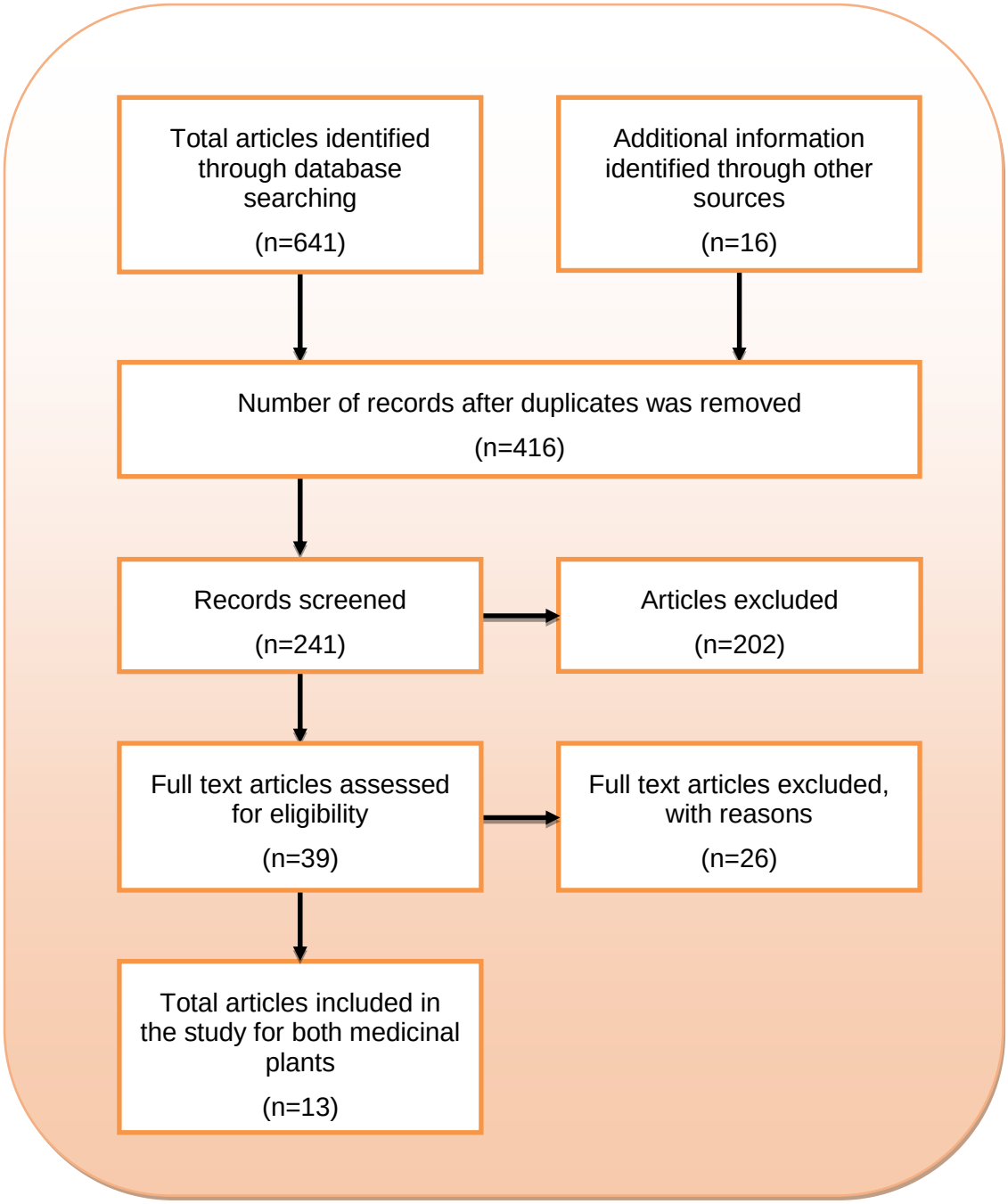

Figure 4.1: The process followed in identifying articles relevant to this study (PRISMA)

Most of the articles from the initial search contained similar information, and were the number of included articles reduced, based on the content of their abstracts, to eliminate any duplicated information (figure 4.1). The remaining abstracts were re-read and were those that had not met the inclusion criteria also eliminated. The full text articles were printed and read with the aim of this phase in mind. In cases were difficulty was experienced with locating articles, the librarians were helpful in finding all articles.

In the process of assessing the studies to be included in this systematic review, the researcher followed the following five steps, as described by Khan *et al*. (2003:118-121):

- Framing the question for review.
- Identifying relevant work.
- Assessing the quality of the studies.
- Summarising the evidence.
- Interpreting the findings.
- Each of these steps are described below.

4.4.1 Step 1: Framing the question for review

To focus on the aim of this phase, the researcher formulated a focused review question for use during this phase, which was the following:

- *What knowledge is available from published or unpublished literature with regards to the preparation, administration and toxicity of using wildeals and wynruit as mono therapies?*

In order to answer the focus question for the phase, the **PICO**(**T**) mnemonic, as described by Hoffmann *et al*. (2010:22-23), was used and adopted for this research. Although, according to Stillwell *et al*. (2010:58-61), most researchers make use of the letter **T** with reference to the first time of usage, the letter **T** was added to the mnemonic during this study to refer to the toxicity of the medicinal plants being reviewed. The letter **M** that replaced **C** (**C** for comparison) referred to the methodology that had been followed during this study. The resultant mnemonic used in this phase was therefore **PIMOT** and was applied as follows:

P = Population (what population was used in the study?).

I = Intervention (what was the purpose or nature of intervention of the study?).

M = Methodology (what research methodology was used in the study?).

O = Outcomes (what outcomes did these interventions bring?).

T = Toxicity (are there any known toxic effects experienced by the population?).

The literature for both medicinal plants was reviewed individually as the combined literature could not show any studies, using the PIMOT approach, which was designed and based upon the focus of this research. In view of the fact that these medicinal plants are basically

used for the same conditions by the Griqua community who are the study population, the similarities between these medicinal plants were summarised and are presented in table 4.1.

As discussed in chapter 3, the community during *makgotla* claimed to have used these medicinal plants to treat flu as either mono-, or combination therapy. They also believe that when used in combination, there is a strong interaction between the plants that yields results faster. Based on this feedback from the study population, the literature was scrutinised for any reports on the usage of these two medicinal plants as combination therapy for any condition.

4.4.2 Step 2: Identifying relevant work

In identifying the relevant literature, the published literature was read and added to the study. Articles for assessment were extracted from the following computer based scientific search engines, but not limited to PubMed, Science Direct, Scopus, Medline, EbscoHost and CINAHL. Articles that were included in the research had significant relevance to the topic being investigated. The initial search identified 641 articles; whilst 16 other sources were also consulted, of which some were excluded, due to the duplication of information, while others did not meet the said inclusion criteria. The search focused on the population, indications for the study, the methodology used, the study outcomes and the toxic effects of these two medicinal plants, as discussed in the following paragraphs.

4.4.2.1 Wildeals (Artemisia afra, African wormwood)

According to Van Wyk *et al*. (2009:142), *wildeals (Artemisia afra)* is one of the oldest and best known medicinal plants, and is it still used effectively today in the world, in Africa and in South Africa by people of all cultures. This medicinal plant is an erect growing, shrubby, woody, perennial plant, growing up to 2 m tall, with a leafy and hairy stem. Its leaves grow up to 8 cm long and 4 cm wide and are the leaf shape narrowly ovate, bi-pinnatipartite, feathery and finely divided (Van Wyk *et al*., 2009:142).

In view of this medicinal plant being widely used, indigenous ethnic groups of South Africa have a long history of using *wildeals* for various ailments, and as such each ethnic group has a name by which this plant is known, i.e. *umhlonyane* (Xhosa), *mhlonyane* (Zulu), *lengana* (Sotho and Tswana), *Artemisia afra* or *African wormwood* (English) and *wildeals* (Afrikaans) (Watt & Breyer-Brandwijik, 1962:197-198; Dube, 2006:5). Other species are found in China, called *Artemisia annua L* and *Artemisia apiacea* (*qing hao* and *cao hao*), as explained by Willcox (2009:101-109).

4.4.2.2 Wynruit (Ruta graveolens, Rue L.)

According to Van Wyk *et al*. (2009:250-251), *wynruit* is an indigenous plant that is small, an evergreen sub-shrub, or semi-woody perennial that is about 0.6 - 0.9 m tall and almost as wide. The stem becomes woody near the base, but remains herbaceous towards the tips. It has long leaves that are dissected innately into oblong, or spoon shaped segments and are about 7.6 - 12.7 cm long. These leaves are fleshy and usually covered with a powdery bloom on top.

This medicinal plant has many synonyms and is it widely used. In South Africa it is commonly known by its Afrikaans name, *wynruit*, as referred to in this study.

Some similarities exist among *wildeals* and *wynruit.* Both plants belong to the plantae kingdom, the magnoliophyta division and the magnoliopsida class and have they reportedly been used independently for the treatment of a number of ailments, including chest related problems (Van Wyk *et al*., 2009:250-251). Table 4.1 below summarises the similarities among *wildeals* and *wynruit* in terms of classification, Kingdom and division. It is therefore a reasonable assumption that the possibility exists that these medicinal plants could have similar effects and that either of the medicinal plants decoction used as mono-, or in combination may be used to treat the same diseases. In the case of study community, they were both used to treat common cold as either mono-, or in combination therapies.

Table 4.1: Botanical classification and morphology of *wildeals* and *wynruit*

Classification criterion	***Wildeals*** **(Artemisia afra)**	***Wynruit*** **(Ruta graveolens)**
Kingdom	Plantae	Plantae
Division	Magnoliophyta	Magnoliophyta
Class	Magnoliopsida	Magnoliopsida
Sub-class	Asteridae	Rosidae
Order	Asterales	Sapindales
Family	Asteraceae	Rutaceae
Genus	*Artemisia*	*Ruta L. (Rue)*
Species	*Artemisia afra*	*Ruta graveolens*

The following step discusses the assessment of the quality of studies identified during the literature search.

4.4.3 Step 3: Assessing the quality of studies

Existing studies were included in this research, based on the population on which the studies had been conducted, the conditions having been treated by using these plants, the outcomes, the methodologies being used, as well as any reported toxicity of these medicinal plants. In reviewing the literature, several sources were consulted and were the following key words used for the search, i.e. *indigenous*, *health*, *knowledge*, *artemisia afra*, *wildeals ruta greveolens* and *wynruit.* All articles used in this study had relevant information and were all written in English.

The selection of articles to be included in this research was conducted by following the 2009 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram, as described by the PRISMA group (2009), as illustrated in figure 4.1 below. From the initial search, a total of 641 articles, relating to both medicinal plants, were found. The literature search was limited by the set inclusion constraints that all articles had to be in English, that they had to be published between 2000 and 2012 and that full text needed to be available for the study to be included. Where full text could not be located, the librarian at the University of South Africa was contacted and was the full text made available. The retrieved articles included those that had information on the preparation, administration, methodology, study population and toxicity of decoctions prepared from these medicinal plants. The articles that were finally included in this study were evaluated according to the adopted PRISMA flow diagram.

4.4.3.1 Critical appraisal of the articles to be finally included in this research

The articles that were ultimately included in this study were critically appraised, as advised by O'Mathúna (2010:414-418). The author advises the use of eleven questions, in accordance with the Assessment of multiple systematic reviews (AMSTAR), as they provide a good inter–reliability/inter-relatedness of the articles, since this tool had been validated and been used successfully (table 4.2). In addition, the author also advises that a systematic review must have a clearly defined question, which is normally presented by the use of the PICO(T) and PIMOT acronyms, as adopted in this study and explained earlier in this chapter. Below are the eleven basic AMSTAR questions for assessing systematic reviews and used during this phase.

Table 4.2: The basic AMSTAR questions for assessing systematic reviews

AMSTAR ITEM	Yes	No	NA
Was an 'a priori' design provided?			
Was there duplicate study selections and data extraction?			
Was a comprehensive literature search done?			
Was the status of the publications used as an inclusion criterion?			
Was the list of studies being included and excluded provided?			
Were the characteristics of the included studies provided?			
Was the scientific quality of the included studies assessed and documented?			
Was the scientific quality of the included studies used appropriately in formulating conclusions?			
Were the methods used to combine the findings of studies appropriate?			
Was the likelihood of publication bias assessed?			
Were potential conflicts of interest included?			

Although some of these questions may not be applicable, the studies to be included in the review must have at least more Yes's than No's / Or not applicable combined for the quality assessment. In this research, articles included for both medicinal plants were assessed using the same AMSTAR questions. Articles that were found to have at least eight yes based on AMSTAR scale were included in the study. This research was also assed using the AMSTAR systematic review questionnaire. Most of the answers were found to be positive based on the questionnaire.

4.4.3.2 Final list of articles included in this research for wildeals

Table 4.4 below lists the final articles that had met the inclusion criteria and were included with regards to *wildeals* as a medicinal plant. There were about six articles that had met the criteria of PIMOT for this plant. The author and the year of publications are indicated in the table.

Table 4.3: Final list of articles included in this research for *wildeals*

Reference	Population / participants	Intervention / indications	Method	Outcome	Toxicity
Mulatu & Mekonnen (2007)	Mice and pigs	Spasmodic effects	*In vitro*	Reduction of intestinal mortality	Not reported
Guantai & Addae-Mensah (1999)	Rabbits	Cardiovascular effects	*In vivo*	Decreases the inotropic activity of the heart	No toxic effects reported
Mukinda & Syce (2007)	BALB mice Wistar rats	Acute and chronic toxicity studies	*In vivo*	Intra-peritoneal injection showed toxicity, while oral administration was safe	Death when given intra-peritoneally
Dube *et al*. (2007)	Guinea-pigs	Muscle relaxation effects	*In vivo*	Muscle relaxation recorded as positive	Not reported
Ntulela *et al*. (2009)	Mice	Efficacy in tuberculosis	*In vivo* *In vitro*	Dose and duration dependent	Not reported
Sunmonu & Afolayan (2013)	Wistar albino rats	Anti-diabetic activity and toxicity of Artemisia afra	*In vivo*	Positive anti-hyperglycemic effects	Not toxic

As per the above table 4.3, most of the studies about the medicinal properties of *wildeals* were done through *in vitro* and *in vivo* testing.

4.4.3.3 Medicinal and chemical properties of wildeals

According to the literature the most common preparation method used was boiling to make teas and extracts. In addition, the medicinal properties of *wildeals* revealed that it has a broad spectrum of inhibitory activities against some organisms and can it be used for various ailments, including, but not limited to chest infections, fever, colds, coughs, asthma and bronchitis (Mukinda & Syce, 2007:138-44; Ntulela *et al*., 2009:s33-44; Mukinda *et al*., 2010:439-449). In the following paragraphs, the medicinal properties that are found in *wildeals* are discussed.

a. Anti-spasmodic properties

According to Mulatu and Mekonnen (2007:371-376), *wildeals* demonstrated having some anti-spasmodic effects, since an ethanolic oil extract made from the leaves had shown a significant reduction of spontaneous rhythmic contractions, of agonist-induced abdominal pains and of intestinal cramps, in a study done on isolated mouse duodenum and pig ileum. The study also confirmed that a *wildeals* decoction could be used to relieve bronchial spasms during an asthmatic attack. The study revealed that the use of *wildeals* had caused the relaxation of the smooth muscles, thereby reducing spasms.

b. Cardiovascular effect

Guantai and Addae-Mensah (1999:351-356) utilised rabbits to assess the cardiovascular effects of *wildeals*. Their assessment revealed that aqueous extracts of *wildeals* had had a hypertensive and a concentration dependent biphasic effect on the heart. In addition, a compound that had been isolated from the plant, called scopoletin, had induced a dose dependent decrease in inotropic activity and a decrease in heart rate, especially when administered at higher doses. Low concentrations had induced initial cardio stimulation, followed by cardio depression. From the preceding, it could be concluded that the use of *wildeals* in high doses could decrease the heart rate and if used as such, precautions must be taken not to cause life threatening bradycardia, as had been experienced during the above mentioned study. Murota *et al*. (2002:1956-1961) furthermore confirmed that flavonoids, which are polyphenolic compounds that occur naturally in several plants as secondary metabolites, had demonstrated protecting effects, such as anti-osteoporotic and anti-cardiovascular activities. It was found that flavonoids is one of the essential oils present in *wildeals* hence its cardiovascular effects.

c. Anti-oxidant activity

In a study by Naidoo *et al*. (2008:214-219), it was found that *wildeals* had shown anti-coccidial potential, due to the anti-oxidant activities of its oils. It was herefore claimed that the volatile oils of *wildeals* could serve as a non-specific donor for hydrogen atoms or electrons, and was it also revealed that these oils could act as effective hydroxyl radical scavenging agents in the deoxyribose degradation process. Based on the tests and analyses being conducted on these oils, it was suggested that the radical scavenging effect could be as a result of the sesquiterpene and chamazulene found among the *wildeals* oils. The use of *wildeals* to treat various inflammatory diseases, such as rheumatism, fever and

diabetes dates as far back as 1989 (Liu *et al.,* 2008:193) has also been reported. To summarise, *wildeals* usage could aid in supplying the body with anti-oxidant substances that are needed for its protection as well as be used for inflammatory diseases.

d. Sedative and central nervous system-acting activities

Studies done on *wildeals* species had proven that it has anti-convulsive and GABA-benzodiazepine receptor-binding activities (Sayyah *et al*., 2004:283-287; Salah & Jäger, 2005:145-149). They also found that the GABA-benzodiazepine receptor-binding activity of *wildeals* had reduced the incidence of convulsions. These findings are confirmed by the outcomes of a study by Stafford *et al*. (2005:210-215), during which they discovered that the flavonoids found in the oil extracts of *wildeals* had shown sedative and central nervous system acting activities, when performing GABA-benzodiazepine receptor-binding assays.

e. Anti-depressant activity

The anti-depressant effects of *wildeals* were hypothesised by Rang *et al*. (2002:345), when stating that some transmitters, such as serotonin, noradrenalin, dopamine, GABA and L-glutamate, were related to depression. Most of the anti-depressants available today are based on the selective inhibition of serotonin re-uptake. Nielsen *et al*. (2004:159-163) also report that the ethanolic (oil) extracts of *wildeals* showed a low affinity towards the serotonin transporter protein. They concluded that the affinity of this extract had further exhibited a concentration dependent relationship, which was indicative of *wildeals* possessing a certain potential towards the possible use thereof in the treatment of depression.

f. Anti-plasmodial properties

The study conducted by Liu *et al*. (2010:230-235) on the plasmodial properties of *wildeals* showed some activity by the non-polar fraction of *wildeals* while the traditionally prepared tea infusion did not show any activity at a concentration of 20 µg/ml. The plasmodial properties of *wildeals* were demonstrated also during a study by Avula *et al*. (2009:633-644), as the lipophilic extract from *wildeals* had proven to be the most active against the chloroquine sensitive strain, PoW and the chloroquine resistant clone, Dd2 of Plasmodium falcipaprum. In addition, the aerial parts of *wildeals* showed the highest activity against the chloroquine sensitive Plasmodium *falciparum* strain and against the chloroquine resistant clone of plasmodium falciparum (Kraft *et al*., 2003:123-128). Even though the aerial extract of the plant showed high activity against Plasmodium *falciparum*, it was concluded that it was not an effective treatment for malaria.

g. Wildeals toxicity

According to Timbrell (2002:163-179), the toxicity of medicinal plants can be evaluated by observing human or animal populations being exposed to the plant material, by administering the plant materials to animals under controlled conditions, by observing the effects (*in vivo*), and by exposing the cells (sub-cellular fractions, or single celled organisms) to the plant material (*in vitro*). Toxic effects are defined as harmful responses of a biological system to a toxic compound, resulting in the death of the cells, or of the whole organism. Toxic effects can mostly manifest after acute or chronic exposure of the organism to a toxic compound through oral ingestion, inhalation, or absorption following skin contact (Pascoe, 1983:1-60). Toxic effects are seen as signs or symptoms, or as a reflection of a disturbance of the normal activities of enzymes that perform essential biochemical roles in all forms of life, or as an alteration of the normal activities of the plasma membrane that regulates the exchange of nutrients and metabolites between the cell and its surroundings, or as disturbances of other normal cell activities, such as RNA and DNA synthesis, growth, cell division, and general metabolism at all levels of an organism from sub-cellular to organ to organ system (Timbrell, 2002:163-179).

Studies by Jennet-Siems *et al*. (2002:351-352) and Mativandlela *et al*. (2008, 841-845) both showed that the extracts, sesquiterpene lactone and crude ethanolic from *lengana,* had cytotoxic effects. In another study, Mukinda and Syce (2007:138-144) tested the acute and chronic toxicity of *wildeals* on rodents through *in vivo* laboratory tests. During these acute toxicity assays, the aqueous extract of the plant was administered as single doses peritoneally and orally. The results from this study showed that acute doses of *wildeals* had been relatively non-toxic in mice, irrespective of the route of administration, whilst even the chronic toxicity results showed that *wildeals* had been safe in the healthy mice being used in the study. These results suggested that extracts of *wildeals* as it is traditionally used by humans, whether during self-medication or not, are relatively safe. From the biological information available on *wildeals* this plant is being used for many ailments across the African continent. From the literature study, *wildeals* was hence found to be widely used, despite controversial reports regarding its safety, stemming from the high levels of thujone and from the use of essential oils being isolated by hydrodistillation from the twigs.

Analysis of the extracted oils from *wildeals* from different locations in South Africa revealed variations in composition with regards to the levels of alpha- and beta-thujone, 1.8-cineole and camphor (Oyedeji *et al*., 2009:849-852). This study revealed varying levels of alpha-thujone and other components in *wildeals* sampled from different locations across South

Africa. Plants from Phillipolis (Free State) and Keiskammahoek (Eastern Cape) had the highest levels of alpha-thujone (between 62 - 74%), but a very low camphor content. *Wildeals* samples from Gqumashe and Hogsback (Eastern Cape) and Empangeni (Kwazulu Natal) had a very low alpha-thujone content of 3.7 - 20% while the 1.8 cineole concentration was 13 - 49.5%, with camphor being 13.9 - 21.2%. This study also revealed a difference in both the alpha and beta contents among dry and fresh *wildeals* leaves, as dry leaves had higher concentrations of these compounds than fresh leaves (Oyedeji *et al*., 2009:849-852). From the above, it was concluded that the toxicity of *wildeals* would vary from place to place, based on the composition of the essential oils. It was further concluded that locally based research findings of *wildeals* could not be generalised, based only on the study outcomes of Oyedeji *et al*. (2009:849-852).

Thujone alpha and beta are reported to be present in *wildeals* (Graven *et al*., 1990:215-220; Van Wyk *et al*.,1997:142; Dube, 2006:16) and is it also suspected to cause a condition, known as absinthism (Lachenmeier *et al*., 2006:1-8). Mukinda and Syce (2007:138-144) report on the occurrence of hypo-activity, a loss of appetite, pilo-erection, convulsions, dizziness, syncope, disorientation and hyperventilation, amongst the acute toxic effects found to result from using *wildeals* in tests done on rodents. These same effects were also identified during a chronic toxicity study, including hyper salivation. Based on the outcomes from these studies, it was important to understand the effects of *wildeals* on the renal system. The study reports on no significant changes among the organs of the treated animals and the control. Mukinda and Syce (2007:138-144) hence concluded that the consumption and use of *wildeals* by human beings were considered safe.

4.4.3.4 Final list of articles included in this research for wynruit

The below table 4.4 summarises the final list of articles that were included for the *wynruit* discussions.

Table 4.4: Final list of articles included in this research for *wynruit*

Reference	Population / participants	Intervention/ indications	Method	Outcome	Toxicity
Rahim *et al*. (2010)	Rats (Wister rats)	Checking sperm mortality	*In vivo* *In vitro*	Low epididymal sperm count with low sperm mortality	Not reported
Preethi *et al*. (2006)	Mice BALB/c	Anti-tumour activity checking	*In vivo*	Anti-oxidant Effective against ascites and solid tumours	Cytotoxic apoptosis
Raghav *et*. *al*. (2006)	Murine macrophage cells	Anti-inflammatory effect	*In vitro*	Inhibition of nitrite level in LPS murine macrophages	Paw oedema
Saeed *et al*. (2009)	Guinea pig liver	Evaluation of inhibition of xanthine oxidase	*In vivo*	Good inhibitor of xanthane oxidase	Not reported
De Freitas *et al*. (2005)	Mice *(Mus domesticus* CF1)	Effects on pregnant mice	*In Vivo*	Normal implantation No fetal expulsion	No maternal toxicity but suggestive fetotoxicity
Pathak *et al*. (2003)	Human beings with cancer tumours	Induction of cell death in brain cancer	*In Vivo* *In vitro*	Effective in treatment of intra-cranial brain cancer	Minimal side effects reported
Gutiérrez-Pajares *et al*. (2003)	Mice (Swiss albino)	Pre-implantation of embryo	*In Vivo*	Alteration of the normal blastocyst Fetal expulsion	Arbotifacient

4.4.3.5 Medicinal and chemical properties of wynruit

A large number of plants, including *wynruit*, had been used by indigenous people as a medicinal plant since time immemorial. *Wynruit* had been used for various clinical conditions, but the rationality of its use is still controversial to this day, despite several *in vitro* and *in vivo* studies on its medicinal uses (Gutiérrez-Pajares *et al*., 2006:234-239).

Wynruit has been studied extensively and the extracts of this plant were found to have a mixture of furoquinoline alkaloids in a concentration of approximately 1.5%, with the furoquinoline containing arborine, arborinine and gamma-fagarine (Pathak *et al.*, 2003:975-982). Other studies revealed that acridone alkaloids are found in high concentrations in the roots of *wynruit,* as well as the flavonoid, rutin, which is believed to strengthen the blood

vessels and reduce blood pressure. Other studies conducted on *wynruit* as a medicinal plant, indicated that it had the following medicinal properties, i.e. anti-cancerous, cardiovascular, anti-spasmodic, anti-fertility, anti-inflammatory, anti-bacterial/-fungal, anti-parasitic, anti-pyretic, anthelmintic, anticeptive, the relieve of deep aching pain, rheumatism and eyestrain induced headaches, as well as being able to decrease the lipopolysaccharide (Miguel, 2003:231-144; Gutiérrez-Pajares *et al*., 2003:667-672; Raghav *et al*., 2006:234-239). The preceding is indicative that *wynruit* has many medical properties, although its usage as medicinal plant is still controversial. The controversy surrounding this seemingly valuable medicinal plant has contributed towards investigating the effects of this plant independently and in combination with *wildeals* on the renal system during this research, so as to provide scientific evidence of the effects of both *wildeals* and *wynruit* independently, as well as in combination.

a. *Anti-spasmodic properties*

The anti-spasmodic effects of tea and oil extracts of *wynruit* on smooth muscles, especially are reported (Preethi *et al*., 2006:439-443). These effects were attributed to the alkaloids, arborine and arborinine, as well as to the coumarins/rutamarins (Faisal *et al*., 2005:1478-1480). These effects were also observed during an isolated study on gastrointestinal smooth muscles. These same effects of arborinine were further demonstrated on the coronary muscles of the pig. These effects were found reversible in all of the studies being conducted (Minker*et al*., 1980:7-11).

b. *Anti-fertility properties*

The anti-fertility and abortifacient properties of *wynruit* were found to be caused by using teas and oils from this plant. These effects of the *wynruit* extracts were attributed to an anti-implantation action, whereby the fertilised egg failed to be implanted in the uterus. Those findings then showed that wynruit has abortifacient effects, and can cause infertility. Another study identified chalepensin as the active component present, especially during the early pregnancy of rats. In another study on rats, some of the fetuses showed malformation, whilst others were dead, and were these effects attributed to the use of *wynruit* extracts. The study results reported that *wynruit* could also be linked to fetotoxicity as the possible cause of fetal deaths. The study further speculated on the use of *wynruit* by women for abortive intent, but was it suspected that it may cause multiple organ failure and even death. The outcomes from these animal studies should therefore be interpreted cautiously, before extrapolating them to humans, because there exists no direct relationship between chemical equivalent

dose in different animal species and the concentrations in the blood or tissues, and are endogenous metabolic process not necessarily the same in animals and humans. Another study also concluded that ingestion of the aqueous extract of *wynruit* during the pre-implantation phase had altered normal blastocyst formation in mice, which could be explained by a reduced embryo cell number and retarded embryo development (Gandhi *et al*., 1991:45-49; Gutiérrez-Pajares *et al*., 2005:74-77).

The usage of *wynruit* by humans for anti-fertility or abortive intensions may be dangerous and has its safety for such purposes not been confirmed. In a study done by Rahim *et al*. (2010:63-66) to assess the sperm mortality in rats, it was revealed that *wynruit* had reduced the sperm count, as well as decreased the sperm mortality. It was deduced that the use of wynruit during the first trimester could cause fetal expulsion. In addition, the use of this medicinal plant by men could result in a low sperm count and low sperm mortality.

c. *Abortifacient properties*

In countries, like Brazil, *wynruit* has been used as an abortifacient. The study conducted in Brazil by de Freitas *et al*. (2004:74-77) had proven the abortifacient properties of this plant. The study was done *in vivo*, by using pregnant mice. The findings from this study revealed that *wynruit* could cause fetotoxicity and pre-implantation complications, but was no maternal toxicity reported. Congruent to the above findings, Gutiérrez-Pajares *et al*. (2003:667-672) also reported that indigenous people had used this medicinal plant to promote menstruation and fetal expulsion as an abortifacient. Based on these findings, use of this medicinal plant by pregnant women must be closely monitored.

d. Anti-cancer properties

A study by Pathak *et al*. (2003:975-982) revealed *wynruit* as having preventative properties towards brain cancer proliferation, this happens by protecting the B-lymphocyte cells from hydrogen peroxide induced damage. Because some studies had demonstrated *wynruit* induced apoptosis (cell death), a study was conducted to assess its anti-cancer properties. The results showed a high level of anti-cancer properties. The study consisted of 34 early stage and 22 advanced stage cancer patients. The effects of the *wynruit* extract, chalepensis, were found to be more apparent in the early stages of cancer, but were the same results not found in the advanced stages of this disease. Anti-cancer activity was demonstrated with regards to three types of human cancer cells (Hela, MCF7 and A431), whereby the proliferation of these cells was attributed to furanoacridone and acridone alkaloid extracts. The other cytotoxic effects of these extracts were observed in Dalton's

lymphoma ascites (DLA). Most of these studies confirmed that the lifespan of tumour bearing animals had been increased, due to the use of *wynruit* extracts. Although this plant has shown anti-cancer properties, no studies have yet confirmed which of *wynruit's* ingredients are actually responsible for its anti-cancer properties (Preethi *et al*., 2006:439-443; Rethy *et al*., 2011:181-191).

In another study by Pathak *et al*. (2003:975-982), it is reported that the extract, Ruta 6, had shown anti-cancer activity in a patient with brain cancer, when used in combination with calcium phosphate. This study also confirmed that despite Ruta 6, in combination with calcium phosphate, having demonstrated causing mitotic catastrophe in human cancer cells, the actual mechanism used to target these human brain cancer cells could not be explained. It was also suggested in this study that, as a homeopathic cancer treatment, the combination of Ruta 6 and calcium phosphate could be prescribed for the optimum treatment of brain cancers in general and gliomas in particular, and may it possibly aid in reducing the severe side effects and in protecting blood forming cells in patients with brain cancer (Asgarpanah & Khoshkam, 2012:3940-3949).

e. *Anti-bacterial and anti-fungal properties*

From *in vitro* studies done, it was revealed that *wynruit* compounds had both anti-bacterial and anti-fungal properties, and were 15 of these compounds identified in total. The extracts, furanocoumarins, as well as quinoline and quinolone alkaloids, have shown to be highly effective in the treatment of fungal infections, especially *Trichomonas vaginalis*. The most effective alkaloid was found to be acridone, while the coumarins were able to inhibit bacterial growth when used in high doses, but would such doses be toxic to the body (Ivanova *et al*., 2005:344-347; Meepagala *et al*., 2005:2689-2695).

The *wynruit* extracts demonstrated inhibitory effects against the following bacteria, i.e. gram positive organisms (*Staphylococcus aureus* and *Streptococcal pyogens*) and *Bacillus subtilis*. Other properties that were identified during these anti-bacterial studies were that some of the components of *wynruit* had shown some interference with the DNA of some of the viruses, thereby preventing the propagation of these viruses. Other studies indicated that in China, *wynruit* is popularly used as vermifuge and also for treating insect bites and was this attributed to one of its non-medicinal uses as an insect repellant (Al Heali & Rahemo, 2006:272-274; Asgarpanah & Khoshkam, 2012:3940-3949).

f. *Cardiovascular properties*

In an *in vivo* study conducted on rats, it was found that *wynruit* had positive chronotropic and inotropic effects on isolated right atria and was it also responsible for prolonging the atrio-ventricular nodal refractoriness. These effects had been observed in isolated rat hearts, which suggested cardiotonic and anti-arrythmic activities. Given the above effects, it was suggested that the *wynruit* alkaloid fraction or the plant itself could be beneficial to the treatment of supra-ventricular tachyarrhythmia (Chiu & Fung, 1997:859-862; Khori *et al*., 2008:357-363).

g. *Anti-inflammatory properties*

In a study done on rats by Ageel *et al*. (1989:369-372), a 96% ethanol extract of *wynruit* had inhibited inflammation by at least 30%, when administered as an oral dose of 500 mg/kg body weight. These findings could be linked to the study conducted by Ratheesh *et al*. (2010:18-24), during which a *wynruit* alkaloid fraction was found to reduce edema by exerting anti-inflammatory activity in arthritic affected joints. These effects were observed at a dose of 10 mg/kg, at which the anti-inflammatory effects were higher, compared to a polyphenolic fraction and diclofenac. The activity *wynruit* was found to be a suppression of the production of nitric oxide from lipopolysaccharide in murine macrophage cells, thereby reducing the inflammatory process (Raghav *et al*., 2006:234-239).

h. *Wynruit toxicity*

From the above discussions it was confirmed that *wynruit* is one of the oldest medicinal plants and had its effects as medicinal plant been well tested and confirmed during both *in vitro* and *in vivo* studies. The alkaloids present in *wynruit* are skimmianine and graveoline. Some alkaloids, like bergaptene and xantotoxine, which are responsible for photo-sensitisation, hepatotoxicity and nephrotoxicity, are part of the furocoumarins. Some of the alkaloids from *wynruit* were also found to be responsible for fetal deaths if taken during pregnancy. Other studies claim that the extracts of *wynruit* had been found to be highly mutagenic during experimental mutagenicity screens, but must the clinical importance of these findings still be established. Some studies also claim that the fresh leaves of *wynruit* were found to be more toxic than the dried ones. This was attributed to the fact that dried leaves had lost some of their volatile oils (Kohne & Kremer-Kohne, 1990:57-62).

Findings from a study by Seak and Lin (2007:173-175) claim that large doses (more than 100 ml of the oil, or approximately 120 g of the leaves in 1 dose) could cause violent gastric

pain, vomiting and general body system complications, which may even result in death. A study conducted on guinea pigs, during which a single dose of 400 mg/kg was given, resulted in the fatality of those guinea pigs, due to hemorrhage of the adrenal gland, liver and kidney. In another case report regarding toxicity, a 78-year old woman had multiple organ failure after taking *wynruit* for cardiovascular protection. Three days after having started to take the medicine, she was taken into the hospital due to toxicity and did she present with bradycardia, acute renal failure, hyperkalaemia and coagulopathy, and required haemodialysis (Kohne & Kremer-Kohne, 1990:57-62). However it must be emphasised that, although this medicinal plant, has been used to treat common cold and other conditions, it was also found to can cause infertility and also cause abortion. It is for this reason that the community health nurses and the community needs to be education on the cautious and safety usage of this medicinal plant.

4.4.4 Step 4: Summarising the evidence collected from the literature

Wynruit and *wildeals* were found to belong to the same kingdom, division and class, as summarised in table 4.2. It became evident from the literature that these medicinal plants had been used by indigenous people to treat a number of conditions and had they been tested for their efficacy with regards to such treatments. The methodologies used in testing these medicinal plants were both *in vitro* and *in vivo* investigations. These medicinal plants have demonstrated to possess mainly three medicinal properties, being cardiovascular, hypoglycaemic effects and anti-spasmodic effects. Differences between these medicinal plants are that *wynruit* showed to be effective against brain tumour cells, while *wildeals* showed to possess sedative and central nervous system effects (Preethi *et al*., 2006:439-443; Salah & Jäger, 2005:145-149). Common properties among these plants include that both are used to treat a variety of conditions, such as diabetes mellitus, rheumatoid arthritis, kidney infections, fever, common colds and flu (Thring & Weitz, 2006:261-275). Most of the studies that were done on these medicinal plants followed either the *in vivo* or *in vitro.* This implies that if these medicinal plants are used with less understanding they can be toxic to the body.

4.4.5 Step 5: Interpreting the findings

Most of the tests done on these medicinal plants were either *in vitro* or *in vivo.* The findings with regards to both medicinal plants from the reviewed literature did not reveal any serious toxicity concerns. The commonly used preparation methods during the reviewed studies included boiling, hydro-distillation and injections, among others. Most of the studies did not

report on any deaths of the trial animals used during *in vivo* testing, except for a study conducted by Mukinda and Syce (2007), during which the acute and chronic effects of *wildeals* had been tested. This study reported deaths of the rats that were given the decoction intra-peritoneally. The efficacy of these medicinal plants in combination was not reported on in the available literature. It was also reported that these medicinal plants had been trusted and used for several conditions.

4.4.6 Conclusion

Although there could be many indications for the uses of these medicinal plants, the main purpose of this phase was to use the literature to elicit the known uses of *wildeals* and *wynruit*, by considering each plant independently. The information from the literature was then compared with that obtained from the community during the *makgotla.* Another purpose was to elicit any similarities in the usage of these medicinal plants. *Wildeals* and *wynruit* were each evaluated as mono therapy, as no reports on any combination were found in the literature and was it assumed that the combination therapy for influenza by the Griqua community had been a community innovation.

This chapter gave evidence on what is known about the two medicinal plants, *wildeals* and *wynruit*, in terms of their medicinal properties. It also highlighted the preparations and the most common methods of administration of these medicinal plants. Almost all of the experiments done on these medicinal plants had proven that they were safe for human consumption, despite some reports on their adverse side effects. It was also discovered from the literature that most of the tests done on these medicinal plants were either through *in vitro* or *in vivo* testing. The following chapter addresses the *in vivo* and *in vitro* clinical experiments being conducted during this research and are the findings of these phases also discussed.

Chapter 5

Clinical Experiments

(Phases 3 and 4)

"We have come to recognise that we are in a situation of increasing interdependence, and that our future is intrinsically linked to the preservation of the global life-support systems and to the survival of all human forms of life. The nations and scientists of the world are called upon to acknowledge the urgency of using knowledge from all fields of sciences in a responsible manner to address human needs and aspirations without misusing this knowledge".

Nabudere (2011:101)

5.1 Introduction

The previous chapter discussed the systematic review, during which the medicinal properties of *wildeals* and *wynruit* were identified from the available literature as mono-therapy. These two medicinal plants were found to share some similarities, whilst they also had some differences in terms of their medicinal properties. It was also identified that these medicinal plants belonged to the same family and species and that both plants could be used to treat several conditions. Although clinical toxicity studies had reportedly been performed on these two plants, little was reported about how they would affect the renal system and/or liver. Most of the past experiments were done either *in vitro* or *in vivo*.

5.1.1 Clinical experiments conducted during this research

This chapter focuses on the clinical research being conducted during this study, whereby the background to *in vitro* and *in vivo* clinical phases are discussed, followed by an explanation of these phases and an in depth description of the procedures having been executed during each phase.

Durie (2003:510-511) states that indigenous people have always had a way of treating and looking upon their sick in the community. These dimensions of health and survival are viewed as a collective and individual, inter-generational continuum, encompassing a holistic perspective that incorporates the four distinctly shared dimensions of life, i.e. the spiritual,

the intellectual, the physical and the emotional well-being, and are they viewed as co-existing in multiple levels, being the past, the present and the future.

Although the indigenous way of healing had been used since time immemorial, Shrestra (2002:107) is of the opinion that indigenous knowledge had not been well and easily accepted, since communities and groups who had adhered to indigenous belief systems and local knowledge in health and development practices, were often misrepresented as being ill-educated, backward, or even uncivilised. This misrepresentation happens irrespective of the fact that over 80% of the world population still making use of indigenous health practices (WHO, 2003).

Taking from the above, Ohenjo *et al*. (2006:1937-1946) are of the opinion that indigenous people are still facing the same challenges of trying to convince policymakers to accept their perspectives on development initiatives and appropriate service provision, because of such high demand and usage of indigenous medications.

Applied to this research, the researcher attempted to address this challenge by testing decoctions of the two commonly used medicinal plants, as prepared by the Griqua community in South Africa, in a Western laboratory, to confirm the effects of these decoctions on the kidneys and the sensitivity of the kidneys towards these decoctions. The decoctions were prepared as both mono- and combination therapies, as is done by the community. This process comprised of a hybrid research interaction (Pienaar, 2014), as these decoctions had been prepared indigenously and were then, in sharp contrast, tested in a Western environment. The reason for testing these preparations in a Western platform partially stemmed from the fact that through prolonged involvement and discovery, the community already knows and trusts the decoctions, as had become clear during the *makgotla* discussions and during numerous interactions of the researcher with this community. The testing of indigenously prepared decoctions contrary to expectation was to carve and argue as well as to promote co-existence of local African indigenous knowledge and Western health practices.

5.1.2 *In vitro* and *in vivo* investigations during this research

This research followed the Western *in vitro* and *in vivo* scientific processes, by testing medicinal plants in a controlled laboratory environment. *In vitro* testing was done during phase 3 of this research, by evaluating the sensitivity of the influenza virus towards the two selected medicinal plants in the laboratory. *In vivo* testing was performed during phase 4, by utilising 35, all male, *Spraque-Dawley* rats to evaluate the effects of *wildeals* and *wynruit* on

the renal system. Both phases were performed by using the plant decoctions, as prepared by the community. These decoctions were prepared as both mono- and combination therapies. The experiments took place concurrently, but independent of each other. The *in vitro* testing took much shorter to complete (about 48 hours) than the *in vivo* tests.

5.1.3 Defining the *in vitro* and *in vivo* processes

5.1.3.1 The definition of an in vitro test

According to Gallo (2002:1-2), *in vitro* testing refers to the test that is done in the laboratory, so as to elicit the medicinal properties, or sensitivity of the organism against the medication being tested. Such testing does not involve any live animals, as it is either done in test tubes, or petri dishes, using a culture medium. Full application is discussed in the paragraphs that follow.

5.1.3.2 The definition of an in vivo test

According to Gallo (2002:1-2), *in vivo* testing is defined as the research that is conducted on live animals in the laboratory, and are rats the most used for research purposes. Accordingly, rats were used during this study also, due to their size, the accumulated knowledge regarding these species as test animals, the lower relative experimental costs involved, and due to the near similarity of their metabolism to that of humans (Timbrell, 2002:163-179). Full application is discussed in the paragraphs that follow.

5.1.3.3 Contextualising this chapter within the research project

The clinical experiments on the chosen medicinal plant decoctions aimed at confirming what is already known by the community as to what has always worked for them and to inform Western researchers and practitioners about the findings of this research. It was hoped that these outcomes would assist in advocating for the continued usage, or modification of the usage of these traditional plant decoctions. The information that had been obtained during the *makgotla* (chapter 3) and systematic review (chapter 4), would be used to make final conclusions, based on the experimental outcomes. This research would henceforth endeavour advocating for the healing practices used by the Khoi-San community in the Northern Cape of South Africa.

As perceived by Carr *et al*. (2003:5497-5502), indigenous people have always had a way of looking after their sick and is the way in which the sick are taken care of different from the

Western way. Kirmayer (2004:33-48) in addition explains that the indigenous healing practices follow a hierarchy, in which the healing aspect starts from a bottom to top order. It is therefore important to acknowledge that the art and science of healing originates from both the Western and the African indigenous perspectives. It is also important to educate community health workers (doctors and nurses) to acknowledge and understand the importance of indigenous healing systems.

5.2 Collection and preparation of the medicinal plants for the clinical experiments

The required medicinal plant samples were collected at the end of May to the beginning of June 2014, at a time that these decoctions are commonly used by the community to treat common colds. The plants were harvested at Campbell, in the Griqualand-West region in the Northern Cape, from the medicinal garden at the home of one of the community elders. These plants were of the same species than those that are found in the wild. The harvested plants had green leaves and stems and were considered mature and ready for use by the community and were they placed in a dish for a few minutes before preparation.

Figure 5.1: The community knowledge holder passing on the knowledge of harvesting the medicinal plants (Pic A), and the harvested medicinal plants in a dish (Pic B). (Used with permission from community and participants) Mphuthi, (2014)

The community elder advised and showed the researcher how to prepare and measure the plants. The community measurement system (chapter 3 section 3.7.2) was used to measure the plants. The preparation was planned and executed as directed by the elder, as follows:

Two decoctions each were prepared from the *wildeals* and *wynruit* plants separately, as well as from a combination of the two plants, by boiling one batch of each for 15 minutes (three weaker decoctions) and the other for 30 minutes (three stronger decoctions). Four individual plant decoctions and two combination decoctions were thus prepared through boiling of the plants. The bottles were labelled, by indicating the name of the plant, the boiling time and the preparation date. The collection and preparations were done in the morning as it is a belief that in the morning a person is still pure.

5.2.1 Step by step preparation and boiling processes

The *wildeals* was boiled first, followed by the *wynruit* and lastly the combination of plants. A two plate electric stove and a tin were used for boiling the decoctions. The researcher did not interfere during the preparation of these decoctions, but observed the processes and took field notes and pictures. The researcher became the active participant after having observed the preparation of the first decoction. 500 ml of fresh, plain tap water was used during preparation of medicinal plant samples. A batch of each medicinal plant was boiled for 15 minutes and another for 30 minutes. The timing started as soon as the boiling point was reached. The tin (figure 5.2 below) used was thoroughly cleaned, before preparing the next decoction.

For the combination therapy, the measurements being used were unique to the community, as discussed in chapter 3, section 3.7.2. Equal amounts of each plant were placed into the tin and the same procedure followed as for the mono therapies. The boiled decoctions were then poured into the well labelled bottles that had been cleaned with hot water to minimise the risks of contamination.

Figure 5.2: Stove and tin used for boiling the decoctions at the point where the boiling point was reached. (Used with permission of community) Mphuthi (2014)

The researcher followed and observed the preparation process exactly according to the way in which the community prepares decoctions for their own use. The figure above (5.2) shows the stove and the tin used for boiling the decoctions.

During this research, the concentrations/strengths of the two medicinal plants were determined by the unique practices being employed by the community, who firmly believes that the boiling time determines the readiness of the decoctions. As a result, the boiling times were used to determine the concentrations. Two boiling times, i.e. 15 and 30 minutes each, were used during this study and were two different strengths of decoctions hence prepared from each individual plant and from the combined *wildeals* and *wynruit*.

In order to know how the indigenous people determine the concentration of the decoctions, this is what one of the *lekgotla* attendees, a knowledge holder, who also supervised the proceedings, said:

> *"Look, you will have to taste it in between. Eeeeeehhhh, sometimes 15 minutes or 30 minutes (Hoe meer bitter hy word, hoe meer werk hy)".*

The researcher followed the same principle of tasting the readiness of each decoction, while assisting with the preparations of the decoctions to be tested.

The prepared decoctions were left to cool down and were then placed in a box for transportation to the vivarium, where *in vivo* testing commenced the followed day, while

another batch of the same decoctions were taken to the laboratory for the *in vitro* testing, which commenced 24 hours after preparation.

5.3 The *in vitro* testing procedure and resources (phase 3)

According to Gallo (2002:1-2), *in vitro* testing refers to the test that is done in the laboratory, so as to elicit the medicinal properties, or sensitivity of the organism against the medication being tested. Such testing does not involve any live animals, as it is either done in test tubes, or petri dishes, using a culture medium.

Applied to this research, *in vitro* testing was done to elicit the medicinal properties of *wildeals* and *wynruit* as single and in combination therapies against the influenza virus. Although *wildeals* and *wynruit* are commonly used as mono therapies to treat common colds, as discussed in chapter 4, no literature source was found that had reported on their use as combination therapy, as is common practice by the Griqua community.

5.3.1 Significance of this phase

The significance of this phase was to elicit the sensitivity of the influenza virus to the *wildeals* and *wynruit* decoctions, as well as to promote co-existence between indigenous health system and western medicine. Furthermore the study aimed to promote recognition of sensitivity to the indigenous health system commonly used by the researched community. This was done through *in vitro* testing, and reporting the research findings back to the community for the validation and confirmation of the information received from the community. These medicinal plants were tested as both mono- and combination therapies.

5.3.2 Objective and hypothesis of this phase

- To test (*in vitro*) the medicinal properties of decoctions prepared from *wildeals* and *wynruit* as both mono- and combination therapies for the treatment of common colds caused by the influenza virus (flu).
- The decoction prepared as either mono-, or combination therapy from *wildeals* and *wynruit* has no influence on the treatment of common cold.

5.3.3 Clinical process of *in vitro* experiments

In vitro testing was done by an independent qualified laboratory microbiologist from National Health Laboratory Service (NHLS) in Pretoria. NHLS is an accredited laboratory that performs sensitivity testing on various micro-organisms, including viruses. The researcher handed the prepared decoctions to the laboratory and explained the test to be done. Due to the laboratory rules and ISO 9000, the researcher was not allowed into the laboratory but the procedure followed was explained to the researcher's understanding for interpretation. The influenza virus sensitivity test was undertaken by using a 0.5 McFarland standard test. The test was undertaken to determine the minimal inhibitory concentration of the two indigenous medicinal plants used by the researched community.

Andrews (2006:1-19) defines minimum inhibitory concentrations (MICs) as the `golden standard' for determining the susceptibility of organisms to anti-microbials and are they therefore used to judge the performance of all other methods of susceptibility testing. MICs are used in diagnostic laboratories to confirm unusual resistance, to give a definitive answer when a borderline result is obtained through other methods of testing, or when disc diffusion methods are inappropriate.

5.3.3.1 Preparation of the in vitro test plates

For the pathogen to grow, agar, which is a complex sulfated polysaccharide that usually originates from red algae and that is used as a solidifying agent, was used in the preparation of the culture media (Willey *et al*., 2011:830). The agar was prepared according to the recommendations of the manufacturer. A series of medicinal plants serving as anti-viral agents were prepared in 1 ml volumes. A medicinal free control plate was also prepared. Molten agar was thoroughly mixed and poured into pre-labelled sterile petri dishes on a level surface. Eight different plates were prepared, comprising of six for each of the different concentrations of the prepared *wildeals* and *wynruit* decoctions (two each for the prepared *wildeals* and *wynruit* and combination decoctions) to be tested, one for the control (no decoction) and one for all of the prepared decoctions together.

5.3.3.2 Inoculation of test plates

The plates were clearly marked for the orientation and identification to be obvious and easy. A sterile swab was used to inoculate the Mueller Hinton Agar plates with meat extracts to support growth of the virus. The Mueller Hinton Agar was evenly inoculated across the

surface of the medium in three directions, by rotating the plate at approximately 60^0 to ensure an even distribution. The excess fluid was removed by pressing and rotating the swab against the sides of the tube above the surface of the suspension.

The agar was allowed to dry somewhat, after which sterile, autoclaved filter papers were each soaked into a prepared decoction. A sterile forceps was used to place each soaked filter paper disc in the center of its clearly labelled agar plate. The prepared plates were clearly labelled by indicating the decoction name and the boiling time for easy identification.

Six filter paper discs, two for *wildeals* two for *wynruit* and two for the combination decoctions were tested. The two control filter papers were dipped in sterile water and also clearly labeled.

5.3.3.3 Incubation of test plates

Within 30 minutes of applying the soaked filter paper discs, the plates were inverted as per the recommendations of the manufacturer and were they also incubated aerobically at a controlled temperature of 35-37°C for 16-18 hours for the first period. If there would be no growth after 18 hours, the plates would be re-incubated.

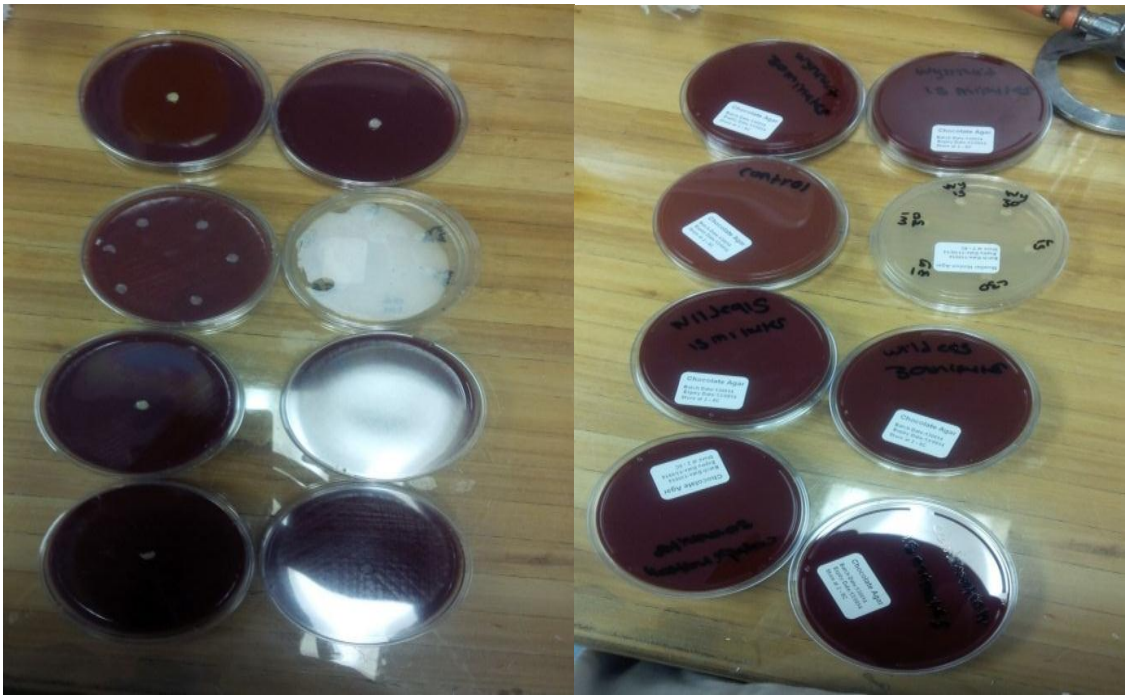

Figure 5.3: Clearly labelled inoculated plates

The following images show the labelled inoculated plates with the different medicinal decoctions.

Figure 5.4: Combination of *wynruit* and *wideals*, boiled for 30 minutes and *wynruit* boiled for 15 minutes, showing the placement of the soaked filter paper discs on the plate.

The following pictures show the viral activity after the first day of incubation.

Figure 5.5: *Wynruit* and *wildeals* boiled for 15 and 30 minutes, respectively

Figure 5.6: A plate with six discs containing all of the decoctions on a single inverted plate

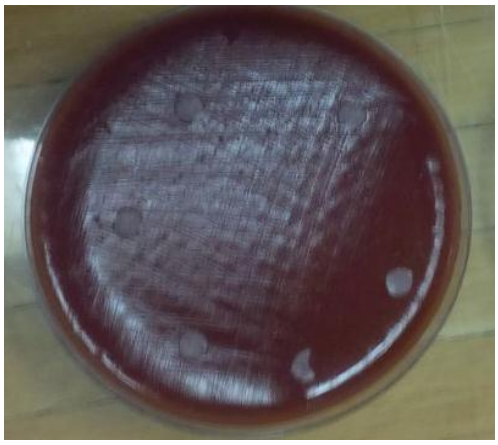

Figure 5.7: A control plate with a disc that was soaked in sterile water

5.3.4 The findings of this phase

The findings of this phase were recorded after 18 hours and were based upon a plate that contained six filter papers that had each been soaked in each of the six different decoctions. The soaked filter paper discs were clearly labelled by indicating the boiling times and names of each decoction. The below images represent the plates used for these findings.

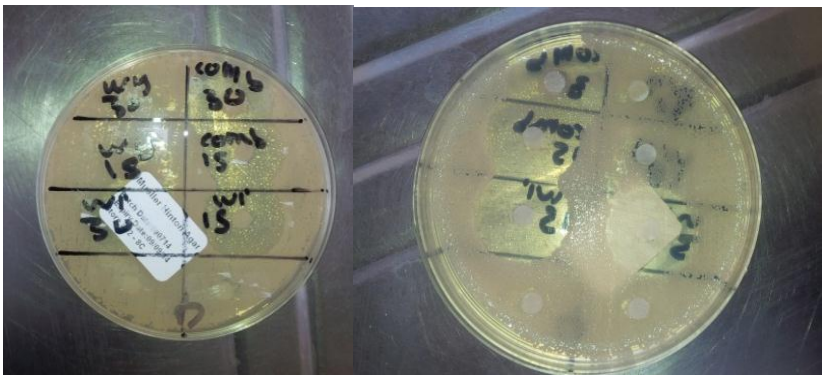

Figure 5.8: Plates that were used to record the findings of the *in vitro* phase after 18 hours

In order to establish the effectiveness of the medicinial plants being tested against the pathogen (influenza virus), the minimal inhibitory concentration (MIC) was used, as described by Willey *et al*. (2011:830). The MIC is defined by these authors as the lowest concentration of a drug that prevents growth of a particular pathogen.

5.3.4.1 Significance and interpretation of the MIC

In microbiology, the minimum inhibitory concentration (MIC) is the lowest concentration of an anti-microbial (or an anti-fungal) drug that would inhibit visible growth of a micro-organism after overnight incubation. MICs can be determined on plates of solid growth medium, called agar, or with broth dilution methods after a pure culture is isolated. To identify the MIC through broth dilution, for example, identical doses of virus are cultured in wells of liquid media, containing progressively lower concentrations of the drug. The minimum inhibitory concentration of the antibiotic is between the concentrations of the last well in which no bacteria had grown and the next lower dose, which had allowed bacterial growth. Several commercially available methods can be used to experimentally measure MIC values *(www.BoundlessMicrobiology*, 2014).

In addition to the above definition, Street *et al*. (2014:1) consider the MIC as the lowest concentration of a drug that inhibits the growth of the organism. This is investigated in laboratories by inoculating the organism that is isolated from the patient into a series of tubes, or cups that contain two-fold dilutions of the drug. Additionally, after the standardised incubation, the lowest concentration of the drug that has inhibited the growth of the organism is considered as the MIC. These authors further argue that these tests have no true normal values, as the presumed baseline would be susceptible, which is not always true.

The following paragraphs discuss the MIC outcomes after 18 hours of incubation of the test samples. These findings are based on the single plate containing samples of all of the medicinal plant preparations. The control plate did not show any form of contamination, nor any MIC.

5.3.4.2 Determination of the MIC readings after 18 hours of incubation

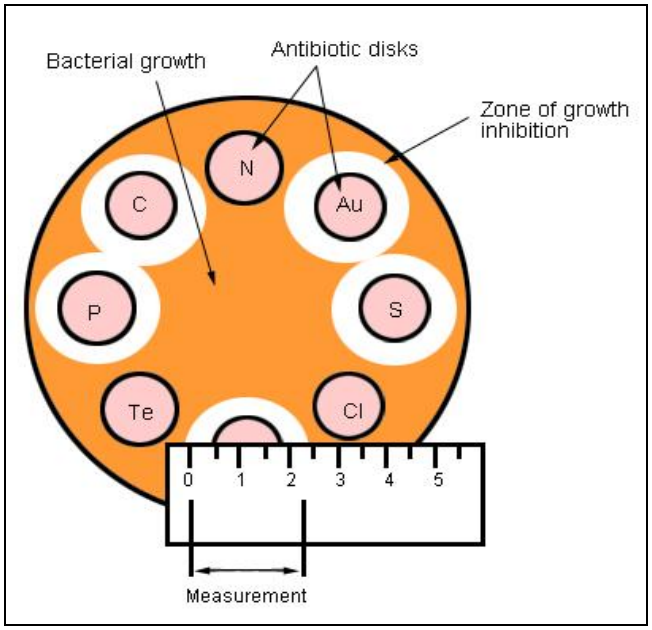

Figure 5.9: Growth on the agar plate and measurement of the zone of growth inhibition

The above illustration demonstrates the way in which to determine the MIC of samples on a petri dish, as adopted from Street *et al*. (2014:1). The MIC is determined by measuring the zone of growth inhibition from the disc. Applied to this research, the principle of determining the MIC, as shown by figure 5.9 above, was followed. The interpretation of the readings comprised that a high value meant that more of the medicine would be needed to affect the organism's function, or replication, while a low value meant that less medicine would be needed (Street *et al*., 2014:1). The following paragraphs discuss the reading from the medicinal plants that were tested during this research.

- The ***wynruit* decoction boiled for 15 minutes** showed some growth around the filter paper disc, which could have been indicative of some form of contamination. The contamination could have either arisen during the preparation of the decoction, or from the filter paper disc, even though care had been taken to minimise any

possibility of contamination. Testing was repeated by using freshly prepared plates and filter papers, and the same results were obtained, which suggested that contamination had occurred during the preparation of the decoction. This could also mean that the virus is resistant to the medicinal plant being tested.

- The ***wynruit*** **decoction boiled for 30 minutes** was effective against the influenza virus, as the MIC from the area of source was 9 mm. This finding also comfirmed the possibility of contamination, while preparing the weaker ***wynruit*** decoction that had been boiled for 15 minutes.

- The ***wildeals*** **decoction boiled for 15 minutes** showed anti-viral activity, as the virus was sensitive to this decoction. There was an MIC zone around the disc of 14 mm from the source area.

- The ***wildeals*** **decoction boiled for 30 minutes** also showed effectiveness, due to the MIC zone of 11 mm from the area of source.

- **Both combination decoctions, boiled for 15 and 30 minutes**, respectively demonstrated sensitivity towards the influenza virus, since the clearing zone around the disc was about 8 mm from the area of source for the decoction boiled for 15 minutes, and 7 mm for the decoction boiled for 30 minutes.

5.3.5 Interpretation of the findings

The findings were evaluated by using the interpretative chart for interpreting the zone sizes of each decoction and by reporting the organisms as being resistant, intermediate, or sensitive.

5.3.5.1 Resistant

A pathogen is reported as being resistant to a drug, when the pathogen excludes the drug or medication from the cell, pumps the drug out of the cell, alters the drug enzymatically, or modifies the target enzyme or structure so that it is no longer affected by the drug (Willey *et al*., 2011:848). This means that the infection caused by the resistant pathogen will not respond to any treatment with the drug to which it is resistant, irrespective of the dose, or site of infection.

5.3.5.2 Intermediate

According to Acharya (2013:1), this definition is applicable to strains that are 'moderately susceptible' to the tested drug. The intermediate category serves as a buffer zone between susceptible and resistant. The intermediate category is used to indicate a number of possibilities, including:

- The tested medication can be used in those body locations where it may be concentrated at the site of infection (e.g. the urinary tract), or if a high concentration of the medication is used, because of its low toxicity.
- The tested medication may still be effective against the tested isolate, but possibly less so than against a susceptible isolate.

5.3.5.3 Sensitive

This category indicates that the tested medication may be an appropriate choice for treating an infection caused by the micro-organism isolate being tested. This would be the case if the organism is likely to respond to treatment with this drug at the recommended dosage, or if bacterial resistance is absent, or at a clinically insignificant level (Acharya, 2013:1).

5.3.6 Realisation of the findings of phase 3

The above interpretations were taken back to the laboratory technologist for confirmation of the interpretations. Few corrections were done with the assistance of the virologist. It was concluded that all of the medicinal plants that had been tested had been effective against the influenza virus, with only the *wynruit* decoction, that had been prepared through 15 minutes of boiling, having had no MIC from the area of source. This finding could have been attributed to possible contamination, as reported by the laboratory technician, having either occurred during preparation of the decoction, or of the filter paper disc. The test was repeated, but on both occasions the same results were obtained for the *wynruit* decoction with the lower concentration (prepared by 15 minutes of boiling). It was suggested that the *wynruit* be re-tested during another study, before finally concluding on the generated results. The stronger *wynruit* decoction (mono therapy boiled for 30 minutes) had been effective against the influenza virus, based on the MIC results.

Both the *wildeals* decoctions (prepared through 15 and 30 minutes of boiling) had been effective against the influenza virus. This meant that this plant could be used effectively to treat common colds, caused by the influenza virus.

Both of the combination decoctions had also demonstrated some effectiveness against the virus. It was assumed that the effectiveness of these combination therapies may have been influenced by the presence of the anti-viral *wildeals*.

The findings from this phase linked well with the knowledge being owned by the community, i.e. that *wildeals* decoctions had been effectively used to treat common colds. The *wynruit* decoctions could not be ruled out as being ineffective, as it had also been successfully used by the community to treat common colds. The resistance or growth against the weaker *wynruit* preparation could have been as a result of contamination that had occurred during preparation, or of the filter paper disc.

5.3.6.1 Hypothesis testing in phase 3

The decoction prepared as either mono-, or combination therapy from wildeals and wynruit has no influence on the treatment of common cold. Hypothesis is partially rejected.

Based on the finding that the prepared decoction as either mono-or combination therapy has an effect on the treatment of common cold, the hypothesis is thus partially rejected. Care to be caution needs to be taken as virus showed to be resistant to *wynruit* prepared for 15 minutes, as this might be due to contamination. Furthermore the rejection if the hypothesis is based on the discussion below.

Both phases 1 (qualitative community based) and 2 (systematic review) had confirmed that these two medicinal plants could be effectively used to treat common colds, as well as other conditions. The hypothesis was therefore accepted, since the stronger *wildeals wynruit* and combination therapies that had been boiled for 30 minutes had proven to be effective against the influenza virus that is responsible for causing common colds.

The researched community had also reported on the use of both plants as combination therapy for the effective treatment of common colds. The findings by the community were again proven correct, as this phase confirmed that the combination therapy was more effective, based upon the interpretation of the MIC values, of which the combination therapies had lower readings.

5.3.7 Summarising phase 3

The discussion of this phase dealt with the *in vitro* testing of the two medicinal plants, *wildeals* and *wynruit*, commonly used by the Griqua community. The investigations took place in the NHLS laboratory. The outcomes from this phase confirmed the reported outcomes, as experienced by the Griqua community, of successfully treating colds by using these two medicinal plants. Only the weaker *wynruit* decoction had shown some growth around the filter paper, whereas the stronger *wynruit*, both the *wildeals* preparations and both the combination therapies had proven to be effective for the treatment of common cold. The *in vitro* phase followed the international standards of the pathogen sensitivity test. The next phase deals with the *in vivo* testing of the same decoctions.

The *in vitro* phase confirmed that the knowledge being owned by the community, as well as existing information in the published literature that these medicinal plants are effective in treating common colds. The influenza virus showed acceptable sensitivity towards the decoctions prepared from the separate *wildeals* and from the combination. Although the virus had shown some resistance towards the weaker *wynruit* (decoction prepared through 15 minutes of boiling), it could not be concluded that it was ineffective against common colds. Both the community and the literature had confirmed that it could be effectively used to treat common colds as mono therapy. It could only be assumed that there had been an element of contamination during the preparation of this decoction.

5.4 The *in vivo* testing process and procedure (phase 4)

In vivo testing is defined by Gallo (2002:1-2) as research that is done by utilising live animals in the research laboratory, and are rats the most generally used for this purpose. *Spraque-Dawley* rats were chosen for use in this study, because they are the most commonly used species, due to their size, the accumulated knowledge of them, the relative costs involved, as well as the near similarity of their metabolism to that of humans (Timbrell, 2002:163-179).

Applied to this research, the 35 all-male rats were used to clinically test the effects of both *wildeals* and *wynruit* on their renal system, and indirectly on that of humans. The test was undertaken by administering both the mono- and combination decoctions, having been prepared by the Griqua community knowledge keeper/holder.

5.4.1 Significance of this phase

This phase was significant, because it had aimed at illustrating the effects on the renal system of the prepared natural decoctions from the two said medicinal plants. This phase would reveal whether these decoctions were responsible for causing renal failure, or not.

5.4.2 Objective of this phase

The objective of this phase was to establish the effects of both decoctions prepared from *wildeals* and *wynruit* separately and in combination on the renal system (*in vivo*).

The purpose of the phase was to administer the decoctions (both mono- and combination therapies), being prepared by the community, to the rats twice a day for 6 consecutive days, to perform the urine tests daily and the liver enzyme tests on the last day only.

5.4.3 The *in vivo* clinical testing setup

The *in vivo* testing was done at the Department of Science and Technology (DST) at the North-West University (NWU, Potchefstroom Campus) at the Preclinical Drug Development Platform (PCDDP) vivarium. The vivarium falls under the Faculty of Health Sciences. The PCDDP is an accredited centre for the use of animals for research purposes. The experiment was conducted with the assistance of a qualified veterinarian laboratory technician. Rats were divided into four groups, i.e. ten (n=10) rats for the decoction prepared from *wildeals* ten (n=10) for the decoction prepared from *wynruit*, and ten (n=10) for the decoction prepared from a combination of both *wildeals* and *wynruit*. These three main groups were each divided into two sub-groups and were five (n=5) rats each of each group exposed to testing of the weaker decoction (boiled for 15 minutes) and the stronger decoction (boiled for 30 minutes), respectively. The last group of five (n=5) rats, i.e. the control group, was given the placebo.

5.4.3.1 Environmental conditions of the rats during in vivo testing

For the duration of the *in vivo* testing, the rats were kept and exposed to the same environmental conditions, which were maintained and controlled as follows:

Temperature	22 ±2ºC
Humidity	55 ±10%
Pressure	Positive
Air changes	20 times/hour
Nocturnal cycle	12 hour light and12 hours darkness cycles

These conditions were in accordance with the standard operating procedure of the PCDDP, as per the Animal use in research ethics requirements. The animals were housed in Labotec cages from 08h00 to 19h00 with a constant supply of food and water. They were then placed in the metabolic cages from 19h00 to 08h00, without food and water. The metabolic cages were numbered and were the rats placed in the same cages according to the numbering. Movement, noise and lighting were strictly controlled, to prevent any undesirable external stress to the rats that could impact on the test results.

5.4.3.2 Food and water supply for the rats

All of the animals/rats had a constant supply of reversed osmosis (purified) water during the day. The water was purified so as to prevent any undesirable impact on the test results. The food was ordered from Nutroscience (Pty) Ltd (Malmesbury, South Africa). The following food ingredients were recommended by the Nutroscience department:

Protein	160 g/kg
Moisture	120 g/kg
Lipid	25 g/kg
Fibre	60 g/kg
Phosphorus	7 g/kg
Calcium	18 g/kg

This food was given to the rats as their daily nutritional maintenance requirement. The rats strictly only received the recommended food and purified water for the duration of the test phase.

5.4.3.3 Researcher training

The researcher observed and took field notes and images on how to handle the rats, administer the decoctions and withdraw the blood samples. The researcher was later trained to work on those rats that had already been at the vivarium for other prior investigations. The training included observation, theory and practical experience. The training aimed at orientating the researcher with regards to the handling of, blood sampling and urine collection from rats. Figure 5.10 shows the animal science technician demonstrating to the researcher the withdrawal of blood samples from rats.

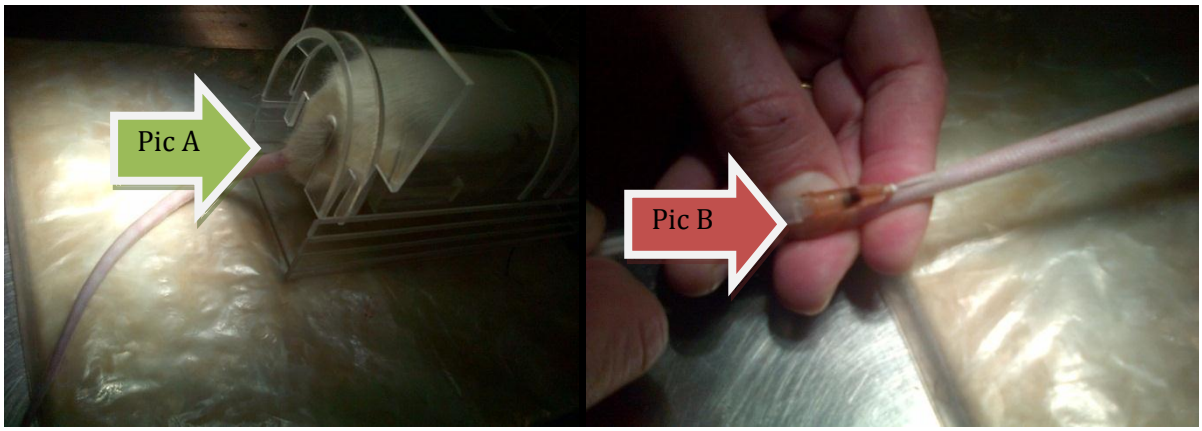

Figure 5.10: Preparing the rat for blood sampling (Pic A) and taking the blood sample from the tail (Pic B) Mphuthi (2014)

5.4.3.4 Preparation of the rats before the experiments

All rats were born in March 2014, the oldest being born on the 20th and the youngest on the 31st. At the start of the phase, the rats were all about 12 weeks old and fully grown. All rats used in this phase were males, having a body weight above 250 g, as per the PCDDP standard recommendations. All rats were weighed and the groups and weights of the rats summarized. The weights per group are discussed under the medicinal plants in the paragraphs to follow. The rats were numbered on the ears, in accordance with standard operating procedure (SOP) of the PCDDP vivarium (see Annexure F). The rats were primarily identified by the numbers on their right ears which is interpreted according to the PCDDP procedure.

Rats were put into metabolic cages 3 days before commencement of the experimental phase, to ensure that they had acclimatised well to the cages and were they made used to being handled the same way that they would be handled during the experiments. They were

housed in metabolic cages so as to be able to separate and collect the urine samples from their solid excretions.

The cages were also numbered according to the rat numbers and were each numbered rat consistently placed in its corresponding cage to ensure that the collected urine samples for analysis from each cage was that of the respectively numbered rat. The qualified animal research scientist also showed and trained the researcher on how to handle rats during the acclimatisation phase. The animal scientist ensured that the rats were not unnecessarily stressed and that they were handled in accordance with the requirements of the Animal use in research council.

5.4.4 Handling of rats and specimens during the experiments

All rats were numbered on the last day of the 3 days of acclimatisation. The first phase of the experiments started on the Sunday with fifteen (n=15) rats, of which five (n=5) were given decoctions being boiled during preparation for 15 minutes from *wildeals* and five (n=5) were given the *wildeals* decoction boiled for 30 minutes*,* whilst the last five (n=5) rats comprised of the control group. Only one control group was used to generate the base line results for all 30 of the rats, as advised by the Animal use in research ethics guidelines. This phase lasted for 7 days and all animals were afterwards sacrificed and both the kidneys and livers were harvested for pathological analysis. Direct heart blood samples were taken for serum aspartate aminotransferase (AST) and gamma-glutamyl transpeptidase (GGT) from this group. No animal got sick, nor died as a result of the administration of the *wildeals* decoctions*.* There was no specific criterion used to put the rats in groups. They were hand-picked and labelled as per the group name.

The second phase also started on the same Sunday, with ten (n=10) rats being experimented on by administering the prepared *wynruit* decoctions*.* Five (n=5) were placed on the weaker decoction (boiled for 15 minutes) and another five (n=5) on the stronger decoction (boiled for 30 minutes). No rat showed any unusual signs and all safely survived the experiment as well. These animals were also sacrificed at the end of the experiment and both the kidneys and livers were harvested for pathological analysis, whilst direct heart blood samples were collected as in the first phase.

The third and final phase also started on the same Sunday with ten (n=10) rats, of which five (n=5) rats each were administered the combination decoction boiled for 15 minutes, and the combination decoction boiled for 30 minutes. No animals showed any unusual signs and did they all also survive the experiment. All animals were also sacrificed and both the kidneys

and livers were harvested for pathological analysis, whilst direct heart blood samples were taken for AST and GGT determinations and for the serum urea and creatinine determinations. The serum urea and creatinine analyses were done only with regards to this group, because the rats had been administered combination decoctions prepared from of the two medicinal plants.

The urine samples were collected daily in the morning from all the animals and sent to the PathCare Laboratory in Cape Town for analysis. The direct heart blood samples for AST, GGT, serum urea and creatinine determinations were taken at the time of sacrificing the animals for the harvesting of their organs. Figure 5.11 shows the rats in their metabolic cages, with the urine being collected for analysis.

Figure 5.11: Test rats in metabolic cages with their collected urine samples below

The rats were disturbed as minimal as possible so as to reduce their stress levels and hence the impact of external stress factors on the test results. The urine samples were collected in the morning, after the rats had spent the night in the metabolic cages. As shown in figure 5.11 above, the urine was collected into a specimen collector, attached to the cage. The cages had been designed in a way for the solid excretions of the rats to collect on a mesh wire, while the urine collected in the specimen collector below.

The collected urine samples were sent to the laboratory for urea and creatinine analysis on a daily basis by the qualified laboratory technologist in Cape Town. The reason for the analysis of both urea and creatinine emanated from the study being conducted by Saxena

and Pabotra (2003:188-189), based on which they had claimed that acute renal failure was one of the most serious complications resulting from the use of traditional remedies. Sharing the same sentiment, Singh and Prakash (2008:150-155) also confirmed that it was the belief that allopathic medicines were more toxic and had more side-effects than medicines from other branches of science. The two medicinal plants being investigated in this study were identified as being commonly used by the researched community.

In diagnosing renal failure, Alspach (2006:560-561) and Terrill (2002:24-25) claim that early signs could be structurally free from any damage and continuation of normal tubular function, during which water is reabsorbed, but the electrolytes are retained, continued normally. Testing of the urine would therefore give low concentrations of both urea and creatinine, as they are retained in the body. The blood samples of all rats were tested with regards to AST and GGT concentrations, whereas the serum urea and creatinine analyses were conducted on the last day on samples from the group being given the combination decoctions.

Serum urea and creatinine levels were tested only with regards to samples taken from the test group being given the combination decoctions, because their daily urine results had not shown any significant abnormalities. The two liver enzymes that were tested for on all experimental rats on the last day of sacrificing were aspartate aminotransferase (AST) and gamma-glutamyl transpeptidase (GGT). As discussed by Fraser (2007:194-196), an increased GGT level could be caused by the drugs/medication that the individual had taken, while an elevation of AST could also be associated with medications or hepatic congestion (Guidelines and Protocols, 2011). It was for that reason that the researcher tested the liver enzymes so as to rule out any hepatic toxicity.

The prepared decoctions were administered to the rats in constant doses twice daily, after discussion with and recommendation by the animal scientist. All the rats were given the same amount of the respective decoctions, since the community had mentioned that the amounts that they administer are in mug and spoon measures. The recommended dose by the laboratory technician was to administer the decoctions in 2 ml doses each, twice daily, hence 4 ml per day. The control group was given 2 ml doses of sterile water twice daily at the same intervals as the experimental group. This ensured that all rats were treated the same.

The decoction and sterile water doses were administered daily at 08h00 in the morning and 20h00 in the evening. A sterile 2 ml syringe and a sterile metal gavage tube were used to administer the decoctions to the rats. An adequate volume of each decoction was separated from the bulk preparations and transferred into a smaller container before administration so

as to minimise the risk of contamination of the bulk preparations. The metal gavage used was put in a container, cleaned and re-sterilised. Disposable syringes were used per decoction on the 5 test rats per dose per rat and were safely discarded after use (in accordance with laboratory protocol regarding the handling and discarding of medical waste).

5.4.5 Collection of blood samples and isolation of solid organs

On the day of sacrificing the experimental rats, after completion of the urine samples collection process, blood collection tubes, sterile syringes and needles, and formalin filled specimen jars were made ready. Blood tubes and specimen jars were labelled according to the rat numbers, as shown in figure 5.12 below.

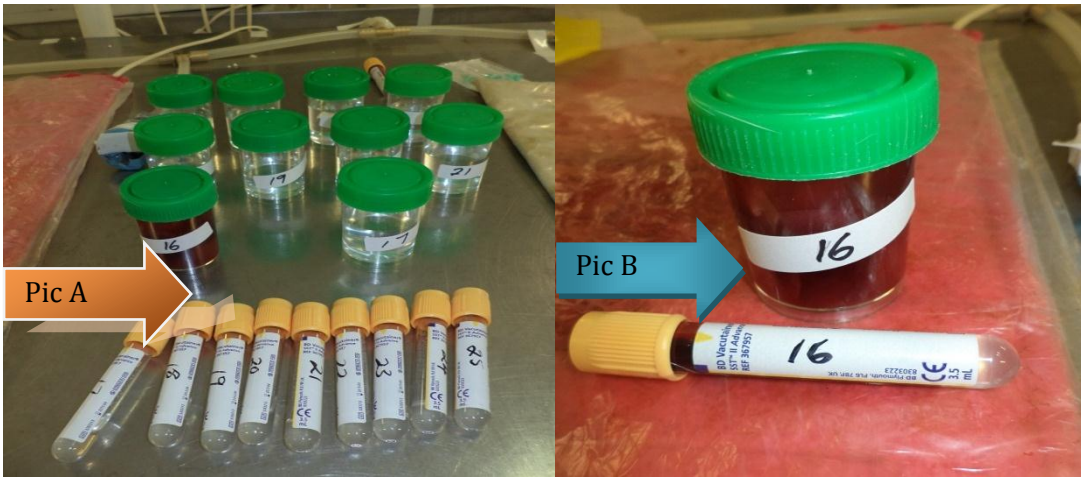

Figure 5.12: Specimen jars prepared for specimen collection (Pic A). Collected specimen blood and solid organs of rat 16 (Pic B)

After a week of administering the decoctions to the test animals twice daily, the rats were humanely sacrificed through anaesthetisation with halothane gas. One rat at a time was placed into a 5 liter clear glass container with 0.5% of halothane anesthetic gas for inhalation by the rat. Each rat had been closely watched, and as soon as it became completely anaesthetised, it was removed from the container and placed on a dissecting table. The rats were immediately dissected and the diaphragm perforated to collapse the lungs. Direct heart blood (2 ml) was collected by using sterile syringes and needles and by emptying the samples into serum separating tubes (SST II) blood test tubes. Each blood test tube was tilted once and ready to be sent to the laboratory for analysis. Next, both kidneys and the

whole liver were excised and put into the formalin containing specimen jars for histology examinations. As shown in figure 5.13 below.

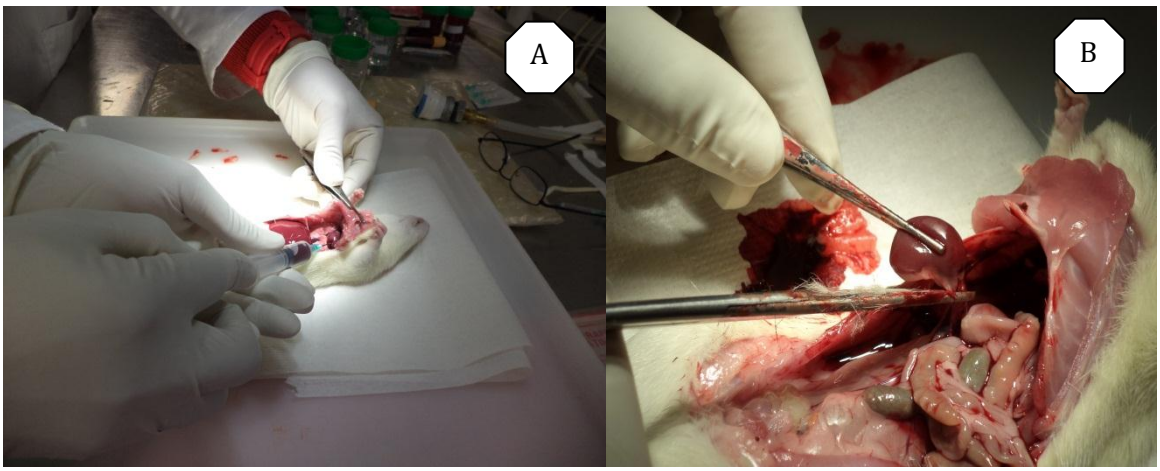

Figure 5.13: Sampling the direct heart blood (Pic A) and harvesting a solid organ, the kidney (Pic B) Bester (2014)

All blood samples, the solid organs (kidneys and livers) and urine samples were analysed and verified by PathCare Laboratories in Cape Town independently. The researcher only collected the specimen and sends them to Cape Town. The collected specimens were analysed with regards to the concentrations of urea, creatinine and liver enzymes in the rats being administered the three types of indigenous decoctions that had been prepared from *wildeals* and *wynruit* each and from a combination of the two plants, as well as a placebo for the control group. The solid organs were tested for histopathology following the administration of medicinal plants decoctions. These analysis were done independently and only the results were sent to the researcher for interpretation.

5.4.6 Background to the descriptive statistical data

For the purpose of this study, the test rats' urine samples were collected and tested daily for 6 consecutive days to determine the urea and creatinine concentrations. The blood samples were collected when the rats were sacrificed at the end of the 6 days experiments, for the analysis of the liver enzyme concentrations. The serum urea and creatinine analyses were performed additionally for the rats having been administered the *wildeals/wynruit* combination decoctions. Results were interpreted as follows: Where the urine urea or creatinine would be less than the lower reading, it would be an indication of the kidneys failing to excrete the waste products. That would be the sign of acute kidney failure (ARF)

which would then be correlated to the administration of the decoctions. In the case where the creatinine is within the normal range that would signify good kidney function. The samples were measured against the normal ranges as per the PathCare Reference Laboratory as follows:

- **Urine**
    - Urea 165-585 mmol/L
    - Creatinine 9.0-17.7 mmol/L in 24 hours
- **Serum liver enzymes**
    - Aminotransferase (AST) < 200 U/L (units per litre of blood)
    - Gamma-glutamyl transpeptidase (GGT) < 5 U/L

The serum liver enzyme descriptive was done on aminotransferase (AST) only. The gamma-glutamyl transpeptidase (GGT) readings were less than 5 U/L, with no actual measurable values.

To test the hypothesis of this research study, the following statistical analyses were executed from the urine and serum specimens taken to the laboratory:

- Descriptive statistics.
- Cronbach's alpha (α) coefficient for evaluating the consistency of the data.
- One-tailed *t*-test for hypothesis testing.

The data was analysed using Microsoft Excel. The statistical add-ins, Regressit and RealStats were utilised for the regression and hypothesis testing, as shown below. The analyses and test outcomes were divided into groups, as per the groups of rats, based on the decoctions they were given. The urea, creatinine and liver enzymes were analysed with respect to all the groups, i.e. the control, *wildeals wynruit* and *wildeals/wynruit* combination groups. The results and interpretations were based on the mean values obtained for all test results.

5.4.6.1 Control group statistical data

a. Weights of the rats in the control group

Table 5.1 below summarises the weights and average weight of rats that were used in the control group. Although all of the rats were above the recommended weight of 250 g, rats 11, 13 and 15 were below the group average of 344.2 g. Rat 11 was the smallest, with a weight of 340 g and rats 12 and 14 the biggest, at 348 g.

Table 5.1: Weights of five rats in the control group

Plant	**Treatment**	**Rat No**	**Weight** (g)
Control	Placebo	11	340
Control	Placebo	12	348
Control	Placebo	13	343
Control	Placebo	14	348
Control	Placebo	15	342
		Average	**344.2**

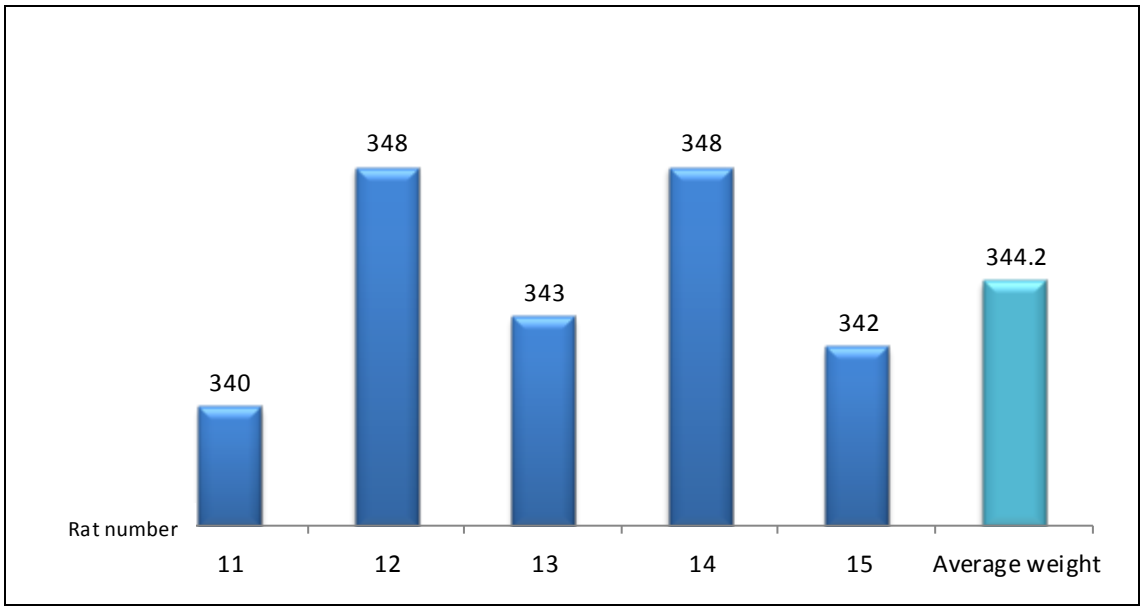

Figure 5.14: Weight distribution of five rats used in the control group, compared to the group average

Figure 5.14 above illustrates the weight distribution among the test animals taking part in the control group, indicating that this group had an uneven weight distribution. The arrows indicate those rats that had body weights below the group average.

b. Urine urea concentrations of the control group

Table 5.2: Daily and average urea concentrations over 6 days of five rats in the control group

Plant	Treatment	Rat No	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Average (mmol/L)
Control	Placebo	11	233	440	451	498	503	345	411.67
Control	Placebo	12	300	485	423	401	398	460	411.17
Control	Placebo	13	483	458	469	394	506	506	469.33
Control	Placebo	14	310	425	473	440	399	400	407.83
Control	Placebo	15	383	425	409	445	572	533	461.17

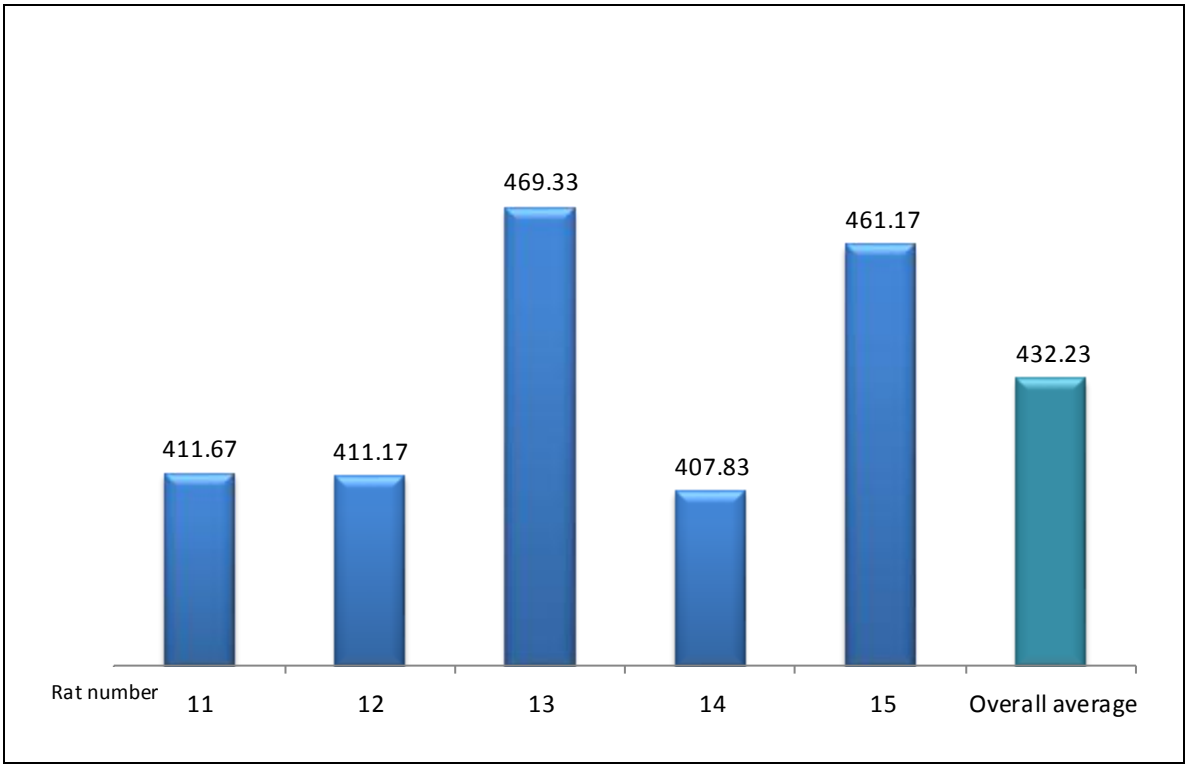

Figure 5.15: Average urea concentration distribution of five rats in the control group over 6 days, compared to the group average

Table 5.1 and figure 5.15 above represent the urea concentrations of the control group. Although rats 11, 12 and 14 were below the average group concentrations of 432.23 mmol/L, their lower weights did not have any effect on the urea readings.

All of the five control rats had urea values within the normal range, as per the analytical laboratory standard of 165-585 mmol/L. The urea of all of these rats showed fluctuations that moderately increased from day 2. Rat 13 and 15 shows high levels of urea which could be due to laboratory error or stress food with protein.

Table 5.3: Daily descriptive statistics over 6 days for urea concentrations of all five rats together in the control group

Control group statistics	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
Mean	341.80	446.60	445.00	435.60	475.60	448.80
Standard Error	42.56	11.36	12.60	18.61	33.81	34.38
Median	310.00	440.00	451.00	440.00	503.00	460.00
Standard Deviation	95.17	25.40	28.18	41.62	75.59	76.88
Sample Variance	9057.70	645.30	794.00	1732.30	5714.30	5910.70
Kurtosis	0.30	-0.11	-2.33	0.16	-1.93	-1.46
Skewness	0.72	0.96	-0.40	0.75	0.03	-0.41
Range	250.00	60.00	64.00	104.00	174.00	188.00
Maximum	483.00	485.00	473.00	498.00	572.00	533.00
Minimum	233.00	425.00	409.00	394.00	398.00	345.00
Sum	1709.00	2233.00	2225.00	2178.00	2378.00	2244.00
Count	5.00	5.00	5.00	5.00	5.00	5.00
Geometric Mean	331.59	446.03	444.28	434.05	470.75	443.31
Harmonic Mean	321.91	445.48	443.55	432.53	465.92	437.64

Table 5.3 above summarises the descriptive statistical values over 6 days. The mean (M) for the group over 6 days was M=432 mmol/L and was the day 1 mean (M=341.80 mmol/L) the only reading below the group average. From day 2 there had been an increase in the urea mean, with day 3 taking a slight dip. The daily high urea mean values could have been

indicative of some stress that the rats may have experienced, despite all efforts made to eliminate the stressors. The standard deviation (SD) was the highest on days 1, 5 and 6, which correlated with the respective higher mean values.

c. Urine creatinine concentrations of the control group

Table 5.4: Daily and average creatinine concentrations over 6 days of five rats in the control group

Plant	Treatment	Rat No	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Average (mmol/L)
Control	Placebo	11	10	10.1	10.5	13.4	15	16.7	12.62
Control	Placebo	12	12.4	12.3	11.5	13.2	14.8	15.7	13.32
Control	Placebo	13	12.4	12.4	12.5	14.3	15	15.2	13.63
Control	Placebo	14	10.3	9.3	11.4	12.6	12.9	14.0	11.75
Control	Placebo	15	9.8	10.1	9.8	12.6	13.4	16.8	12.08

The table above summarises the daily creatinine concentrations of the control group. The readings were all within the normal range of 9.0-17.7 mmol/L, as per the laboratory standard.

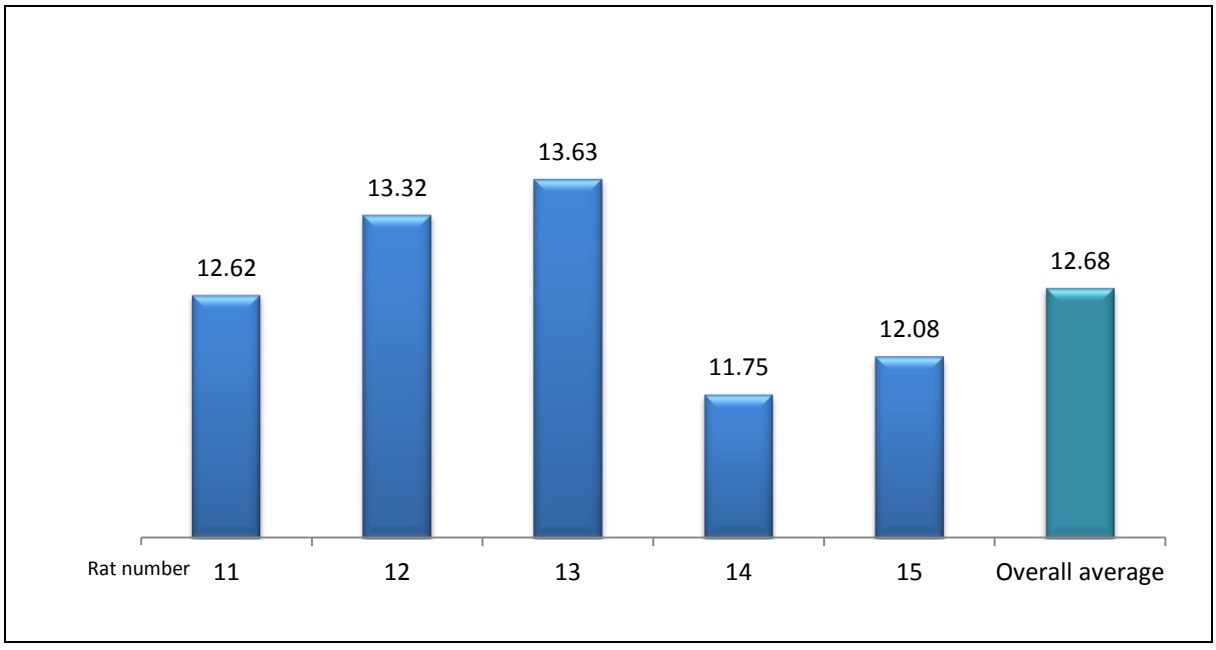

Figure 5.16: Average creatinine concentration distribution of five rats in the control group over 6 days, compared to the group average

As shown in figure 5.16 above, rats 12 and 13 had higher readings over the 6 days than the group average for the 6 days.

Table 5.5: Daily descriptive statistics over 6 days for creatinine concentrations of all five rats together in the control group

Control group statistics	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
Mean	10.98	10.84	11.14	13.22	14.22	15.68
Standard Error	0.59	0.63	0.46	0.31	0.45	0.52
Median	10.30	10.10	11.40	13.20	14.80	15.70
Standard Deviation	1.31	1.42	1.03	0.70	1.00	1.16
Sample Variance	1.71	2.01	1.06	0.49	0.99	1.34
Kurtosis	-3.22	-2.83	-0.44	0.56	-2.49	-0.61
Skewness	0.53	0.36	-0.03	0.95	-0.72	-0.63
Range	2.60	3.10	2.70	1.70	2.10	2.80
Maximum	12.40	12.40	12.50	14.30	15.00	16.80
Minimum	9.80	9.30	9.80	12.60	12.90	14.00
Sum	54.90	54.20	55.70	66.10	71.10	78.38
Count	5.00	5.00	5.00	5.00	5.00	5.00
Geometric Mean	10.92	10.77	11.10	13.21	14.19	15.64
Harmonic Mean	10.86	10.70	11.06	13.19	14.16	15.61

As depicted by table 5.5 above, the mean creatinine concentrations had increased from days 3 to 6. These mean concentrations were compared to the group mean value of excreted creatinine over the 6 days.

In summary, the control group was given the placebo of sterile water over a 6 day period. Both the urea and creatinine concentrations were all within the normal range, as per the analytical laboratory standards used. There were, however, signs of inconsistencies in urine and creatinine clearance. The rats with lower weights seemed to have cleared urea and creatinine better than the heavier rats in this group.

d. Liver enzyme concentrations of the control group

Table 5.6: Liver enzyme concentrations of five rats in the control group

Plant	Treatment	Rat No	Blood liver enzymes (U/L)
Control	Placebo	11	137
Control	Placebo	12	126
Control	Placebo	13	128
Control	Placebo	14	143
Control	Placebo	15	142
		Average	**135.20**

Table 5.6 above summarises the liver enzyme (AST) readings. All AST concentrations were within the normal range, as they were less than 200 U/L, as per the laboratory standards.

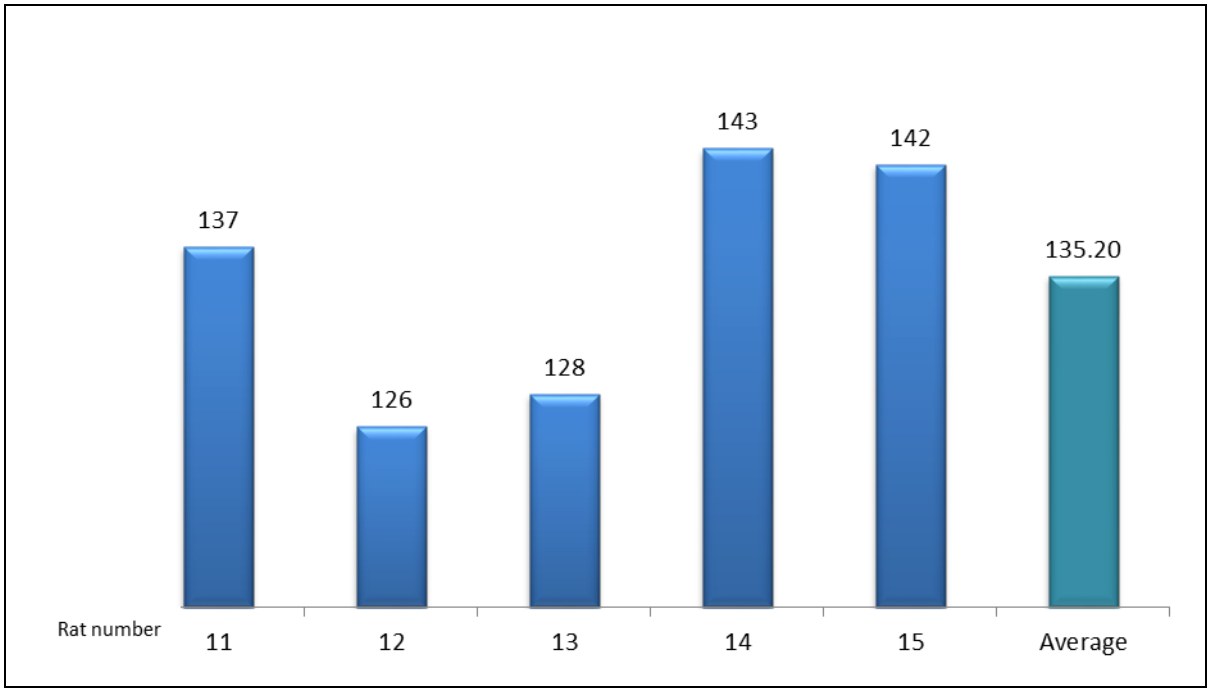

Figure 5.17: Liver enzyme concentration distribution of five rats in the control group after 6 days, compared to the group average

Rats 11, 14 and 15 had higher concentrations than the group average of 135.2 U/L. These outcomes were inconsistent, as this group had only been given sterile water over the 6 days of testing. All rats were healthy at the beginning of the experiment and none showed any signs of their health having deteriorated.

Table 5.7: Descriptive statistics of liver enzyme concentrations after 6 days of all five rats together in the control group

Control group statistics	**Blood liver enzymes** (U/L)
Mean	135.20
Standard Error	3.51
Median	137.00
Standard Deviation	7.85
Sample Variance	61.70
Kurtosis	-2.84
Skewness	-0.31
Range	17.00
Maximum	143.00
Minimum	126.00
Sum	676.00
Count	5
Geometric Mean	135.016
Harmonic Mean	134.8307

Despite some inconsistencies in terms of the liver enzyme concentrations of the test rats, the mean average was less than 200 U/L, which meant that the group could have been regarded as healthy after the 6 days of treatment.

5.4.6.2 Wildeals group statistical data

a. Weights of the rats in the wildeals group

Table 5.8: Weights of five rats each subjected to the *wildeals* decoctions boiled for 15 and 30 minutes, respectively

Plant	**Boiling time**	**Rat No**	**Weight** (g)
Wildeals	15 min	1	294
Wildeals	15 min	2	342
Wildeals	15 min	3	352
Wildeals	15 min	4	364
Wildeals	15 min	5	365
		Average	**343.4**
Wildeals	30 min	6	286
Wildeals	30 min	7	319
Wildeals	30 min	8	292
Wildeals	30 min	9	281
Wildeals	30 min	10	300
		Average	**295.6**

Table 5.8 summarises the weights of all of the ten rats taking part in the *wildeals* group. All of the rats were above the recommended 250 g. The five rats being subjected to the *wildeals* decoction boiled for 15 minutes, had a higher average weight (w=343.4 g), than those five having been subjected to the stronger *wildeals* decoction boiled for 30 minutes (w=295.6 g).

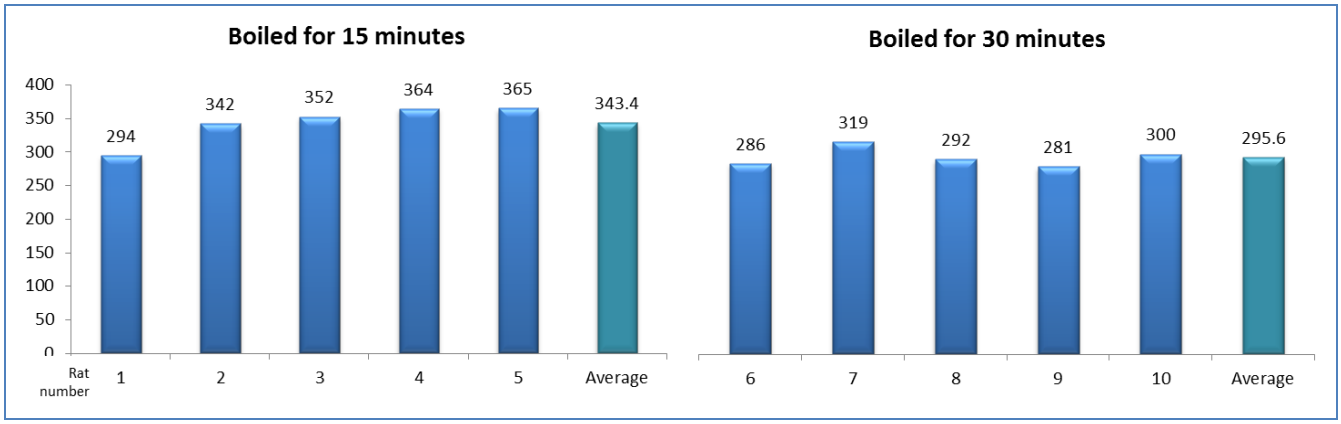

Figure 5.18: Weight distribution of five rats each subjected to the *wildeals* decoctions, boiled for 15 and 30 minutes, respectively, compared to the group averages

Table 5.9: Daily and average urea concentrations over 6 days of five rats each, subjected to *wildeals* decoctions, boiled for 15 and 30 minutes, respectively

Plant	**Boiling time**	**Rat No**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Average** (mmol/L)
Wildeals	15 min	1	291	371	466	581	508	501	453.00
Wildeals	15 min	2	357	422	403	363	532	504	430.17
Wildeals	15 min	3	340	548	503	471	300	377	423.17
Wildeals	15 min	4	339	409	548	577	372	530	462.50
Wildeals	15 min	5	501	534	462	401	330	460	448.00
Wildeals	30 min	6	373	319	329	185	467	171	307.33
Wildeals	30 min	7	291	574	506	370	460	487	448.00
Wildeals	30 min	8	336	469	571	512	561	580	504.83
Wildeals	30 min	9	281	569	522	458	507	176	418.83
Wildeals	30 min	10	376	496	541	567	484	470	489.00

The weight distribution for both test animal groups subjected to the *wildeals* decoctions boiled for 15 and 30 minutes, showed an even distribution. Although both groups had two rats each that were lighter than the average group weight, it was insignificant. Most of the rats being subjected to the *wildeals* decoction boiled for 15 minutes, weighed more than

300g while those being subjected to the *wildeals* decoction boiled for 30 minutes, mostly were below 300 g.

b. Urine urea concentrations of the wildeals group

As depicted by table 5.9 above, the day to day urea excretion by the rats was within the normal range of 165-585 mmol/L for both groups being subjected to the two different strengths of *wildeals* decoctions. The readings also showed some inconsistencies in fluctuations per rat per day.

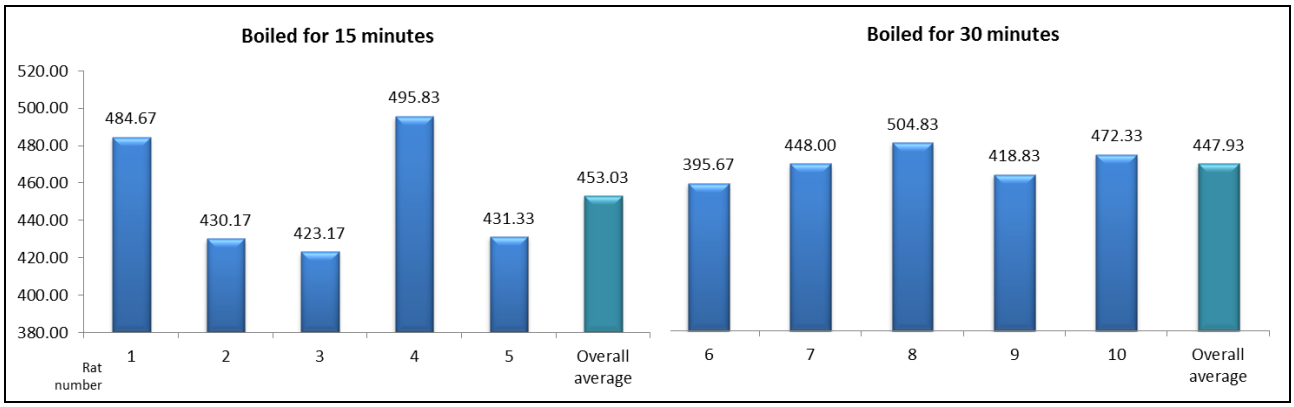

Figure 5.19: 6 days' average urea concentration distribution of five rats each, subjected to the *wildeals* decoctions, boiled for 15 and 30 minutes, respectively, compared to the group averages

Figure 5.19 above summarises the average excreated urea concentration per rat over a 6 day period, compared to the group average. Among the five rats being subjected to the *wildeals* decoction boiled for 15 minutes, only two rats (rats 1 and 4) had urea concentrations above the group average. Rats 2, 3 and 5 all had averages below the group average.

Among the five rats being subjected to the *wildeals* decoction boiled for 30 minutes, only two rats (rats 6 and 9) were below the group average (M=447.93 mmol/L). The rats subjected to the weaker (15 minutes boiling) decoction, had a higher group average weight, than those being administered the stronger (30 minutes boiling) decoction. The rats with lighter body weights had excreted more urea than the heavier rats.

Table 5.10: Combined daily and average descriptive statistics over 6 days for urea concentrations of all ten rats together, subjected to both *wildeals* decoctions, boiled for 15 and 30 minutes

Combined *wildeals* statistics	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Average** (mmol/L)
Mean	348.50	471.10	485.10	448.50	452.10	425.60	438.48
Standard Error	20.05	27.91	23.23	39.14	27.92	45.09	16.94
Median	339.50	482.50	504.50	464.50	475.50	478.50	448.00
Standard Deviation	63.40	88.25	73.47	123.78	88.28	142.59	53.55
Sample Variance	4019.17	7787.66	5398.32	15322.28	7793.66	20330.93	2868.13
Kurtosis	3.56	-1.06	1.07	0.97	-0.75	0.34	4.21
Skewness	1.58	-0.43	-1.14	-0.96	-0.74	-1.25	-1.65
Range	220.00	255.00	242.00	396.00	261.00	409.00	197.50
Maximum	501.00	574.00	571.00	581.00	561.00	580.00	504.83
Minimum	281.00	319.00	329.00	185.00	300.00	171.00	307.33
Sum	3485.00	4711.00	4851.00	4485.00	4521.00	4256.00	4384.83
Count	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Geometric Mean	343.87	463.15	479.46	428.60	443.49	395.11	435.11
Harmonic Mean	339.71	454.75	473.13	402.67	434.10	355.51	431.24

The total mean value over 6 days for the combined group was M=438.48 mmol/L. The daily combined urea group average showed good urea excretion. On day 1, the combined group average was below the overall mean value. This could have been attributed to the concentration level of each decoction in the body. At the end of day 1, the test rats had only been administered two doses of the medicinal plant decoctions.

Table 5.11: Daily descriptive statistics over 6 days for urea concentrations of all five rats together, subjected to the *wildeals* decoction, boiled for 15 minutes

***Wildeals* statistics**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Average** (mmol/L)
Mean	365.60	456.80	516.40	478.60	424.40	476.40	453.03
Standard Error	35.59	35.45	43.46	44.50	57.22	98.28	15.36
Median	340.00	422.00	503.00	471.00	372.00	504.00	431.33
Standard Deviation	79.59	79.27	97.18	99.51	127.94	219.76	34.34
Sample Variance	6333.80	6283.70	9444.30	9902.80	16368.80	48295.30	1179.58
Kurtosis	3.47	-2.76	0.72	-2.66	-2.51	-0.18	-2.93
Skewness	1.68	0.36	0.69	0.01	0.54	-0.55	0.63
Range	210.00	177.00	259.00	218.00	288.00	570.00	72.67
Maximum	501.00	548.00	662.00	581.00	588.00	730.00	495.83
Minimum	291.00	371.00	403.00	363.00	300.00	160.00	423.17
Sum	1828.00	2284.00	2582.00	2393.00	2122.00	2382.00	2265.17
Count	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Geometric Mean	359.43	451.38	509.31	470.20	409.54	423.11	452.01
Harmonic Mean	353.99	446.13	502.47	461.85	395.81	359.89	451.01

The group of five rats being subjected to the *wildeals* decoction boiled for 15 minutes, had a mean urea excretion value of M=453.03 mmol/L, with concentrations on days 1 and 5 below the group average. This group had demonstrated better urea excretion (M=453.03 mmol/L), compared to the total group mean value (M=438.48 mmol/L). This group of rats excreted more urea than the whole group of ten rats being given *wildeals* decoctions, with the highest concentration being 501 mmol/L/24 hr and the lowest, 291 mmol/L/24 hr.

Table 5.12: Daily descriptive statistics over 6 days for urea concentrations of all five rats together, subjected to the *wildeals* decoction, boiled for 30 minutes

***Wildeals* statistics**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Average** (mmol/L)
Mean	331.40	485.40	493.80	418.40	435.80	522.80	447.93
Standard Error	19.89	46.32	42.60	66.79	65.46	94.41	19.25
Median	336.00	496.00	522.00	458.00	467.00	580.00	448.00
Standard Deviation	44.48	103.57	95.25	149.36	146.38	211.10	43.05
Sample Variance	1978.30	10727.30	9072.70	22307.30	21426.70	44561.70	1852.90
Kurtosis	-2.87	1.53	3.83	0.89	3.69	2.04	-1.08
Skewness	-0.16	-1.25	-1.87	-1.08	-1.81	-1.45	0.16
Range	95.00	255.00	242.00	382.00	377.00	525.00	109.17
Maximum	376.00	574.00	571.00	567.00	561.00	701.00	504.83
Minimum	281.00	319.00	329.00	185.00	184.00	176.00	395.67
Sum	1657.00	2427.00	2469.00	2092.00	2179.00	2614.00	2239.67
Count	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Geometric Mean	328.98	475.22	485.03	390.68	407.54	471.69	446.28
Harmonic Mean	326.54	463.70	474.78	356.93	370.23	403.93	444.64

As per table 5.12 above, the average urea mean value for the five rats being subjected to the *wildeals* decoction, boiled for 30 minutes was M=447.93 mmol/L. Most of the urea concentrations for this group of rats were below the group average, with day 1 (M=331.40 mmol/L), day 4 (M=418.40 mmol/L) and day 5 (M=435.80 mmol/L) concentrations. Although this group had a lower group average mean (M=447.93 mmol/L), compared to the five rats being subjected to the *wildeals* decoction, boiled for 15 minutes (M=453.03 mmol/L), the average was also higher than the overall combined mean value of the *wildeals* group (M=438.48 mmol/L). The five rats being subjected to the *wildeals* decoction, boiled for 30 minutes had a lighter weight average (w=295.6 g), compared to the five rats being subjected to the *wildeals* decoction, boiled for 15 minutes (w=434.4 g), but the urea excretion was insignificantly low.

c. Urine creatinine concentrations of the wildeals group

Table 5.13: Daily and average creatinine concentrations over 6 days of five rats each, subjected to *wildeals* decoctions, boiled for 15 and 30 minutes, respectively

Plant	Boiling time	Rat No	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Average (mmol/L)
Wildeals	15 min	1	8.1	9.8	10	12.1	14.8	15.9	11.78
Wildeals	15 min	2	8.8	10.8	9.9	11.4	13.1	15.4	11.57
Wildeals	15 min	3	13.9	12.8	13.3	14.1	16.1	17.2	14.57
Wildeals	15 min	4	8.5	10.1	10.8	14.1	15.7	10.6	11.63
Wildeals	15 min	5	7.4	9.9	11.4	10.6	14.9	11.3	10.92
Wildeals	30 min	6	6.2	10	10.6	11.4	12.2	12.7	10.52
Wildeals	30 min	7	8.8	16.9	9	11.9	14.8	13.1	12.42
Wildeals	30 min	8	5.1	13.6	11.2	10.5	10.5	9.7	10.10
Wildeals	30 min	9	13	16	14.1	12.1	13.8	12.5	13.58
Wildeals	30 min	10	6.5	11.6	9.8	9.1	10	10.1	9.52

As depicted by table 5.13 above, the daily creatinine excretion by the rats had values that were within the normal range of 9.0-17.7 mmol/L for the group being administered *wildeals* decoctions. The concentrations also showed some inconsistencies, due to fluctuations per rat per day, as there was no pattern in the excreted creatinine concentrations.

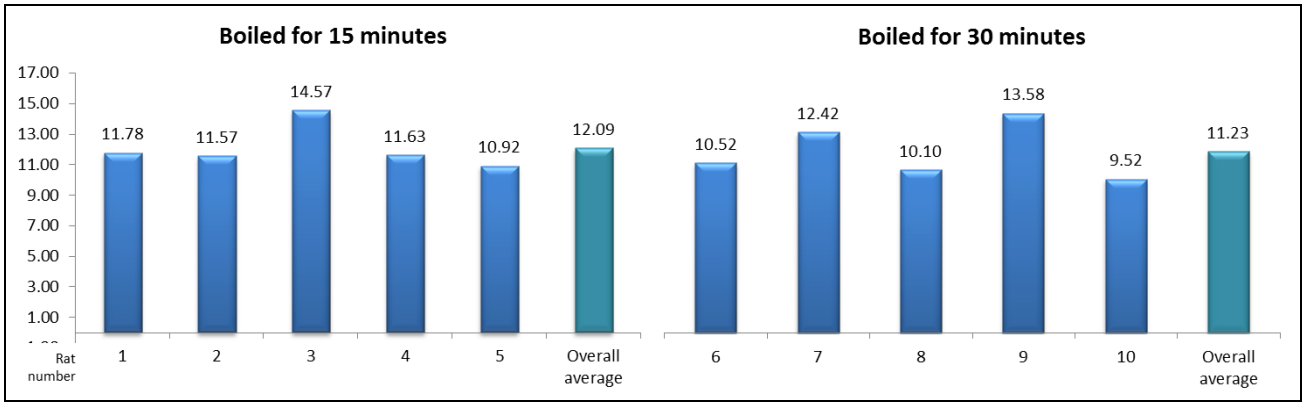

Figure 5.20: 6 days' average creatinine concentration distribution of five rats each, subjected to *wildeals* decoctions, boiled for 15 and 30 minutes, respectively, compared to the group averages

Figure 5.20 above shows the creatinine concentration distribution per rat, compared to the group average over 6 days, for both groups of five rats, of which each were being subjected to the *wildeals* decoctions boiled for 15 and 30 minutes, respectively. The five rats being subjected to the *wildeals* decoction, boiled for 15 minutes showed acceptable levels of creatinine excretion, except for rat 3 that was above the group average. The five rats being subjected to the *wildeals* decoction, boiled for 30 minutes also showed good excreted creatinine concentrations, except for rats 7 and 9 that were above the group average over the 6 days of testing. All of the values that were above group average are indicated by a red arrow.

Table 5.14: Combined daily average descriptive statistics over 6 days for creatinine concentrations of all ten rats together, subjected to both *wildeals* decoctions, boiled for 15 and 30 minutes

Combined *wildeals* statistics	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
Mean	8.630	12.150	11.010	11.730	13.590	12.850
Standard Error	0.892	0.826	0.505	0.488	0.667	0.816
Median	8.300	11.200	10.700	11.650	14.300	12.600
Standard Deviation	2.821	2.613	1.597	1.544	2.109	2.580
Sample Variance	7.960	6.827	2.550	2.385	4.450	6.654
Kurtosis	0.308	-0.444	0.352	0.072	-0.726	-1.017
Skewness	0.988	0.950	0.996	0.195	-0.704	0.486
Range	8.800	7.100	5.100	5.000	6.100	7.500
Maximum	13.900	16.900	14.100	14.100	16.100	17.200
Minimum	5.100	9.800	9.000	9.100	10.000	9.700
Sum	86.300	121.500	110.100	117.300	135.900	128.500
Count	10.000	10.000	10.000	10.000	10.000	10.000
Geometric Mean	8.253	11.917	10.912	11.638	13.431	12.624
Harmonic Mean	7.914	11.707	10.820	11.546	13.262	12.407

The table above summarises the mean creatinine concentrations over the period of 6 days of both groups of five rats each being subjected to the *wildeals* decoctions, boiled for 15 and 30 minutes, respectively. There were no significant variances among the total concentrations of each of the two groups of test animals and the daily combined total group concentrations. Although days 5 and 6 showed higher creatinine concentrations than both sub-groups of five rats each, no rat had died, nor showed any signs of deteriorating health.

Table 5.15: Daily average descriptive statistics over 6 days for creatinine concentrations of all five rats together, subjected to the *wildeals* decoction, boiled for 15 minutes

***Wildeals* statistics**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
Mean	9.34	10.68	11.08	12.46	14.92	14.08
Standard Error	1.163873	0.558032	0.619193	0.710352	0.51614	1.315827
Median	8.5	10.1	10.8	12.1	14.9	15.4
Standard Deviation	2.602499	1.247798	1.384558	1.588395	1.154123	2.942278
Sample Variance	6.773	1.557	1.917	2.523	1.332	8.657
Kurtosis	4.247957	2.97394	1.389748	-2.5574	1.356999	-2.74344
Skewness	2.005965	1.754047	1.263584	0.1195	-1.0605	-0.4078
Range	6.5	3	3.4	3.5	3	6.6
Maximum	13.9	12.8	13.3	14.1	16.1	17.2
Minimum	7.4	9.8	9.9	10.6	13.1	10.6
Sum	46.7	53.4	55.4	62.3	74.6	70.4
Count	5	5	5	5	5	5
Geometric Mean	9.097596	10.62584	11.01446	12.37904	14.88295	13.82185
Harmonic Mean	8.899683	10.57578	10.95266	12.29869	14.84457	13.55738

Table 5.15 above summarises the mean creatinine concentrations over the 6 days of the five rats being subjected to the *wildeals* decoction, boiled for 15 minutes. The combined sub-group average was M=12.09 mmol/L. This sub-group started to show some signs of creatinine accumulation from day 4 (M=12.46 mmol/L), with day 5 (M=14.92 mmol/L) being the highest, and day 6 (M=14.08 mmol/L) showing some decline.

Table 5.16: Daily average descriptive statistics over 6 days for creatinine concentrations of all five rats together, subjected to the *wildeals* decoction, boiled for 30 minutes

***Wildeals* statistics**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
Mean	7.92	13.62	10.94	11.00	12.26	11.62
Standard Error	1.41	1.30	0.87	0.55	0.92	0.71
Median	6.50	13.60	10.60	11.40	12.20	12.50
Standard Deviation	3.14	2.90	1.95	1.23	2.06	1.59
Sample Variance	9.88	8.40	3.81	1.51	4.26	2.53
Kurtosis	1.52	-2.05	1.96	0.36	-2.28	-2.99
Skewness	1.36	-0.12	1.28	-1.09	0.14	-0.56
Range	7.90	6.90	5.10	3.00	4.80	3.40
Maximum	13.00	16.90	14.10	12.10	14.80	13.10
Minimum	5.10	10.00	9.00	9.10	10.00	9.70
Sum	39.60	68.10	54.70	55.00	61.30	58.10
Count	5.00	5.00	5.00	5.00	5.00	5.00
Geometric Mean	7.49	13.37	10.81	10.94	12.12	11.53
Harmonic Mean	7.12	13.11	10.69	10.88	11.98	11.44

Table 5.16 above summarises the mean values for the creatinine concentrations for the five rats being subjected to the *wildeals* decoction, boiled for 30 minutes. The total group concentration for excreted creatinine was M=11.23 mmol/L. This sub-group had inconsistent values, as it showed the highest concentration on day 2 (M=13.62 mmol/L). Although days 5 (M=12.26 mmol/L) and 6 (M=11.62 mmol/L) had higher creatinine concentrations, there was a general decline from the day 2 peak value.

d. Liver enzyme concentrations of the wildeals group

Table 5.17: Liver enzyme concentrations after 6 days of five rats each, subjected to *wildeals* decoctions, boiled for 15 and 30 minutes, respectively

Plant	**Boiling time**	**Rat No**	**Blood liver enzymes** (U/L)
Wildeals	15 min	1	135
Wildeals	15 min	2	143
Wildeals	15 min	3	141
Wildeals	15 min	4	153
Wildeals	15 min	5	122
Wildeals	30 min	6	156
Wildeals	30 min	7	148
Wildeals	30 min	8	127
Wildeals	30 min	9	126
Wildeals	30 min	10	145
		Overall average	**139.6**

Table 5.17 summarises the liver enzyme concentrations of each of the ten rats being subjected to the *wildeals* decoctions boiled for 15 and 30 minutes, respectively. The group average concentration was M=139.6 U/L. All of the values were within the normal range of below 200 U/L. The group average (M=139.6 U/L) was below the normal range. Only two rats (rats 4 and 6) had values above M=150 U/L, i.e. one rat each that had received the weaker (15 minutes boiling) and that had received the stronger (30 minutes boiling) *wildeals* decoctions.

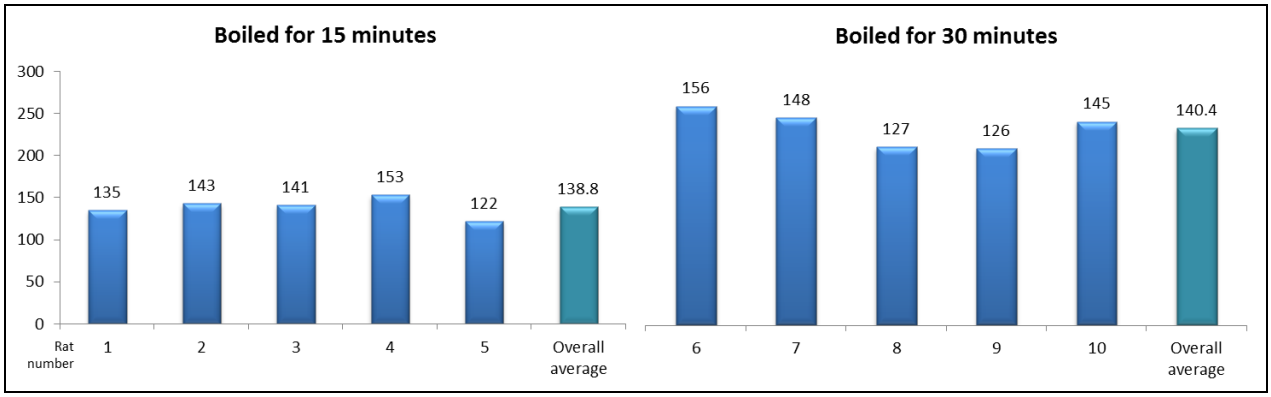

Figure 5.21: Liver enzyme concentration distribution of five rats each, after 6 days of being subjected to *wildeals* decoctions, boiled for 15 and 30 minutes, respectively, compared to the group averages

The rats being subjected to the *wildeals* decoction boiled for 15 minutes, had an average concentration of M=138.8 U/L. The distribution of this group showed three rats (rats 2, 3 and 4) that had values higher than the group average, with rat 4 having reached the highest AST concentration. This could have been indicative of more than 50% (n=3) of the test animals' livers having been affected somewhat as a result of taking the *wildeals* decoctions.

The five rats being subjected to the *wildeals* decoction boiled for 30 minutes, had a group average of M=140.4 U/L, with more than 50% (n=3) of rats in this group also having reached AST concentrations above the group average. Rat 6 had the highest value (M=156 U/L).

The liver enzyme concentrations of the five rats each that had been given *wildeals* decoctions, boiled for 15 and 30 minutes, respectively, did not differ significantly. The average concentrations over 6 days of all ten rats were below 200 U/L, with the group average of the animals subjected to the *wildeals* decoction boiled for 15 minutes being M=138.80 U/L, to the stronger remedy (boiled for 30 minutes) being M=140.40 U/L, giving an overall average of M=139.60 U/L. It could be assumed that both strengths of the *wildeals* decoctions had not affected the liver enzyme concentrations, especially those of AST, as summarised in table 5.18 below.

Table 5.18: Average descriptive statistics for liver enzyme concentrations after 6 days of all ten rats together, subjected to *wildeals* decoctions, boiled for 15 and 30 minutes below

***Wildeals* statistics**	**Overall**	**15 minutes**	**30 minutes**
Mean	139.60	138.80	140.40
Standard Error	3.71	5.10	5.95
Median	142.00	141.00	145.00
Standard Deviation	11.72	11.41	13.32
Sample Variance	137.38	130.20	177.30
Kurtosis	-1.26	0.91	-2.50
Skewness	-0.21	-0.52	-0.19
Range	34.00	31.00	30.00
Maximum	156.00	153.00	156.00
Minimum	122.00	122.00	126.00
Sum	1396.00	694.00	702.00
Count	10.00	5.00	5.00
Geometric Mean	139.15	138.42	139.89
Harmonic Mean	138.70	138.03	139.38

5.4.6.3 Wynruit group statistical data

a. Weights of the rats in the wynruit group

Table 5.19: Weights of five rats each, subjected to *wynruit* decoctions, boiled for 15 and 30 minutes, respectively

Plant	**Boiling time**	**Rat No**	**Weight** (g)
Wynruit	15 min	16	289
Wynruit	15 min	17	327
Wynruit	15 min	18	273
Wynruit	15 min	19	278
Wynruit	15 min	20	305
		Overall average	**294.40**

Plant	**Boiling time**	**Rat No**	**Weight** (g)
Wynruit	30 min	21	302
Wynruit	30 min	22	299
Wynruit	30 min	23	290
Wynruit	30 min	24	317
Wynruit	30 min	25	286
		Overall average	**298.80**

Table 5.19 summarises the body weights of the five rats each being subjected to the two *wynruit* decoctions boiled for 15 and 30 minutes, respectively. The group having taken the weaker decoction (boiled for 15 minutes), had an average weight of w=294.40 g, while the group taking the decoction boiled for 30 minutes, had an average weight of w=298.80 g. The average weight differences among the two groups were insignificant.

Of the five rats being subjected to the *wynruit* decoction boiled for 15 minutes, only two rats were above 300 g. All five rats were above the recommended 250 g. Of the five rats being

subjected to the *wynruit* decoction boiled for 30 minutes, two rats were also above 300 g, and were all also above the recommended 250 g.

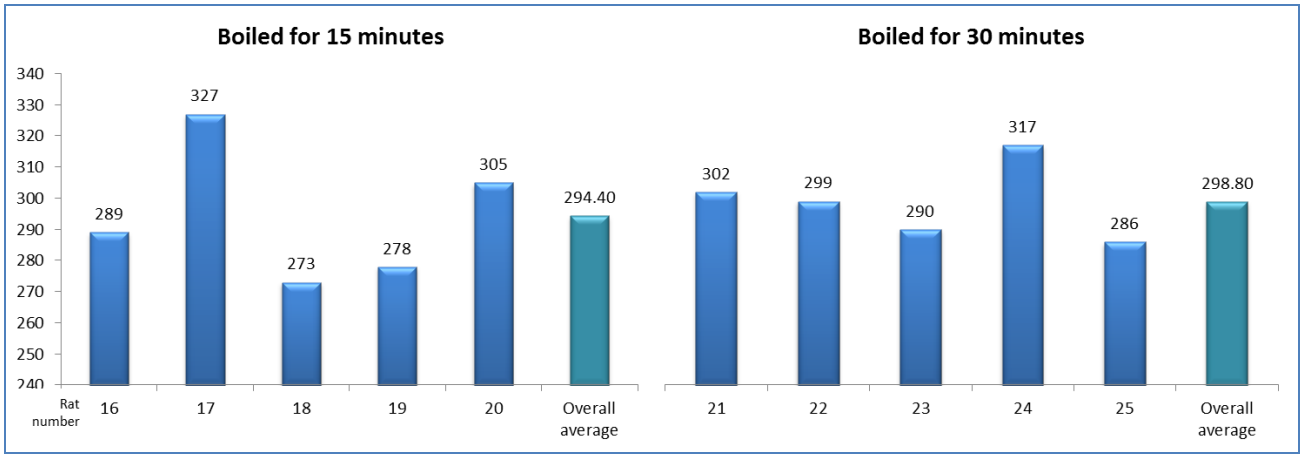

Figure 5.22: Weight distribution of five rats each, subjected to *wynruit* decoctions, boiled for 15 and 30 minutes, respectively, compared to the group averages

Figure 5.22 illustrates the weight distribution of the five rats each, compared to the average group weights for both decoctions boiled for 15 and 30 minutes, respectively. The rats being subjected to the *wynruit* decoction boiled for 15 minutes, had a group average weight of w=294.4 g. Among this group, more than 50% of the rats were below the group average. Of the rats being subjected to the *wynruit* decoction boiled for 30 minutes, the average weight was w=298.80 g, with more than 50% of the rats being above the group average. All ten rats being administered *wynruit*, were above the recommended 250 g.

b. Urine urea concentrations of the wynruit group

Table 5.20: Daily and average urea concentrations over 6 days of five rats each, subjected to *wynruit* decoctions, boiled for 15 and 30 minutes, respectively

Plant	**Boiling time**	**Rat No**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Average** (mmol/L)
Wynruit	15 min	16	260	407	501	461	479	498	434.33
Wynruit	15 min	17	279	401	461	371	387	369	378.00
Wynruit	15 min	18	276	428	477	490	510	508	448.17
Wynruit	15 min	19	240	401	540	499	468	514	443.67
Wynruit	15 min	20	233	293	537	489	369	469	398.33
Wynruit	30 min	21	244	304	462	398	409	502	386.50
Wynruit	30 min	22	310	498	489	389	498	544	454.67
Wynruit	30 min	23	360	501	409	501	408	489	444.67
Wynruit	30 min	24	270	491	499	501	489	508	459.67
Wynruit	30 min	25	304	511	461	424	403	368	411.83

Table 5.20 above shows that the urea concentrations for all of the ten rats taking the *wynruit* decoctions, ranged within the normal ranges of 165-585 mmol/L/24 hr. Daily fluctuations in the concentrations occurred. All of the average concentrations per rat in this group over 6 days were also within the normal concentration range, with no rat having reached an average above 500 mmol/L over the 6 day period. Figure 5.23 below illustrates the urea concentration distribution of each and the sub-group averages.

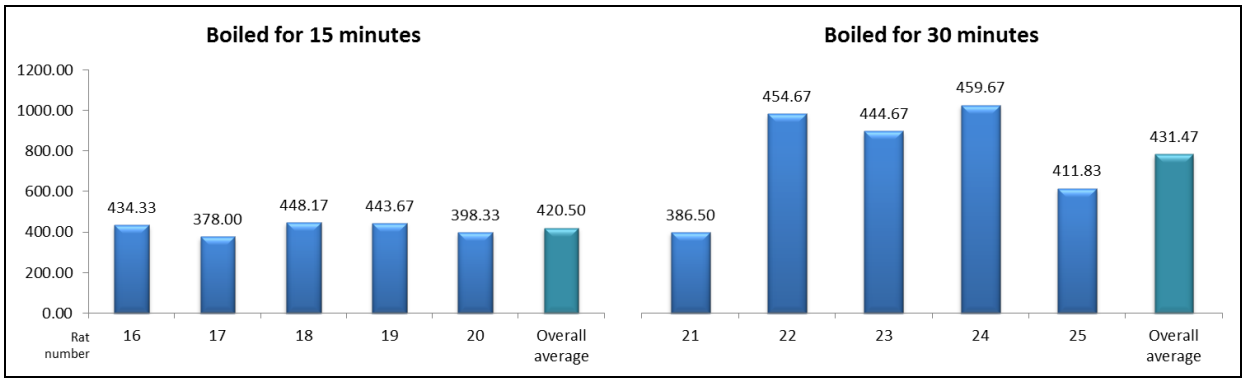

Figure 5.23: 6 days' average urea concentration distribution of five rats each, subjected to *wynruit* decoctions, boiled for 15 and 30 minutes, respectively, compared to group averages

As shown by figure 5.23 above, the five rats being subjected to the *wynruit* decoction boiled for 15 minutes, had a consistent urea concentration distribution. In this group of rats, less than 50% (n=2) had urea concentrations below the group average. Among the five rats being subjected to the *wynruit* decoction boiled for 30 minutes, also less than 50% (n=2) had urea concentrations below the group average. All ten rats taking the two *wynruit* decoctions boiled for 15 and 30 minutes, had an average body weight of approximately w=290 g. Based on the above, over 60% (n=6) out of ten (n=10) test animals of the *wynruit* group had demonstrated good urea excretion capabilities.

Table 5.21: Combined daily and average descriptive statistics over 6 days for urea concentrations of five rats each, subjected to *wynruit* decoctions, boiled for 15 and 30 minutes, respectively

***Wynruit* statistics**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
Mean	277.60	423.50	483.60	452.30	442.00	476.90
Standard Error	12.22	25.03	12.34	16.38	16.38	19.03
Median	273.00	417.50	483.00	475.00	438.50	500.00
Standard Deviation	38.64	79.15	39.01	51.78	51.78	60.18
Sample Variance	1493.38	6264.94	1522.04	2681.57	2681.56	3622.10
Kurtosis	1.04	-0.78	0.38	-1.64	-1.89	0.67
Skewness	1.03	-0.59	-0.25	-0.54	-0.03	-1.34
Range	127.00	218.00	131.00	130.00	141.00	176.00
Maximum	360.00	511.00	540.00	501.00	510.00	544.00
Minimum	233.00	293.00	409.00	371.00	369.00	368.00
Sum	2776.00	4235.00	4836.00	4523.00	4420.00	4769.00
Count	10.00	10.00	10.00	10.00	10.00	10.00
Geometric Mean	275.32	416.26	482.16	449.53	439.25	473.11
Harmonic Mean	273.17	408.48	480.69	446.66	436.50	468.92

Table 5.21 above shows the combined mean urea values per day for the total number of rats (n=10) being given the two *wynruit* decoctions. The day 1 group mean value (M=277.60 mmol/L) was lower than all the other day's averages in both groups. This could have been as a result of the lower systemic levels (trough level) of the medicinal plant in the body on the first day, when compared to the other days where medicinal plant could have accumulated in the body over time. On day 2, the average urea concentration was higher than that of the group average of the rats being subjected to the *wynruit* decoction boiled for 15 minutes, but was it still lower than the group average concentration of all rats subjected to the *wynruit* decoction boiled for 30 minutes. From days 3 - 6, the mean average daily urea concentrations were all higher than the group average mean values of both groups. This was indicative that both groups had satisfactorily eliminated urea, when compared to the group mean excretion value.

Table 5.22: Daily average descriptive statistics over 6 days for urea concentrations of all five rats together, subjected to the *wynruit* decoction, boiled for 15 minutes

***Wynruit* statistics**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
Mean	257.60	386.00	503.20	462.00	442.60	471.60
Standard Error	9.27	23.77	15.76	23.63	27.41	26.79
Median	260.00	401.00	501.00	489.00	468.00	498.00
Standard Deviation	20.72	53.16	35.24	52.83	61.28	59.90
Sample Variance	429.30	2826.00	1242.20	2791.00	3755.30	3588.30
Kurtosis	-2.67	4.24	-2.51	3.49	-2.53	3.29
Skewness	-0.20	-1.98	-0.04	-1.87	-0.36	-1.82
Range	46.00	135.00	79.00	128.00	141.00	145.00
Maximum	279.00	428.00	540.00	499.00	510.00	514.00
Minimum	233.00	293.00	461.00	371.00	369.00	369.00
Sum	1288.00	1930.00	2516.00	2310.00	2213.00	2358.00
Count	5.00	5.00	5.00	5.00	5.00	5.00
Geometric Mean	256.93	382.68	502.21	459.34	439.11	468.22
Harmonic Mean	256.25	378.96	501.22	456.44	435.57	464.50

Table 5.22 above summarises the daily descriptive statistical values of the five rats being subjected to the *wynruit* decoction boiled for 15 minutes. According to these results, on days 1 and 2 the average urea concentrations were below the group mean value. From days 3 - 6 the rats started to excrete urea well and were the urea concentrations above the group mean value (M=420.50 mmol/L), with day 3 having reached the highest mean urea concentration (M=503.20 mmol/L). This increase could have been due to the accumulative effects of the decoction over time in the test rats' systems.

Table 5.23: Daily average descriptive statistics over 6 days for urea concentrations of all five rats together, subjected to the *wynruit* decoction, boiled for 30 minutes

***Wynruit* statistics**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
Mean	297.6	461	464	442.6	441.4	482.2
Standard Error	19.65095	39.38147	15.6333	24.52468	21.34151	29.97065
Median	304	498	462	424	409	502
Standard Deviation	43.94087	88.05964	34.95712	54.83885	47.72106	67.01642
Sample Variance	1930.8	7754.5	1222	3007.3	2277.3	4491.2
Kurtosis	0.054231	4.868867	1.243027	-3.08033	-3.19936	3.481273
Skewness	0.34439	-2.19863	-1.05255	0.376986	0.618344	-1.70008
Range	116	207	90	112	95	176
Maximum	360	511	499	501	498	544
Minimum	244	304	409	389	403	368
Sum	1488	2305	2320	2213	2207	2411
Count	5	5	5	5	5	5
Geometric Mean	295.0246	452.7814	462.9085	439.9211	439.3851	478.0404
Harmonic Mean	292.4811	442.9828	461.7792	437.3013	437.4308	473.4332

According to table 5.23 above, the rats being subjected to the *wynruit* decoction boiled for 30 minutes, had mean concentrations higher than the group mean value (M=431.47 mmol/L), except on day 1, during which the mean value was M=297.6 mmol/L. The highest mean value had been reached on day 6 (M=482.2 mmol/L). The fast response of the urea concentrations from day 2 onwards, could have been attributed to the stronger *wynruit* decoction, as it had been boiled for a longer time than the one boiled for 15 minutes only. The rats in this group had excreted urea satisfactorily, as expected.

c. Urine creatinine concentrations of the wynruit group

Table 5.24: Daily and average creatinine concentrations over 6 days of five rats each, subjected to *wynruit* decoctions, boiled for 15 and 30 minutes, respectively

Plant	**Boiling time**	**Rat No**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Average** (mmol/L)
Wynruit	15 min	16	9.2	12.2	11.7	12.2	14.5	16.5	12.72
Wynruit	15 min	17	9.8	11.3	12.5	11.9	13.2	15.3	12.33
Wynruit	15 min	18	9.1	12.2	11.8	12.6	12	14.3	12.00
Wynruit	15 min	19	9.6	10	10.1	12.1	13.5	15.9	11.87
Wynruit	15 min	20	10	11.1	9.9	10.6	12.4	14.6	11.43
Wynruit	30 min	21	9.4	12.3	12.6	12.7	13.5	11.9	12.07
Wynruit	30 min	22	9.8	11.9	11.6	12.3	12.5	16.7	12.47
Wynruit	30 min	23	10.1	12.1	10.5	10.8	12.8	13.9	11.70
Wynruit	30 min	24	10	12.9	13.8	13	13.5	15	13.03
Wynruit	30 min	25	9.8	11.1	9.8	12.5	11.4	9.9	10.75

The above table 5.24 summarises the daily creatinine excretion by each test rat taking part in the *wynruit* experiment, and the total excreted concentration over 6 days. Despite some variations in the creatinine concentrations of both groups of five rats each taking the *wynruit* decoctions, all values were within the normal range of 9.0-17.7 mmol/L/24 hr. All of the rats in this group excreted creatinine satisfactorily, but were there no abnormally high or low creatinine test results.

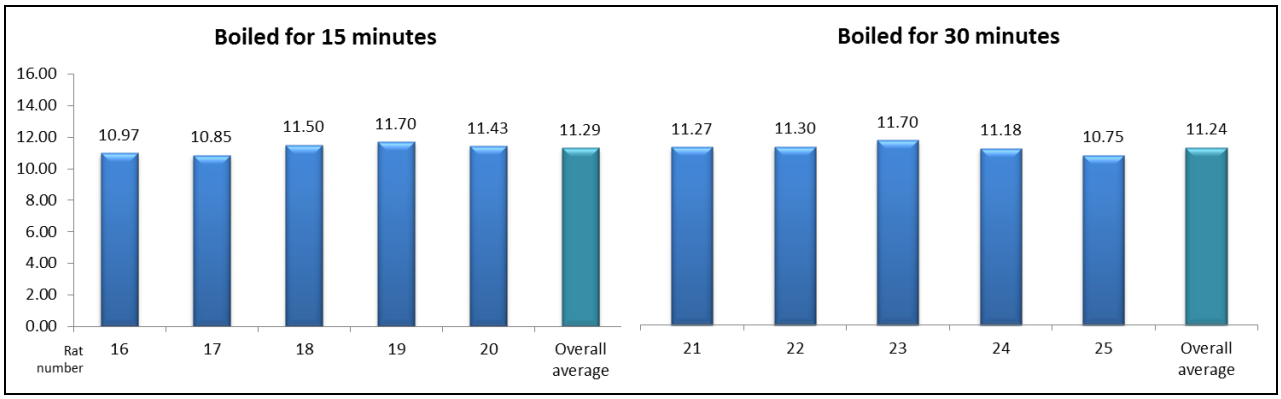

Figure 5.24: 6 days' average creatinine concentration distribution of five rats each, subjected to *wynruit* decoctions, boiled for 15 and 30 minutes, respectively, compared to group averages

Figure 5.24 above illustrates the average creatinine concentrations having been excreted by each rat, compared to the average concentration (M=11.29 mmol/L) for the group having received the *wynruit* decoction boiled for 15 minutes, and (M=11.24 mmol/L) for the rats being given *wynruit* decoctions having been boiled for 30 minutes. This figure shows an even distribution for both groups. There were no significant differences in the average concentrations of both groups, irrespective of the different strengths of the two remedies. For those rats that had concentrations below the group average, the differences were insignificant.

Table 5.25: Combined daily and average descriptive statistics over 6 days for creatinine concentrations of all ten rats together, subjected to both *wynruit* decoctions, boiled for 15 and 30 minutes

***Wynruit* statistics**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
Mean	9.68	11.71	11.43	12.07	12.93	14.40
Standard Error	0.11	0.26	0.42	0.25	0.28	0.67
Median	9.80	12.00	11.65	12.25	13.00	14.80
Standard Deviation	0.35	0.83	1.33	0.79	0.89	2.11
Sample Variance	0.12	0.70	1.78	0.62	0.80	4.44
Kurtosis	-0.90	0.66	-0.81	0.33	0.00	1.23
Skewness	-0.62	-0.80	0.30	-1.11	-0.03	-1.21
Range	1.00	2.90	4.00	2.40	3.10	6.80
Maximum	10.10	12.90	13.80	13.00	14.50	16.70
Minimum	9.10	10.00	9.80	10.60	11.40	9.90
Sum	96.80	117.10	114.30	120.70	129.30	144.00
Count	10.00	10.00	10.00	10.00	10.00	10.00
Geometric Mean	9.67	11.68	11.36	12.05	12.90	14.24
Harmonic Mean	9.67	11.65	11.29	12.02	12.87	14.07

Table 5.25 above summarises the daily combined statistical values. As per figure 5.24 above, there were no significant differences among the average values of both the *wynruit* test groups. This table indicates that there was a steady increase in the creatinine concentrations, with only day 1 having been below the group average. The lower reading on day 1 could have been attributed to a lower blood concentration of the decoction after the initial two doses. The readings are indicative thereof that the rats had been excreting creatinine satisfactorily, as there were no signs of an decrease in creatinine levels in their urine.

Table 5.26: Daily average descriptive statistics for creatinine concentrations of all five rats together, subjected to the *wynruit* decoction, boiled for 15 minutes

***Wynruit* statistics**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
Mean	9.54	11.56	10.44	11.06	11.72	13.42
Standard Error	0.17	0.27	0.18	0.55	0.38	0.56
Median	9.60	11.30	10.70	10.60	12.00	13.00
Standard Deviation	0.38	0.59	0.41	1.22	0.85	1.25
Sample Variance	0.15	0.35	0.17	1.50	0.73	1.57
Kurtosis	-2.28	-3.15	-2.49	-2.48	-1.19	-2.95
Skewness	-0.07	0.46	-0.70	0.46	-0.77	0.43
Range	0.90	1.20	0.90	2.80	2.00	2.60
Maximum	10.00	12.20	10.80	12.60	12.50	14.90
Minimum	9.10	11.00	9.90	9.80	10.50	12.30
Sum	47.70	57.80	52.20	55.30	58.60	67.10
Count	5.00	5.00	5.00	5.00	5.00	5.00
Geometric Mean	9.53	11.55	10.43	11.01	11.69	13.37
Harmonic Mean	9.53	11.54	10.43	10.95	11.67	13.33

The table above shows the daily average creatinine concentrations of the five rats being subjected to the *wynruit* decoction boiled for 15 minutes. These values are neither significantly high, nor low, when compared to the group average (M=11.29 mmol/L). Day 1 had an average value of M=9.54 mmol/L, which was the lowest of this experiment, while day 6 had a value of M=13.42, representing the highest daily creatinine concentration being reached. These results showed that, the more the rats had been given the weaker *wynruit* decoction, the more creatinine they excreted.

Table 5.27: Daily average descriptive statistics over 6 days for creatinine concentrations of all five rats together, subjected to the *wynruit* decoction, boiled for 30 minutes

***Wynruit* statistics**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
Mean	9.82	11.66	10.50	11.70	12.46	11.30
Standard Error	0.12	0.28	0.37	0.39	0.35	0.74
Median	9.80	11.90	10.50	12.20	12.50	10.70
Standard Deviation	0.27	0.62	0.82	0.87	0.78	1.65
Sample Variance	0.07	0.39	0.67	0.77	0.61	2.72
Kurtosis	1.24	-2.68	1.29	-3.18	0.19	0.76
Skewness	-1.00	-0.44	1.15	-0.55	-0.06	1.22
Range	0.70	1.40	2.00	1.80	2.10	4.00
Maximum	10.10	12.30	11.80	12.50	13.50	13.90
Minimum	9.40	10.90	9.80	10.70	11.40	9.90
Sum	49.10	58.30	52.50	58.50	62.30	56.50
Count	5.00	5.00	5.00	5.00	5.00	5.00
Geometric Mean	9.82	11.65	10.48	11.67	12.44	11.21
Harmonic Mean	9.81	11.63	10.45	11.65	12.42	11.12

The above table summarises the average daily creatinine concentrations, compared to the group average. The average values did not vary much from the daily group creatinine values. Day 1 had reached the lowest average concentration (M=9.82 mmol/L), while day 5 had the highest (M=12.46 mmol/L). These values were compared to the group average mean (M=11.24 mmol/L). The results suggested that the renal function of this group taking part in the *wynruit* experiments, was unaffected by the administration of a weaker (boiled for 15 minutes), or stronger decoction (boiled for 30 minutes).

d. Liver enzyme concentrations of the wynruit group

Table 5.28: Liver enzyme (AST) concentrations after 6 days of five rats each, subjected to *wynruit* decoctions, boiled for 15 and 30 minutes, respectively

Plant	**Boiling time**	**Rat No**	**Blood liver enzymes** (U/L)
Wynruit	15 min	16	124.00
Wynruit	15 min	17	136.00
Wynruit	15 min	18	126.00
Wynruit	15 min	19	148.00
Wynruit	15 min	20	122.10
Wynruit	30 min	21	120.00
Wynruit	30 min	22	132.80
Wynruit	30 min	23	150.00
Wynruit	30 min	24	104.00
Wynruit	30 min	25	110.00
		Overall average	**127.29**

Table 5.28 above summarises the liver enzyme (AST) concentrations of all ten rats on the day that they were sacrificed, following the 6 days' administration of the two *wynruit* decoctions. These concentrations were verified and compared to the standard range, i.e. less than 200 U/L. As per the above table, all ten rats being subjected to both the *wynruit* decoctions boiled for 15 and 30 minutes, had values less than 200 U/L. For the rats having received the weaker *wynruit* decoction (boiled for 15 minutes), the highest reading was that of rat 15 (148 U/L). For the rats having received the stronger decoction (boiled for 30 minutes), the highest reading was 150 U/L from rat 30.

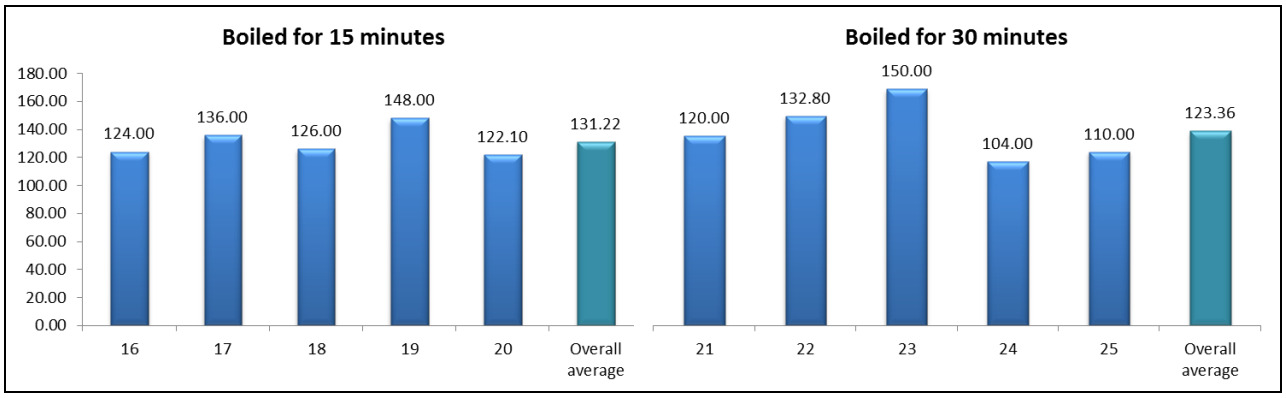

Figure 5.25: Liver enzyme concentration distribution of five rats each, subjected to *wynruit* decoctions, boiled for 15 and 30 minutes, respectively, compared to group averages

The figure 5.25 above illustrates the concentration distribution of the liver enzymes (AST) for both groups of five rats each, subjected to the *wynruit* decoctions boiled for 15 and 30 minutes, respectively. The 15 minutes group had a significantly higher AST average concentration (M=131.22 U/L), compared to the 30 minutes group (M=123.36 U/L). Both groups had two rats each with readings above the respective group averages. The higher AST reading could have been denoted to the liver being affected by the *wynruit* decoctions.

Table 5.29: Average descriptive statistics for liver enzyme (AST) concentrations after 6 days of all ten rats together, subjected to both *wynruit* decoctions, boiled for 15 and 30 minutes

***Wynruit* statistics**	**Overall**	**15 minutes**	**30 minutes**
Mean	127.29	131.22	123.36
Standard Error	4.70	4.83	8.26
Median	125.00	126.00	120.00
Standard Deviation	14.85	10.80	18.46
Sample Variance	220.53	116.74	340.85
Kurtosis	-0.55	0.27	-0.64
Skewness	0.13	1.17	0.67
Range	46.00	25.90	46.00
Maximum	150.00	148.00	150.00
Minimum	104.00	122.10	104.00
Sum	1272.90	656.10	616.80
Count	10.00	5.00	5.00
Geometric Mean	126.51	130.88	122.29
Harmonic Mean	125.73	130.55	121.25

Table 5.29 above summarises the average liver enzyme concentrations for the combined *wynruit* group (five rats each being subjected to the *wynruit* decoctions boiled for 15 minutes and 30 minutes, respectively). The values as per the table were all insignificant, as they were all under 200 U/L. The rats being given the weaker decoction (boiled for 15 minutes) had the highest concentration (M=131.2 U/L), while the 30 minutes group's concentration was the lowest (M=123.36 U/L). The overall mean (M=127.29 U/L) showed that the liver remained unaffected, irrespective of the strength of the *wynruit* decoctions being administered for a 6 day period.

5.4.6.4 Wildeals/wynruit combination group statistical data

This group, comprising the two strengths of *wildeals/wynruit* combination decoctions, was referred to as the combination group. The two decoctions being administered to five rats each consisted of a combination of equal parts of the *wildeals* and *wynruit* medicinal plants, which were boiled for 15 and 30 minutes, respectively. The Griqua community referred to these decoctions as the combination therapies.

a. Weights of the rats in the wildeals/wynruit combination group

Table 5.30: Weights of five rats each, subjected to the *wildeals/wynruit* combination decoctions, boiled for 15 and 30 minutes, respectively

Plant	**Boiling time**	**Rat No**	**Weight** (g)
Combined	15 min	26	325
Combined	15 min	27	306
Combined	15 min	28	340
Combined	15 min	29	306
Combined	15 min	30	328
Combined	30 min	31	343
Combined	30 min	32	295
Combined	30 min	33	309
Combined	30 min	34	329
Combined	30 min	35	333
		Overall average	**321.4**

As shown in table 5.30 above, all of the ten rats that took part in the combination decoctions experiments, were approximately 300 g in weight. The bigger rats were hence used in these tests. The average weight of the rats in the combination group was 321.4 g.

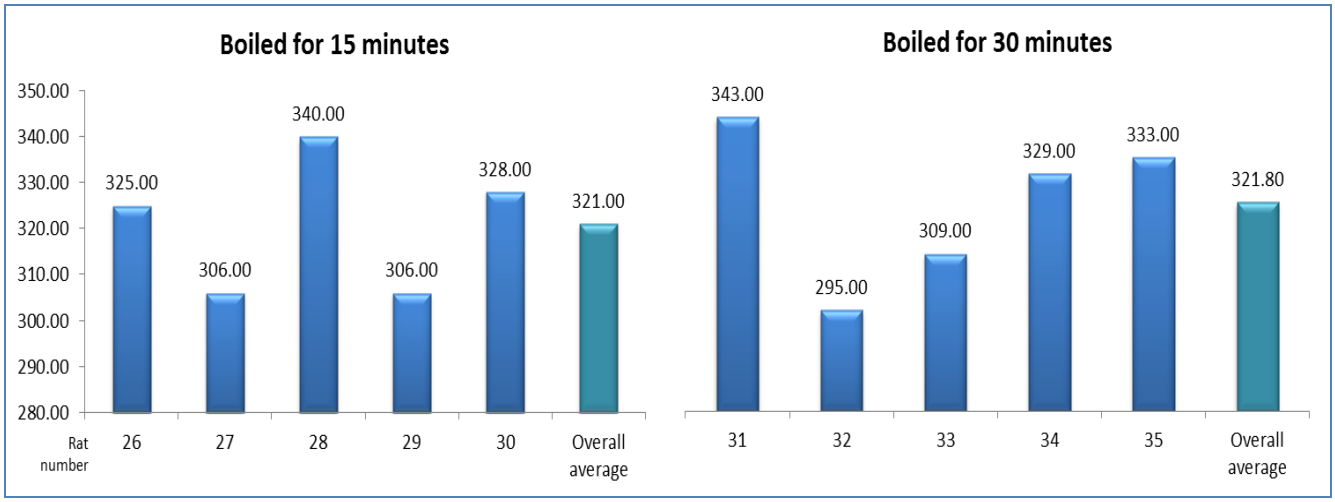

Figure 5.26: Weight distribution of five rats each, subjected to the *wildeals/wynruit* combination decoctions, boiled for 15 and 30 minutes, respectively, compared to the group averages

As demonstrated by figure 5.26 above, both sub-groups had two rats each that were below the group average weights (w=321.00 g) for the 15 minutes sub-group and (w=321.80 g) for the 30 minutes sub-group. These sub-group average weights were exactly the same as that of the combined group (w=321.4 g). The same information is offered by table 5.31, which summarises the descriptive statistical data of the combination group.

Table 5.31: Weight descriptive statistics of all ten rats together, subjected to both *wildeals/wynruit* combination decoctions, boiled for 15 and 30 minutes

***Wildeals/Wynruit* statistics**	**Overall**	**15 minutes**	**30 minutes**
Mean	321.4	321.00	321.80
Standard Error	5.149326	6.618157	8.68562
Median	326.5	325.00	329.00
Standard Deviation	16.2836	14.79865	19.42164
Sample Variance	265.1556	219	377.2
Kurtosis	-1.28853	-1.89535	-1.295509
Skewness	-0.28193	0.06634	-0.57102
Range	48	34	48
Maximum	343	340.00	343.00
Minimum	295	306.00	295.00
Sum	3214	1605.00	1609.00
Count	10	5	5
Geometric Mean	321.0254	320.7272	321.3238
Harmonic Mean	320.6477	320.4547	320.841

Table 5.31 above compares the total group weight of ten rats being subjected to both *wildeals/wynruit* decoctions boiled for 15 and 30 minutes. The differences between the average combined group weight (w=321.4 g) and those of the sub-groups, i.e. the 15 minutes sub-group (w=321.00 g) and the 30 minutes sub-group (w=321.80 g), were insignificant.

b. Urine urea concentrations of the wildeals/wynruit combination group

Table 5.32: Daily and average urea concentrations over 6 days of five rats each, subjected to *wildeals/wynruit* combination decoctions, boiled for 15 and 30 minutes, respectively

Plant	**Boiling time**	**Rat No**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Average** (mmol/L)
Combined	15 min	26	230	365	456	567	585	495	449.67
Combined	15 min	27	392	341	387	492	506	542	443.33
Combined	15 min	28	229	349	265	281	370	485	329.83
Combined	15 min	29	248	275	320	446	531	564	397.33
Combined	15 min	30	296	373	384	420	469	564	417.67
Combined	30 min	31	294	419	382	446	430	569	423.33
Combined	30 min	32	388	315	275	353	339	523	365.50
Combined	30 min	33	377	358	395	463	477	469	423.17
Combined	30 min	34	326	433	551	239	441	431	403.50
Combined	30 min	35	334	326	304	543	539	481	421.17

As shown by table 5.32 above, the combination group of rats had excreted urea within the normal range, despite days 5 and 6 having reached higher concentrations than the other days. All rats had average urea excretion concentrations around 400 mmol/24 hr over a period of 6 days.

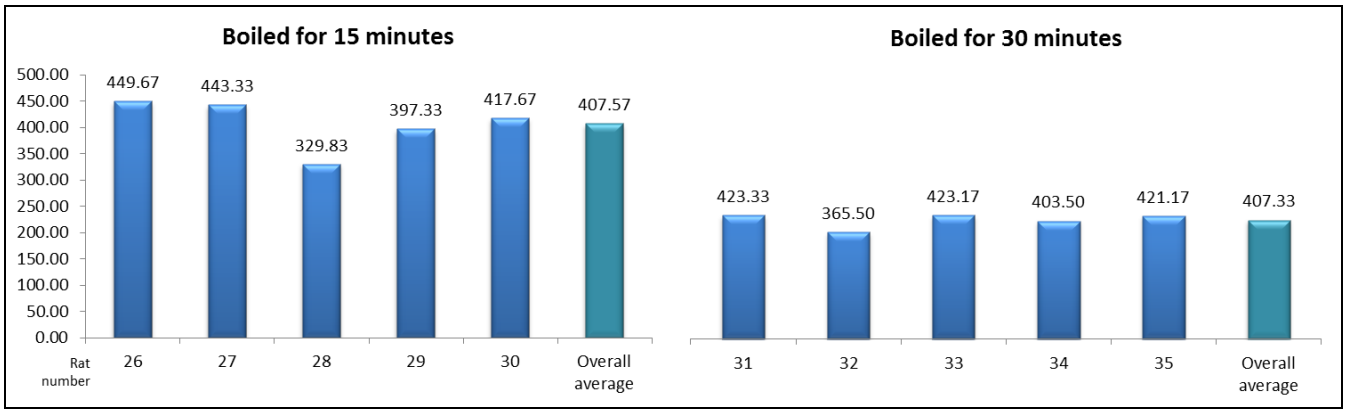

Figure 5.27: 6 days' average urea concentration distribution of five rats each, subjected to the *wildeals/wynruit* combination decoctions, boiled for 15 and 30 minutes, respectively, compared to the group averages

As illustrated by figure 5.27 above, both sub-groups of five rats each had two rats each with average urea concentrations that were below the total group concentration. The five rats being subjected to the *wildeals/wynruit* decoction boiled for 15 minutes had an average of M=407.57 mmol/L, while the 30 minutes sub-group had an average of M=407.33 mmol/L. The mean values among the two sub-groups differed insignificantly, which was attributed to the weights of the rats in both sub-groups having been similar.

Table 5.33: Combined daily and average descriptive statistics over 6 days for urea concentrations of all ten rats together, subjected to both *wildeals/wynruit* combination decoctions, boiled for 15 and 30 minutes

***Wildeals/Wynruit* statistics**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
Mean	311.40	355.40	371.90	425.00	468.70	512.30
Standard Error	19.82	14.79	27.54	33.57	24.18	14.93
Median	311.00	353.50	383.00	446.00	473.00	509.00
Standard Deviation	62.69	46.77	87.10	106.17	76.48	47.22
Sample Variance	3929.60	2187.16	7586.77	11271.56	5848.68	2229.57
Kurtosis	-1.49	0.13	0.69	-0.43	-0.48	-1.08
Skewness	-0.05	0.16	0.79	-0.57	-0.31	-0.25
Range	163.00	158.00	286.00	328.00	246.00	138.00
Maximum	392.00	433.00	551.00	567.00	585.00	569.00
Minimum	229.00	275.00	265.00	239.00	339.00	431.00
Sum	3114.00	3554.00	3719.00	4250.00	4687.00	5123.00
Count	10.00	10.00	10.00	10.00	10.00	10.00
Geometric Mean	305.57	352.62	363.20	411.41	462.81	510.31
Harmonic Mean	299.68	349.82	354.99	396.22	456.65	508.28

The above table 5.33 summarises the daily average urea concentrations of the ten rats taking part in the combination group. These daily averages were compared to the group average of approximately M=407 mmol/L and was it found that from days 1 - 3, the average urea concentrations were lower than that of the group. The concentrations started to rise from days 4 - 6, which was attributed to the rats having been heavier and thus able to tolerate the decoctions given to them better. The increasing urea concentrations were attributed to the accumulative systemic effects of the two decoctions over the 6 days. If was anticipated that prolonged usage could affect the renal system's functioning.

Table 5.34: Daily descriptive statistics over 6 days for urea concentrations of all five rats together, subjected to the *wildeals/wynruit* combination decoction, boiled for 15 minutes

***Wildeals/Wynruit* statistics**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
Mean	279.00	340.60	362.40	441.20	492.20	530.00
Standard Error	30.76	17.35	32.49	47.19	35.90	16.89
Median	248.00	349.00	384.00	446.00	506.00	542.00
Standard Deviation	68.77	38.79	72.66	105.53	80.28	37.77
Sample Variance	4730.00	1504.80	5279.30	11135.70	6444.70	1426.50
Kurtosis	1.84	3.03	-0.35	1.23	1.02	-2.90
Skewness	1.51	-1.66	-0.17	-0.71	-0.79	-0.42
Range	163.00	98.00	191.00	286.00	215.00	79.00
Maximum	392.00	373.00	456.00	567.00	585.00	564.00
Minimum	229.00	275.00	265.00	281.00	370.00	485.00
Sum	1395.00	1703.00	1812.00	2206.00	2461.00	2650.00
Count	5.00	5.00	5.00	5.00	5.00	5.00
Geometric Mean	272.97	338.67	356.35	429.90	486.58	528.91
Harmonic Mean	267.72	336.59	350.15	417.43	480.59	527.81

Table 5.34 above summarises the average descriptive statistical data for the five rats being subjected to the *wildeals/wynruit* decoction boiled for 15 minutes. The combined total average and that of this sub-group showed the same trend. Days 1 - 3 saw the averages being lower than that of the sub-group. From days 4 - 6, the averages were higher than that of the sub-group. This sub-group also showed a steady increase in the level of urea excretion. This sub-group had a total average urea concentration of (M=407.57 mmol/L), with the highest value being on day 6 (M=530.00 mmol/L).

Table 5.35: Daily descriptive statistics over 6 days for urea concentrations of all five rats together, subjected to the *wildeals/wynruit* combination decoction, boiled for 30 minutes

***Wildeals/Wynruit* statistics**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
Mean	343.8	370.2	381.4	408.8	445.2	494.6
Standard Error	17.24645	23.95287	48.09428	52.09453	32.66252	23.69304
Median	334	358	382	446	441	481
Standard Deviation	38.56423	53.56025	107.5421	116.4869	73.03561	52.97924
Sample Variance	1487.2	2868.7	11565.3	13569.2	5334.2	2806.8
Kurtosis	-1.6183	-2.78269	1.265596	-0.01708	1.036264	-0.36555
Skewness	-0.05188	0.291586	1.07627	-0.64368	-0.36781	0.443238
Range	94	118	276	304	200	138
Maximum	388	433	551	543	539	569
Minimum	294	315	275	239	339	431
Sum	1719	1851	1907	2044	2226	2473
Count	5	5	5	5	5	5
Geometric Mean	342.0557	367.1323	370.1721	393.7111	440.1926	492.3589
Harmonic Mean	340.3051	364.1266	359.9669	377.0579	434.9819	490.1529

Table 5.35 above summarises the average descriptive statistical data for the five rats being subjected to the *wildeals/wynruit* decoction boiled for 30 minutes. The combined total average and that of this sub-group showed the same trend. The day 1 - 3 average urea concentrations were lower than that of the sub-group. From days 4 - 6, the averages were higher than that of the sub-group. This sub-group also showed a steady increase in the level of urea excretion, with a total average concentration of M=407.33 mmol/L, and the highest value being on day 6 (M=494.60 mmol/L).

c. Urine creatinine concentrations of the wildeals/wynruit combination group

Table 5.36: Daily creatinine concentrations over 6 days of five rats each, subjected to the *wildeals/wynruit* combination decoctions, boiled for 15 and 30 minutes, respectively

Plant	Boiling time	Rat No	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
Combined	15 min	26	9.6	13	11.6	9.6	14.8	11.8
Combined	15 min	27	10.5	12.3	10.6	10.8	11.4	11.7
Combined	15 min	28	9.1	11.4	15.4	13.6	9.2	10
Combined	15 min	29	9.7	14.3	15.5	13.8	15.6	9.8
Combined	15 min	30	10.1	10.5	12.5	11.8	12.5	10.1
Combined	30 min	31	9.6	12.1	12	13.6	14.2	15
Combined	30 min	32	10.3	9.1	10.6	11.5	10.7	9.7
Combined	30 min	33	9.3	9.8	9.7	9.6	10.7	10.9
Combined	30 min	34	12.6	13.4	12.9	13.1	14.3	15.3
Combined	30 min	35	12.1	13.6	12.9	9.7	12.8	11.4

The above table 5.36 summarises the daily creatinine concentrations for five rats each being subjected to both the *wildeals/wynruit* decoctions boiled for 15 and 30 minutes, respectively. Despite some fluctuations in the creatinine concentrations per rat, all of the readings were within the normal ranges, as supplied by the laboratory (9.0-17.7 mmol/L/24 hr).

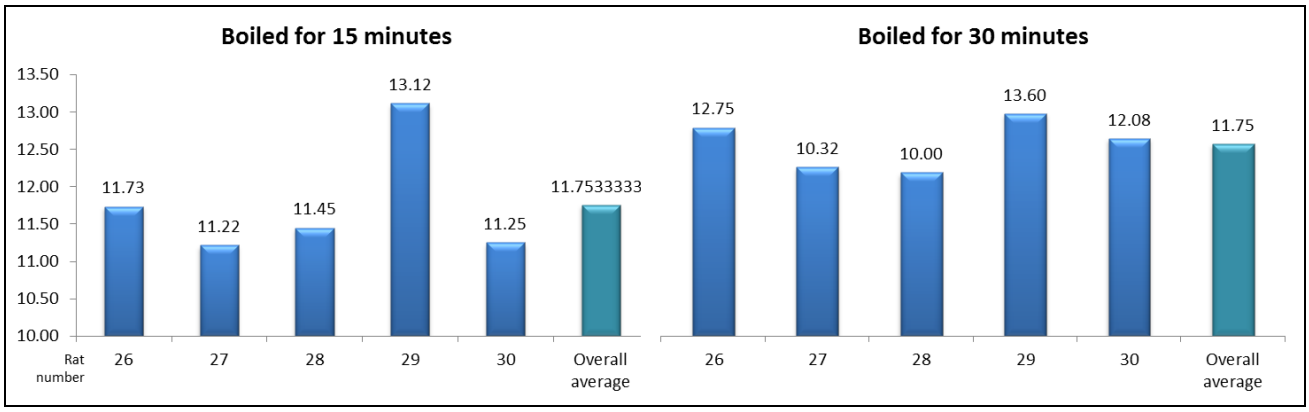

Figure 5.28: 6 days' average creatinine concentration distribution of five rats each, subjected to the *wildeals/wynruit* combination decoctions, boiled for 15 and 30 minutes, respectively, compared to the group averages

Figure 5.28 above shows the average creatinine concentration distribution per rat over 6 days, as well as the group averages of five rats each being subjected to both the *wildeals/wynruit* decoctions boiled for 15 and 30 minutes, respectively. Despite some discrepancies in the creatinine concentrations per rat among the two sub-groups, the sub-groups had the same average concentrations (M=11.73 mmol/L). In the 15 minutes sub-group, only one rat had a value higher than that of the sub-group. In the 30 minutes sub-group, only two rats had concentrations below the sub-group average.

Table 5.37: Combined daily average descriptive statistics over 6 days for creatinine concentrations of all ten rats together, subjected to the *wildeals/wynruit* combination decoctions, boiled for 15 and 30 minutes

***Wildeals/Wynruit* statistics**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
Mean	10.29	11.95	12.37	11.71	12.62	11.57
Standard Error	0.37	0.55	0.61	0.55	0.66	0.65
Median	9.90	12.20	12.25	11.65	12.65	11.15
Standard Deviation	1.17	1.72	1.93	1.74	2.10	2.04
Sample Variance	1.38	2.97	3.74	3.03	4.40	4.16
Kurtosis	0.58	-0.99	-0.42	-1.84	-1.15	0.25
Skewness	1.27	-0.40	0.54	-0.06	-0.16	1.19
Range	3.50	5.20	5.80	4.20	6.40	5.60
Maximum	12.60	14.30	15.50	13.80	15.60	15.30
Minimum	9.10	9.10	9.70	9.60	9.20	9.70
Sum	102.90	119.50	123.70	117.10	126.20	115.70
Count	10.00	10.00	10.00	10.00	10.00	10.00
Geometric Mean	10.23	11.83	12.24	11.59	12.46	11.42
Harmonic Mean	10.18	11.71	12.11	11.47	12.29	11.29

Table 5.37 above summarises the daily mean creatinine concentrations over a period of 6 days for the total number (n=10) of rats in the combination group. Due to the same sub-group averages, they equaled the total group average (M=11.75 mmol/L). Some inconsistencies in the concentrations were noted, whereby days 1 and 4 had the lower mean values (M=10.29 mmol/L and 11.71 mmol/L, respectively). Contrary, days 3 and 5 had the higher mean values (M=12.37 mmol/L M=12.62 mmol/L, respectively).

Table 5.38: Daily average descriptive statistics over 6 days for creatinine concentrations of all five rats together, subjected to the *wildeals/wynruit* combination decoction, boiled for 15 minutes

***Wildeals/Wynruit* statistics**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
Mean	9.80	12.30	13.12	11.92	12.70	10.68
Standard Error	0.24	0.65	1.00	0.81	1.16	0.44
Median	9.70	12.30	12.50	11.80	12.50	10.10
Standard Deviation	0.53	1.46	2.23	1.80	2.59	0.98
Sample Variance	0.28	2.13	4.98	3.25	6.70	0.97
Kurtosis	-0.19	-0.49	-2.71	-1.97	-1.23	-3.21
Skewness	0.05	0.24	0.21	-0.18	-0.27	0.56
Range	1.40	3.80	4.90	4.20	6.40	2.00
Maximum	10.50	14.30	15.50	13.80	15.60	11.80
Minimum	9.10	10.50	10.60	9.60	9.20	9.80
Sum	49.00	61.50	65.60	59.60	63.50	53.40
Count	5.00	5.00	5.00	5.00	5.00	5.00
Geometric Mean	9.79	12.23	12.97	11.81	12.48	10.64
Harmonic Mean	9.78	12.16	12.82	11.70	12.25	10.61

According to table 5.38 above, the creatinine concentration on day 1 represented the lower value (M=9.80 mmol/L), with a steady increase in the creatinine mean values observed for the subsequent days. The total sub-group concentration was M=11.75 mmol/L and on day 6 the creatinine concentration for the five rats being given the weaker decoction (boiled for 15 minutes), was lower than that of the group average. This sub-group generally had inconsistent mean concentrations.

Table 5.39: Daily average descriptive statistics over 6 days for creatinine concentrations of all five rats together, subjected to the *wildeals/wynruit* combination decoction, boiled for 30 minutes

***Wildeals/Wynruit* statistics**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
Mean	10.78	11.60	11.62	11.50	12.54	12.46
Standard Error	0.67	0.92	0.64	0.83	0.80	1.13
Median	10.30	12.10	12.00	11.50	12.80	11.40
Standard Deviation	1.49	2.06	1.43	1.86	1.78	2.53
Sample Variance	2.22	4.25	2.04	3.46	3.17	6.42
Kurtosis	-2.71	-2.72	-1.96	-2.81	-3.02	-2.79
Skewness	0.42	-0.36	-0.56	0.04	-0.18	0.34
Range	3.30	4.50	3.20	4.00	3.60	5.60
Maximum	12.60	13.60	12.90	13.60	14.30	15.30
Minimum	9.30	9.10	9.70	9.60	10.70	9.70
Sum	53.90	58.00	58.10	57.50	62.70	62.30
Count	5.00	5.00	5.00	5.00	5.00	5.00
Geometric Mean	10.70	11.45	11.55	11.38	12.44	12.26
Harmonic Mean	10.62	11.29	11.47	11.26	12.33	12.06

Similarly to the 15 minutes *wildeals/wynruit* sub-group, the 30 minutes sub-group also showed some discrepancies in the creatinine concentrations. From days 1 - 4, the mean values were lower than that of the sub-group mean (M=11.75 mmol/L). Only days 5 and 6 had values higher than that of the sub-group.

d. Liver enzyme concentrations of the wildeals/wynruit combination group

Table 5.40: Combined serum liver enzyme (AST) concentrations after 6 days of all five rats each, subjected to the *wildeals/wynruit* combination decoctions, boiled for 15 and 30 minutes, respectively

Plant	**Boiling time**	**Rat No**	**Blood liver enzymes** (U/L)
Combined	15 min	26	134
Combined	15 min	27	128
Combined	15 min	28	126
Combined	15 min	29	129
Combined	15 min	30	130
Combined	30 min	31	143
Combined	30 min	32	127
Combined	30 min	33	144
Combined	30 min	34	125
Combined	30 min	35	135
		Overall average	**132.1**

Table 5.40 summarises the serum liver enzyme (AST) concentrations for the ten rats being subjected to the two *wildeals/wynruit* combination decoctions. Their blood was collected when the rats had been sacrificed following the 6 day long experiments.

The serum AST values for this group of rats were all less than 200 U/L, i.e. the normal concentration. The concentrations were all below 150 U/L per rat, with the average group concentration being M=132.1 U/L.

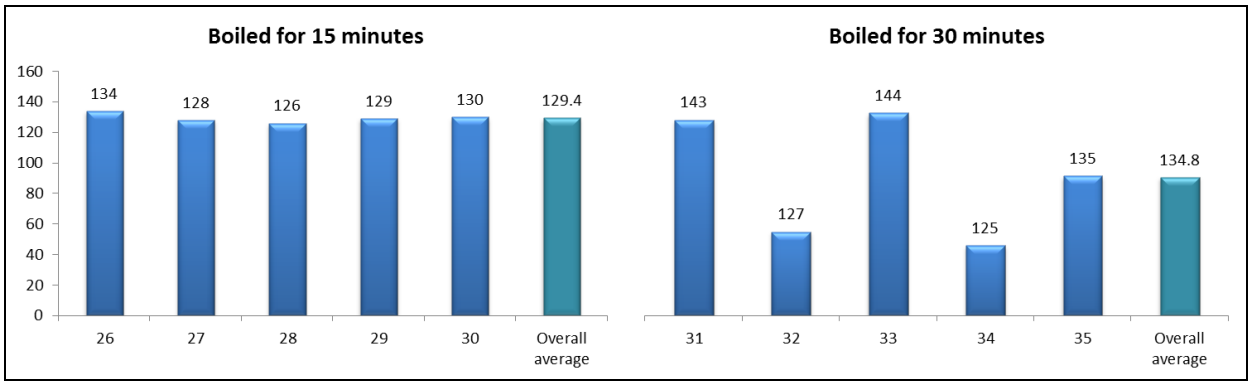

Figure 5.29: Liver enzyme concentration distribution of five rats each after 6 days of being subjected to *wildeals/wynruit* combination decoctions, boiled for 15 and 30 minutes, respectively, compared to group averages

Figure 5.29 above illustrates the concentration distribution of the liver enzymes for the ten rats being subjected to the two *wildeals/wynruit* decoctions boiled for 15 and 30 minutes and the sub-group averages. There were no significant differences in the averages of the two sub-groups (M=129.4 U/L) for the 15 minutes sub-group and (M=134.8 U/L) for the 30 minutes sub-group. Of the sub-group being given the weaker decoction (boiled for 15 minutes), only one rat (rat 26) had a higher concentration than the group total. Of the sub-group being given the stronger decoction (boiled for 30 minutes), two rats (rats 31and 33) had higher concentrations than the total group value.

Table 5.41: Combined liver enzyme (AST) descriptive statistics after 6 days of all five rats each, subjected to the *wildeals/wynruit* combination decoctions, boiled for 15 and 30 minutes, respectively

***Wildeals/Wynruit* Statistics**	**Overall**	**15 minutes**	**30 minutes**
Mean	132.10	129.40	134.80
Standard Error	2.15	1.33	3.93
Median	129.50	129.00	135.00
Standard Deviation	6.81	2.97	8.79
Sample Variance	46.32	8.80	77.20
Kurtosis	-0.35	1.45	-2.84
Skewness	0.96	0.88	-0.05
Range	19.00	8.00	19.00
Maximum	144.00	134.00	144.00
Minimum	125.00	126.00	125.00
Sum	1321.00	647.00	674.00
Count	10.00	5.00	5.00
Geometric Mean	131.95	129.37	134.57
Harmonic Mean	131.80	129.35	134.34

Table 5.41 above summarises the mean concentrations of all ten rats taking part in the *wildeals/wynruit* combination decoctions experiments (M=132.10 U/L), of the 15 minutes sub-group (M=129.40 U/L) and of the 30 minutes sub-group average concentration (M=134.80 U/L). There were no significant differences in the average liver enzymes concentrations among these groups. The mean values were all less than 150 U/L.

5.5 Internal consistency testing

Internal validity, as defined by Talbot (1995:69), is the examination of the approximate truth or falseness of the propositions from which the study was developed. In addition, internal consistency refers to whether the parts of the measurement technique are measuring the same concept (Wood & Ross-Kerr, 2006:211-212), and is it also a useful device for establishing reliability in a highly structured quantitative data collection instrument. Cronbach's alpha (Cronbach's α) coefficient is the most often used to establish internal consistency (Wood & Ross-Kerr, 2006:211-212).

This research used the Cronbach α coefficient to test for consistency within a single test done, and also by using the split-half correlations. The split-half is done when one test is treated as two tests, by dividing items into two sub-sets (Wood & Ross-Kerr, 2006:211-212). The reliability in this research was estimated by using a computing system to measure the correlation between each two sub-sets of items (Conrad, 2014:69). The interpretation of the split-half, per Wood and Ross-Kerr (2006:211-212), refers to comparing the scores of each half, and if all items are consistently measuring the overall concept, the scores on the two halves of the test should then be highly correlated. In addition, if the split-half correlation is low, it implies that some scores were high on odd numbered items, but low on even items. Contrary, if others received high scores on even numbered items and low scores on the odd ones, it would implicate that the correlation pattern is inconsistent.

For the internal consistency of the analysed data to be regarded as acceptable, or good, Cronbach's α coefficient should exceed 0.6. The following sections summarise and discuss the calculated Cronbach α coefficients from the different groups of specimens received. The internal validity was measured without splitting the data into sub-groups, but were the measurements done on the total number of samples per group.

5.5.1 Control group

a. Urine urea consistency

Table 5.42: Urea's Cronbach α coefficient for the control group

Cronbach's α coefficient					
0.334703					
Cronbach's α coefficient with missing item					
Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
-0.40661	0.415653	0.434764	0.569125	0.005741	-0.14762
Split-half					
Halves	0.372639				
OddEven	0.752805				

The control group's urea concentrations (Table 5.42) had a Cronbach α reading of 0.33, which was below 0.6 and therefore indicative of an unacceptable consistency among the urea concentrations in the control group. This was also evidenced by a big difference of halves (0.37) and OddEven (0.75) outcomes, indicating that the samples had very high and very low values.

b. Urine creatinine consistency

Table 5.43: Creatinine's Cronbach α coefficient for the control group

Cronbach's α coefficient					
0.799443					
Cronbach's α coefficient with missing item					
Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
0.706091	0.657012	0.782423	0.739952	0.714781	0.90992
Split-half					
Halves	0.533973				
OddEven	0.80732				

The control group's creatinine concentrations (Table 5.43) had a Cronbach α reading of 0.79, which was above 0.6 and therefore indicative of good consistency among the creatinine samples being analysed. Although the margin between halves (0.53) and OddEven (0.80) indicated some high and low values among the samples, the differences were insignificant.

5.5.2 *Wildeals* group

a. Urine urea consistency

The Cronbach alpha value for the urea concentrations of the *wildeals* group was 0.49, which was below 0.6 and therefore indicative of an unacceptable consistency among the urea samples. This was attributed to the samples being significantly too high, or too low on the other side, according to the halves (0.36) and OddEven (0.69) outcomes.

Table 5.44: Urea's Cronbach α coefficient for the *wildeals* group

Cronbach's α coefficient					
0.495103					
Cronbach's α coefficient with missing item					
Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
0.601572	0.502186	0.246046	0.192432	0.614801	0.236537
Split-half					
Halves	0.366292				
OddEven	0.693274				

Table 5.44 above refers to the wildeals combination group. This table shows acceptable consistency as it is above 0.6.

b. Urine creatinine consistency

Table 5.45: Creatinine's Cronbach α coefficient for the *wildeals* group

Cronbach's α coefficient					
0.772507					
Cronbach's α coefficient with missing item					
Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
0.606815	0.834829	0.75238	0.718539	0.716513	0.750832
Split-half					
Halves	0.608546				
OddEven	0.855838				

The Cronbach α value of the creatinine concentrations was 0.77 (Table 5.45) and hence an indication of acceptable consistency among the creatinine samples in the *wildeals* group. The split-half test outcomes indicated that some samples were higher on either the odd, or

the even sides. However, those differences did not affect the internal consistency of the samples tested.

5.5.3 *Wynruit* group

a. Urine urea consistency

Table 5.46: Urea's Cronbach α coefficient for the *wynruit* group

Cronbach's α coefficient					
0.515637					
Cronbach's α coefficient with missing item					
Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
0.523933	0.506349	0.598827	0.444243	0.255336	0.395791
Split-half					
Halves	0.394538				
OddEven	0.881536				

The Cronbach α value for the urea concentrations of the *wynruit* group (Table 5.46) was 0.51, which was below 0.6 and therefore indicative of unacceptable consistency among the urea samples for this group of rats. This was attributed to the samples being significantly too high, or too low on the other side, as shown by the halves (0.39) and OddEven (0.88) outcomes.

b. Urine creatinine consistency

Table 5.47: Creatinine's Cronbach α coefficient for the *wynruit* group

Cronbach's α coefficient					
0.548621					
Cronbach's α coefficient with missing item					
Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
0.607082	0.477265	0.286511	0.539103	0.402126	0.643783
Split-half					
Halves	0.527054				
OddEven	0.822164				

The Cronbach α value for the creatinine concentrations (Table 5.47) of the *wynruit* group was 0.55, which was less than 0.6. This implied that the hypothesis had been rejected and that wynruit would most likely affect the renal system negatively. This was also evidenced by the split-halves outcomes, in which the OddEven (0.82) value was more than the halves (0.52).

5.5.4 *Wildeals*/*wynruit* combination group

a. Urine urea consistency

Table 5.48: Urea's Cronbach α coefficient for the *wildeals*/*wynruit* combination group

Cronbach's α coefficient					
0.357074					
Cronbach's α coefficient with missing item					
Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
0.449534	0.386651	0.294761	0.123565	-0.00232	0.420597
Split-half					
Halves	-0,36471				
OddEven	0.541186				

The Cronbach α value for the creatinine concentrations (Table 5.48) of the *wildeals*/*wynruit* group was 0.35, indicating unacceptable consistency among the urea data for the combined group. This group had major inconsistencies among the samples, as indicated by the halves (-0.36) and OddEven (0.54) outcomes. The results of the combination group had very high and very low readings on the other side.

b. Urine creatinine consistency

Table 5.49: Creatinine's Cronbach α coefficient for the *wildeals*/*wynruit* combination group

Cronbach's α coefficient					
0.713792					
Cronbach's α coefficient with missing item					
Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
0.713953	0.584299	0.696167	0.695518	0.629463	0.705457
Split-half					
Halves	0.713265				
OddEven	0.854023				

The creatinine Cronbach α value for the creatinine concentrations (Table 5.49) of the *wildeals*/*wynruit* group was 0.71 and hence an indication of good consistency among the creatinine samples in the combination group, as it was above 0.6. The split-half test indicated that the samples were almost consistent on either the odd, or the even side, as per the halves (0.71) and OddEven (0.85) outcomes.

5.6 Hypothesis testing

Hypothesis is an assertion of a specific relationship between two or more variables, and can it either be supported, or rejected by the findings (Wood & Ross-Kerr, 2006:85-86). Hypotheses must be tested, based upon the findings of the study being undertaken. As described by Creswell (2009:16), hypothesis testing is when the researcher tests a theory by specifying a narrow statement, and by collecting data to support or refute the stated hypothesis.

In this research, the researcher aimed at testing the following hypotheses, which could either be accepted, or refuted, based upon the findings. The hypothesis statement to be tested in this phase was:

> *The decoctions prepared from wildeals and wynruit as either mono-, or combination therapies have no effects on the renal system.*

In order to test the hypotheses of this research, the populations mean values were used. The normal ranges of the readings were for urea, creatinine and serum liver enzyme levels. The highest readings of the normal ranges were used in all of the tests. These were 585 mmol/L for urea, 17.7 mmol/L for creatinine and 200 U/L for serum liver enzymes. Significances were tested for each set of fives rats each being subjected to the control and to the three different types of decoctions boiled for 15 and 30 minutes, respectively.

A one tailed *t*-test for the two independent medicinal plants was performed and was interpreted as follows: If the *p* value was <0.05, the hypothesis would be rejected and the medicinal plant would affect the renal system. If the *p* value was >0.05, there was no significant impact on the renal system and the null hypothesis would be accepted, meaning that the prepared decoctions from *wildeals/wynruit* as either mono-, or combination therapy, would not significantly affect the renal system. These same principles were applied to hypothesis statement one. The *t*-test is the classic, powerful, parametric testing technique for analysing the differences among the means of the two groups of natural decoctions being researched during this study (Wood & Ross-Kerr, 2006:260).

The same value was used for the urea, creatinine and liver enzyme concentrations. The liver enzymes were added to this test, so as to assess the effects that these medicinal plants could have on the liver. The testing was done in comparison to the control group.

5.6.1 *Wildeals* decoction group

a. Urine area: Wildeals decoction boiled for 15 minutes

Table 5.50: T-test of two independent urea samples from the *wildeals* and control groups

SUMMARY			**Hyp Mean Diff**	**585**					
Groups	*Count*	*Mean*	*Variance*	*Cohen d*					
WildealsU15	5	443.37	265.6583						
ControlU15	5	432.23	918.925						
Pooled			592.2917	23.57997					
T-TEST: Unequal Variances			Alpha	0.05					
	std err	*t-stat*	*Df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One Tail	15.3921	37.2832	6.134389	0.248065	1.94318			no	0.997801

Based upon the urea concentrations over 6 days of testing, the p-value (0.25) of this test was >0.05 and was the hypothesis hence accepted and indicative thereof that the *wildeals* decoction, boiled for 15 minutes, would not affect the renal system.

b. Urine urea: Wildeals decoction boiled for 30 minutes

Table 5.51: T-test of two independent urea samples from the *wildeals* and control groups

SUMMARY			**Hyp Mean Diff**	**585**					
Groups	*Count*	*Mean*	*Variance*	*Cohen d*					
WildealsU30	5	433.60	6128.008						
ControlU30	5	432.23	918.925						
Pooled			3523.467	9.832297					
T-TEST: Unequal Variances				Alpha	0.05				
	std err	*t-stat*	*Df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One Tail	37.5418	15.54623	5.173257	0.486162	2.015048			no	0.989466

Based upon the urea concentrations over 6 days of testing, the p-value (0.49) for the *wildeals* decoction, boiled for 30 minutes, was >0.05 and was the hypothesis hence accepted and indicative thereof that this remedy would not affect the renal system.

c. Urine creatinine: Wildeals decoction boiled for 15 minutes

Table 5.52: T-test of two independent creatinine samples from the *wildeals* and control groups

SUMMARY			**Hyp Mean Diff**	**17.7**					
Groups	*Count*	*Mean*	*Variance*	*Cohen d*					
WildealsC15	5	12.09	2.02175						
ControlC15	5	12.68	0.633191						
Pooled			1.327471	15.87107					
T-TEST: Unequal Variances				Alpha	0.05				
	std err	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One Tail	0.728689	25.09437	6.281709	0.225323	1.94318			no	0.995049

Based upon the creatinine concentrations over 6 days of testing, the p-value (0.22) of this test was >0.05 and was the hypothesis hence accepted and indicative thereof that the *wildeals* decoction, boiled for 15 minutes, would not affect the renal system.

d. Urine creatinine: Wildeals decoction boiled for 30 minutes

Table 5.53: T-test of two independent creatinine samples from the *wildeals* and control groups

SUMMARY			**Hyp Mean Diff**	**17.7**					
Groups	*Count*	*Mean*	*Variance*	*Cohen d*					
WildealsC30	5	11.23	2.916889						
ControlC30	5	12.68	0.633191						
Pooled			1.77504	14.37557					
T-TEST: Unequal Variances				Alpha	0.05				
	std err	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One Tail	0.842624	22.72978	5.658469	0.06923	1.94318			no	0.994568

Based upon the creatinine concentrations over 6 days of testing, the p-value (0.07) of this test was >0.05 and was the hypothesis hence accepted and indicative thereof that the *wildeals* decoction, boiled for 30 minutes, would not significantly affect the renal system.

e. Liver enzyme (AST): Wildeals decoction boiled for 15 minutes

Table 5.54: T-test of two independent serum liver enzyme samples from the *wildeals* and control groups

SUMMARY			**Hyp Mean Diff**	**200**					
Groups	*Count*	*Mean*	*Variance*	*Cohen d*					
WildealsL15	5	138.8	130.2						
ControlL15	5	135.2	61.7						
Pooled			95.95	20.05021					
T-TEST: Unequal Variances				Alpha	0.05				
	std err	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One Tail	6.195159	31.70217	7.095859	0.289578	1.894579			no	0.996488

Based upon the liver enzyme (AST) concentrations after 6 days of testing, the p-value (0.29) of this test was >0.05 and was the hypothesis hence accepted and indicative thereof that the *wildeals* decoction, boiled for 15 minutes, would not affect the liver.

f. Liver enzyme (AST): Wildeals decoction boiled for 30 minutes

Table 5.55: T-test of two independent liver enzyme (AST) samples from the *wildeals* and control groups

SUMMARY			**Hyp Mean Diff**	**200**					
Groups	*Count*	*Mean*	*Variance*	*Cohen d*					
WildealsL30	5	140.4	177.3						
ControlL30	5	135.2	61.7						
Pooled			119.5	17.81989					
T-TEST: Unequal Variances				Alpha	0.05				
	std err	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One Tail	6.913754	28.17572	6.483254	0.239193	1.94318			no	0.995942

Based upon the liver enzyme concentrations after 6 days of testing, the p-value (0.24) of this test was >0.05 and was the hypothesis hence accepted and indicative thereof that the *wildeals* decoction, boiled for 30 minutes, would not affect the liver.

5.6.2 *Wynruit* decoction group

a. Urine urea: Wynruit decoction boiled for 15 minutes

Table 5.56: T-test of two independent urea samples from the *wynruit* and control groups

SUMMARY			**Hyp Mean Diff**	**585**					
Groups	*Count*	*Mean*	*Variance*	*Cohen d*					
WynruitU15	5	420.50	947.7778						
ControlU15	5	432.23	918.925						
Pooled			933.3514	19.53249					
T-TEST: Unequal Variances				Alpha	0.05				
	std err	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One Tail	19.32202	30.88359	7.998089	0.280262	1.859548			no	0.995833

Based upon the urea concentrations over 6 days of testing, the p-value (0.28) was >0.05 and was the hypothesis hence accepted and indicative thereof that the *wynruit* decoction, boiled for 15 minutes, would not affect the renal system.

b. Urine urea: Wynruit decoction boiled for 30 minutes

Table 5.57: T-test of two independent urea samples from the *wynruit* and control groups

SUMMARY			**Hyp Mean Diff**	**585**					
Groups	*Count*	*Mean*	*Variance*	*Cohen d*					
WynruitU30	5	431.47	978.7972						
ControlU30	5	432.23	918.925						
Pooled			948.8611	19.01618					
T-TEST: Unequal Variances				Alpha	0.05				
	std err	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One Tail	19.4819	30.06722	7.992045	0.484787	1.859548			no	0.995609

Based upon the urea concentrations over 6 days of testing, the p-value (0.48) was >0.05 and was the hypothesis hence accepted and indicative thereof that the *wynruit* decoction, boiled for 30 minutes, would not significantly affect the renal system.

c. Urine creatinine: Wynruit decoction boiled for 15 minutes

Table 5.58: T-test of two independent creatinine samples from the *wynruit* and control groups

SUMMARY			**Hyp Mean Diff**	**17.7**					
Groups	*Count*	*Mean*	*Variance*	*Cohen d*					
WynruitC15	5	12.07	0.234778						
ControlC15	5	12.68	0.633191						
Pooled			0.433984	27.793					
T-TEST: Unequal Variances				Alpha	0.05				
	std err	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One Tail	0.416646	43.94459	6.607761	0.094742	1.894579			no	0.998294

Based upon the creatinine concentrations over 6 days of testing, the p-value (0.09) was >0.05 and was the hypothesis hence accepted and indicative thereof that the *wynruit* decoction, boiled for 15 minutes, would not significantly affect the renal system.

d. Urine creatinine: Wynruit decoction boiled for 30 minutes

Table 5.59: T-test of two independent creatinine samples from the *wynruit* and control groups

SUMMARY			**Hyp Mean Diff**	**17.7**					
Groups	*Count*	*Mean*	*Variance*	*Cohen d*					
WynruitC30	5	12.00	0.735611						
ControlC30	5	12.68	0.633191						
Pooled			0.684401	22.21241					
T-TEST: Unequal Variances				Alpha	0.05				
	std err	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One Tail	0.523221	35.1209	7.95546	0.116312	1.859548			no	0.996791

Based upon the creatinine concentrations over 6 days of testing, the p-value (0.12) was >0.05 and was the hypothesis hence accepted and indicative thereof that the *wynruit* decoction, boiled for 30 minutes, would not significantly affect the renal system.

e. Liver enzyme (AST): Wynruit decoction boiled for 15 minutes

Table 5.60: T-test of two independent liver enzyme samples from the *wynruit* and control groups

SUMMARY			**Hyp Mean Diff**	**200**					
Groups	*Count*	*Mean*	*Variance*	*Cohen d*					
WynruitL15	5	131.22	116.742						
ControlL15	5	135.2	61.7						
Pooled			89.221	21.59504					
T-TEST: Unequal Variances				Alpha	0.05				
	std err	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One Tail	5.973977	34.14476	7.304957	0.262872	1.894579			no	0.996882

Based upon the liver enzyme concentrations after 6 days of testing, the p-value (0.26) was >0.05 and was the hypothesis hence accepted and indicative thereof that the *wynruit* decoction, boiled for 15 minutes, would not significantly affect the liver.

f. Liver enzyme (AST): Wynruit decoction boiled for 30 minutes

Table 5.61: T-test of two independent liver enzyme samples from the *wynruit* and control groups

SUMMARY			**Hyp Mean Diff**	**200**					
Groups	*Count*	*Mean*	*Variance*	*Cohen d*					
WynruitL30	5	123.36	340.848						
ControlL30	5	135.2	61.7						
Pooled			201.274	14.93187					
T-TEST: Unequal Variances				Alpha	0.05				
	std err	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One Tail	8.972714	23.60936	5.402205	0.120071	2.015048			no	0.995189

Based upon the liver enzyme concentrations after 6 days of testing, the p-value (0.12) was >0.05 and was the hypothesis hence accepted and indicative thereof that the *wynruit* decoction, boiled for 30 minutes, would not significantly affect the liver.

5.6.3 *Wildeals/wynruit* combination decoction group

a. Urine Urea: Wildeals/wynruit combination decoction boiled for 15 minutes

Table 5.62: T-test of two independent urea samples from the *wildeals/wynruit* combination and control groups

SUMMARY			**Hyp Mean Diff**	**585**					
Groups	*Count*	*Mean*	*Variance*	*Cohen d*					
CombinedU15	5	407.57	2325.217						
ControlU15	5	432.23	918.925						
Pooled			1622.071	15.13762					
T-TEST: Unequal Variances				Alpha	0.05				
	std err	*t-stat*	*Df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One Tail	25.47211	23.93468	6.734514	0.183168	1.894579			no	0.994173

Based upon the urea concentrations over 6 days of testing, the p-value (0.18) was >0.05 and was the hypothesis hence accepted and indicative thereof that the *wildeals/wynruit* combination decoction, boiled for 15 minutes, would not significantly affect the renal system.

b. Urine urea: Wildeals/wynruit combination decoction boiled for 30 minutes

Table 5.63: T-test of two independent urea samples from the *wildeals/wynruit* combination and control groups

SUMMARY			**Hyp Mean Diff**	**585**					
Groups	*Count*	*Mean*	*Variance*	*Cohen d*					
CombinedU30	5	407.33	615.6944						
ControlU30	5	432.23	918.925						
Pooled			767.3097	22.01777					
T-TEST: Unequal Variances				Alpha	0.05				
	std err	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One Tail	17.51924	34.81315	7.699392	0.097222	1.859548			no	0.996839

Based upon the urea concentrations over 6 days of testing, the p-value (0.09) was >0.05 and was the hypothesis hence accepted and indicative thereof that the *wildeals/wynruit* combination decoction, boiled for 30 minutes, would not significantly affect the renal system.

c. Urine creatinine: Wildeals/wynruit combination decoction boiled for 15 minutes

Table 5.64: T-test of two independent creatinine samples from the *wildeals/wynruit* combination and control groups

SUMMARY			**Hyp Mean Diff**	**17.7**					
Groups	*Count*	*Mean*	*Variance*	*Cohen d*					
CombinedC15	5	11.75	0.623111						
ControlC15	5	12.68	0.633191						
Pooled			0.628151	23.50106					
T-TEST: Unequal Variances				Alpha	0.05				
	std err	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One Tail	0.501259	37.15845	7.999485	0.050946	1.859548			no	0.997116

Based upon the creatinine concentrations over 6 days of testing, the p-value (0.05) was equal to 0.05 and was the hypothesis hence accepted and indicative thereof that the *wildeals/wynruit* combination decoction, boiled for 15 minutes, showed normal levels of creatinine, and may it, or may it not significantly affect the renal system.

d. Urine creatinine: Wildeals/wynruit combination decoction boiled for 30 minutes

Table 5.65: T-test of two independent creatinine samples from the *wildeals/wynruit* combination and control groups

SUMMARY			**Hyp Mean Diff**	**17.7**					
Groups	*Count*	*Mean*	*Variance*	*Cohen d*					
CombinedC30	5	11.75	2.412639						
ControlC30	5	12.68	0.633191						
Pooled			1.522915	15.09592					
T-TEST: Unequal Variances				Alpha	0.05				
	std err	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One Tail	0.780491	23.86874	5.964283	0.139496	1.94318			no	0.994806

Based upon the creatinine concentrations over 6 days of testing, the p-value (0.13) was >0.05 and was the hypothesis hence accepted and indicative thereof that the *wildeals/wynruit* combination decoction, boiled for 30 minutes, would not affect the renal system.

e. Liver enzyme (AST): Wildeals/wynruit combination decoction boiled for 15 minutes

Table 5.66: T-test of two independent liver enzyme samples from the *wildeals/wynruit* combination and control groups

SUMMARY			**Hyp Mean Diff**	**200**					
Groups	*Count*	*Mean*	*Variance*	*Cohen d*					
CombinedL15	5	129.4	8.8						
ControlL15	5	135.2	61.7						
Pooled			35.25	34.66297					
T-TEST: Unequal Variances				Alpha	0.05				
	std err	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One Tail	3.754997	54.80697	5.118257	0.090881	2.015048			no	0.999149

Based upon the liver enzyme concentrations after 6 days of testing, the p-value (0.09) was >0.05 and was the hypothesis hence accepted and indicative thereof that the *wildeals/wynruit* combination decoction, boiled for 15 minutes, showed normal levels of liver enzyme and would it not affect the liver.

f. Liver enzyme (AST): Wildeals/wynruit combination decoction boiled for 30 minutes

Table 5.67: T-test of two independent liver enzyme samples from the *wildeals/wynruit* combination and control groups

SUMMARY			**Hyp Mean Diff**	**200**					
Groups	*Count*	*Mean*	*Variance*	*Cohen d*					
CombinedL30	5	134.8	77.2						
ControlL30	5	135.2	61.7						
Pooled			69.45	24.04704					
T-TEST: Unequal Variances				Alpha	0.05				
	std err	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One Tail	5.270674	38.02171	7.901605	0.470696	1.859548			no	0.997278

Based upon the liver enzyme concentrations after 6 days of testing, the p-value (0.47) was >0.05 and was the hypothesis hence accepted and indicative thereof that the *wildeals/wynruit* combination decoction, boiled for 30 minutes, would not affect the liver.

5.7 Interpretation of the findings of this phase

The test outcomes of this phase were interpreted by using Cronbach's α coefficient to test for internal data consistency. Where the Cronbach α value was below 0.6, the data showed internal inconsistency, which could be attributed to concentration of the medicinal plant, laboratory error, or data capturing mistakes or the break in the cold chain of wynruit as said by the community that this medicinal plant ferments fast if not kept in the fridge. The findings were also interpreted by making use of two independent samples, using the *t*-test. All outcomes from the experimental groups were tested against those of the control group and were the *p*-values of each set of relative data determined. Where the *p*-value was below 0.05, the hypothesis being tested would be rejected.

5.8 Realisation of the findings for this phase

This phase of the research project focussed on the *in vivo* testing of the two medicinal plant decoctions being used by the Griqua community. Single and combination decoctions,

prepared from *wildeals* and *wynruit*, were tested on *Spraque-Dawley* rats to assess any possible negative effects of these therapies on the renal systems and livers of the test rats.

The test outcomes showed that there were some inconsistencies in terms of the sample values supplied for analysis. This was a general occurrence, as it was found with regards to the control group also. These inconsistencies could have either been as a result of laboratory error during the analyses, or due to errors when capturing the data for analysis. The Griqua community had prepared two decoctions each from both *wildeals* and *wynruit* on their own, as well as from the *wildeals/wynruit* combination, by boiling two batches of each plant and the combination at 15 and 30 minutes, respectively. All six of these prepared decoctions, as well as a blank control therapy, were administered to five rats each over periods of 6 days, and were daily samples collected and analysed.

Despite these inconsistencies in the captured data, the test outcomes were within the normal ranges, as per the laboratory standards. The results from the internal consistency testing also showed that the data had some inconsistencies, but generally all of the Cronbach α values were above 0.6, which was indicative of internal consistency among the data.

The research hypothesis had therefore been accepted with regards to all of the tests being carried out. Acceptance of this hypothesis indicated that both these medicinal plants could be used as mono-, or combination therapy, without any effects on both the renal system and the liver. The outcomes with regards to all of the stronger decoctions, boiled for 30 minutes, however, implied that if the decoction would be used for a prolonged period of time, it could significantly affect the renal system.

5.9 Validity and reliability

a. Validity

As viewed by De Vos *et al*. (2008:182) and Bless *et al.,* (2006: 93) validity refers to the extent to which an instrument can accurately reflect the concept being measured. In order to ensure validity of the findings, the blood samples, the solid organs (kidneys and livers) and urine specimens were analysed in the laboratory by an experienced laboratory technician. All the results were captured on spreadsheet and given to the statistician for analysis. Greef and Holtzkamp (2007:189-200) conclude that content validity is established on the basis of judgement, that is, if the researchers, or experts are of the opinion that the instrument/data collection method in use had covered the full range of meanings of the variable being measured, content validity has been established. The researcher made use of an accredited laboratory to perform both phases 3and 4. This was also a measure to ensure validity of the

findings. In phase 3, the *in vitro* testing was also done in an international accredited laboratory by an experienced microbiologist. The animals were kept in the research accredited cages where which can separate urine and faeces. The organs were harvested by the animal scientist and the researcher. The findings of research were also discussed with the community who confirmed the validation of the findings as they have locally based science knowledge (Sillitoe, 2009: 8). The findings obtained in this research apply to the Campbell and '*Melesi* communities (Bless *et al.,* 2006:93).

b. Reliability

Burns and Grove (2007:365) believe that reliability is primarily concerned with how well an instrument measures what it is supposed to measure, meaning that, reliability is the consistency of measurement. In support of the above statement, Bless *et al.*(2006: 150-152) views reliability as the ability of the instrument to measure and give same results when the test is repeated. In this research, the *in vitro* testing was repeated and gave the same results. The equipment used for generating the results ensured reliability of the findings during this study, because they were specifically designed to accurately measure the blood and urine samples, urine samples as well as the solid organs of the animals. The specimens were sent to the animal specific laboratory so as to make sure of the reliability of the findings. Data was also later validated through the community where it was collected so as to make sure what goes out is reliable as known by the community. Literature was also used as a form of ensuring reliability of the findings of this research.

c. Independent processes

In qualitative we refer to co-coder, in this instance there were independent processes in the research chain that took place; and could not have been influenced by researcher or community bias. The in vitro investigation was performed by the independent qualified laboratory technologist from NHLS laboratory in Pretoria. The urine, blood and solid organs from the rats were sent to the independent laboratory that deals with animals research in Cape Town for analysis. These are the internationally accredited laboratories with the trusted results. The researcher only observed and assisted with the preparation of the decoctions, administration to the rats, urine and blood collection as well as harvesting of the solid organs. Then the findings from both the laboratories were sent to the researcher for interpretation.

5.10 Summary

This chapter dealt with both the *in vitro* and *in vivo* tests and test outcomes. The *in vitro* testing used the McFarland test to assess the sensitivity of the influenza virus to the mono- and combination decoctions being prepared from the *wildeals* and *wynruit* medicinal plants. The *in vivo* testing made use of *Spraque-Dawley* rats to test for the effects of these decoctions on the kidneys and the liver. Cronbach's α coefficient for internal consistency was determined, as well as one tail *t*-testing for establishing the significance of the effects of the decoctions on the renal system. Although there were some data inconsistencies, as revealed by the Cronbach α coefficients, the general findings confirmed that the knowledge that is held by the Griqua community with regards to these two medicinal plants, could be used to effectively treat common colds. This was in support of the literature that reports on the use of these medicinal plants to treat common cold and other conditions. The following chapter discusses the findings of this study, the recommendations, as well as the limitations of this study.

Chapter 6

Convergence of the Research Findings and Recommendations

"As modern medicine becomes more impersonal, people are recalling with some wistfulness old country cures administered by parents and grandparents over generations using natural folk medicine. The natural folk medicine represents one of the human's earliest uses of the natural environment and uses herbs, plants, minerals and animal substances to prevent and treat illnesses".

Spector, 1991

6.1 Introduction

Taking from the above quotation by Spector (1991) over twenty years ago, it is clear that there are differences between synthetic and natural medicines. Natural folk medicines had been with human kind since time immemorial and are they trusted to this day, because those who use them take a holistic approach when caring for the sick.

The previous chapter focused on both the *in vitro* and *in vivo* tests having been performed during phases 3 and 4 of this study, on the natural decoctions that had been prepared from *wildeals* and *wynruit*, alone and in combination. The McFarland test method was used for the *in vitro* testing, aimed at assessing the sensitivity of the influenza virus to both the mono- and combination therapies, prepared from the two medicinal plants being investigated. During the *in vivo* experiments, *Spraque-Dawley* rats were utilised for establishing the effects of the six prepared natural decoctions on the renal system, by determining both the urea and creatinine concentrations of the experimental rats' excreted urine over a test period of 6 days. The solid detoxifying organs of these test animals, i.e. the kidneys and livers, were after the 6 days of administering the six decoctions to five rats each, harvested and also sent to the laboratory for histophatological assessments.

This chapter discusses the outcomes reached by converging the main findings from phase 1 (realisation of the qualitative phase), phase 2 (systematic review), phase 3 (*in vitro* testing) and phase 4 (*in vivo* testing). Scientific insights were made from these convergences and relationship statements were construed from these insights. These findings are followed by

recommendations, as well as by a summary of the contributions of this study, as concluded from the relationship statements made. The discussions in this chapter are divided according to findings from each phase, and are then all joined together. The contributory statements follow after the main convergence outcomes. This chapter concludes with recommendations with regards to the clinical nursing practice, to learning and teaching institutions, the African indigenous health profession, as well as with regards to relevant future research.

6.2 Phases 1 and 2 main findings

The findings from these phases are discussed under the two main themes that had emerged during the data collection processes. The data being collected during *makgotla* (phase 1) had revealed how the indigenous people prepare, administer and experience a spiritual connection with the universe and cosmos, when it comes to employing medicinal plants to care for the sick. The indigenous people had always had a way of caring for their sick, long before colonialisation, and had this practice been widely accepted and used by the First Nations (Durie, 2003:510-511).

In support, Stewart *et al*. (2008:181-189) are of the opinion that during the pre-European contact era, the indigenous tribes had maintained a constant level of balanced holistic health. Later contact with Europeans then resulted in an upset with regards to the four aspects of healing practices being, environment, community, family, and individual lives fall these First Nations. In addition, culturally based holistic health approach had thus been disrupted by colonisation and by the assimilation practices of the settlers that had caused a serious loss of all indigenous peoples' ways of maintaining their health balance. According to Mawere (2010:209-221), the disruption of the holistic health approach of indigenous people could be attributed to the distribution of scientific knowledge and Christian religious traditions. These distributions demonised the long standing African health practices, owned by the indigenous people. The findings from phase 1 are discussed in the paragraphs that follow next.

The following main findings were derived from the data collection phase through interaction between the researcher and the Griqua and Lesotho communities, during the *makgotla* discussions and from the observations made, while visiting the research population. The indigenous people have a wealth of knowledge and a strong spiritual connection to the medicinal plants they use, as well as with mother earth, which had originated since long before colonialisation.

6.2.1 Preparation of medicinal plants

As alluded by Chinyama (2009:33-34), the medicinal plants had been used as the very first medicinal therapies known to man, and with time the indigenous people of an area gained essential knowledge as to which medicinal plants could be used for certain diseases, or for a certain state of illness, and by doing so they had also learned which ones were hazardous, or poisonous and which ones were safe for human use. The indigenous people then developed a way of preparing decoctions from these medicinal plants, of which the most common preparation method to this date remains boiling. Although boiling has always been the most common and frequently used preparation method, the green leaves of medicinal plants are also used as poultice, whilst dried leaves were smoked, hence some of the participants said:

"Normally we boil them."

"Cooking the plants is the most common method of preparation."

"Then you throw it in and you cook it."

In agreement with the above statements by the Griqua community members regarding the preparation methods used (phase 1), it was also revealed that indigenous medicines could be prepared in different ways, in accordance with what is being treated and what form of administration would be appropriate for the required therapy. Indigenous medicines can be prepared and administered as enemas, decoctions (i.e. a plant extract obtained from boiling) and infusions (i.e. the extract obtained by soaking the crude plant for a short period of time in cold or boiling water). These preparations can be taken by mouth, as snuffs (if prepared from a dried medicinal plant and grinded into a powder that can be drawn up into the nostrils through inhalation), and as inhalants, powders for licking, under the skin implants, bath mixtures, poultices, balms, internal cleansing solutions and lotions intended either for bathing with, or rubbing into the painful area (Mukinda & Syce, 2007:138-144).

Adding to the preparation methods being used by indigenous people, Mukinda (2005:15-16) refers to the preparation of indigenous medicines as a critical point, as it mostly deals with either the fresh, or the dried form of the plant, and can the duration of boiling, or of partially burning the plant to get the odour, not be measured, because of the two main aims of these preparations, i.e. to extract most of the aqueous extract from the plant, as well as to neutralise some toxins that might be active in the plant. Additionally, the plant can be boiled until the required colour, or taste is attained. These findings were also confirmed by the community, in the following statements, referring to measurements and readiness:

"We use the fingers to measure how much we need (demonstrating by show of fingers). Sometimes we make use of a full hand, or half a hand. Once the decoction is prepared, the measurement is done with teaspoon, tablespoon and/or cups. These medicinal plants should not be used more than a week for the same condition. You need to change your herbs if there is no improvement. The leaves are boiled until the water changes its colour and the person that is preparing the decoction is the one that will decide when the decoction is ready for use. This person must have knowledge, as we also taste the bitterness of the decoction to decide when to stop boiling."

In combining the statement by Mukinda (2005) and that of the community quotation above, it is therefore important to realise and acknowledge that the decoctions prepared indigenously are less likely to be toxic, due to the neutralisation effect during preparation.

6.2.2 Heritage (spiritual connection and usage of trust)

Indigenous people have a wealth of knowledge regarding the use of medicinal plants. As a result of the prolonged and proven outcomes to them, their trust and connection to these natural resources form the basis of their respect, or belief systems.

The following statement was made by one of the *lekgotla* participants and the other attendees generally agreed:

"The medicinal plants in this country are very important, because we believe in them and these plants, they make us healthy and in most of the cases we use them in mixtures. They are important also for healing and cleansing."

Congruently, in his speech during *lekgotla,* Kok (2013) stated that the veld is their chemist and have they used it with hope and trust and has it never failed them.

"Now, you do not receive the pills there by the clinic, there is always an option to go to the veld (field). The reason why our plants are so important to us is that in the case that we cannot receive the medication we need, we can always go to the veld and get something there…"

The community is aware of the co-existence among African indigenous health practices and Western health practices. During the interaction with the community, it came out that the mingling of both these health practices is also common and that the community uses both approaches, as they co-exist within them.

"Remember, sometimes to break the fever, they also utilise some Western medicines, like Grandpa, or Disprin, and mix it with the cooking of plants, understand?("Onthou, om die koors te breek hulle gebruik ook die Westerse medisyne, hulle voeg miskien Grandpa of Disprin in, verstaan jy?"). This helps with the quicker curing of the fever".

During *makgotla* discussions, it was also emphasised that not everybody can just go to the veld and harvest medicinal plants. It has to be a person with wisdom and an understanding of the connection with the earth, because without the connection, the medicinal plants may most likely not heal the sick person, as expected. These medicinal plants are used to treat many different conditions.

"We use these plants for common cold, for treating of the intestinal worms (manyowa), so we do deworming (re bolaya manyowa ka tsona), menstrual pains (bohloko ba ho ea kgweding), malaria, killing of germs (di bolaya dikokwana-hloko).These plants, they also help the drivers and people doing sedentary types of work with their kidneys (re phekola mafu a diphio). We also use these plants against witchcraft (boloi)".

Several studies had been conducted on the medical properties of *wildeals* and from these studies it was revealed that *wildeals* has a broad spectrum of inhibitory activities against some organisms. The aerial parts of *wildeals* showed the strongest activity against the chloroquine sensitive *Plasmodium falciparum* strain and against the chloroquine resistant clone of *Plasmodium falciparum* (Kraft *et al*., 2003:123-128). In agreement, Thring and Weitz (2006:261-275) also allude that *wildeals* can be used for many other ailments, like bladder and kidney disorders, diabetes, coughs, colds, fevers, headaches, as well as for deworming. Furthermore, Suliman *et al*. (2010:655-661) revealed that *wildeals* can be widely used to

treat chest related conditions, mostly in polyherbal combinations. This was found to be common practice by the Griqua and Lesotho communities.

> *"The medicinal plants in this country are very important, because we believe in them and these plants, they make us healthy and in most of the cases we use them in mixtures".*

> *"I know precisely, they cook and they also mix both the wildeals and the wynruit".*

This confirmed the knowledge held by the community, as the mixing of medicinal plants had been happening in the community since time immemorial.

Wynruit, as a medicinal plant, showed the following medicinal properties, i.e. anti-cancer, cardio-vascular, anti-spasmodic, anti-fertility, anti-inflammatory, anti-bacterial/-fungal, anti-parasitic, anti-pyretic, anthelminthic and anti-conceptive, as well as being effective in the treatment of deep aching pain, rheumatism, eyestrain induced headaches, while also being able to decrease lipopolysaccharides (Miguel, 2003:231-144; Gutiérrez-Pajares*et al*., 2003:667-672; Raghav *et al*., 2006:234-239). In support of the number of conditions that can be treated by using *wynruit*, Thring and Weitz (2006:261-275) also add conditions, such as the treatment of convulsions, sinuses and worms.

6.2.3 Administration of decoctions prepared from medicinal plants

It was also noted from the *makgotla* discussions and interaction with the community that the medicinal plants prepared indigenously, could be used to treat the sick in different forms.

> *"They then drink the juice (sap) that comes from the cooking, use green leaves, put them on the painful part. Smoke the dried leaves single as lengana, mixed with kwena leaves".*

As perceived by Mukinda and Syce (2007:138-144), the most common methods of administering indigenous medicines are found to be orally, sublingually, rectally, topically, nasally, and through smoking, steaming and bathing, whilst preparation is either through boiling, or heating, or by using the leaves as they are. The community and the literature are in agreement with regards to the administration of decoctions, prepared from the medicinal plants, generally being orally.

These two phases have also revealed the multiple uses of medicinal plants. The specific usage of both *wildeals* and *wynruit* in treating chest related conditions, like the common cold (flu), was confirmed during both phases. This was also verification that when Western science came and tested the medicinal plants' effects on treating different conditions, the indigenous people had this knowledge within themselves already. The following paragraphs discuss the main findings of phase 3.

6.3 Main findings from phase 3 (*in vitro* testing)

The main findings from this phase are discussed according to the minimum inhibitory concentrations (MIC) that were recorded for the six (two strengths each) *wildeals wynruit* and *wildeals/wynruit* combination decoctions that were tested to establish their sensitivity towards the influenza virus. Decoctions had been prepared under the supervision of the community elder, who was also referred to as holder. The prepared decoctions, as described in chapter 5, were taken to a Western test laboratory, where the sensitivity of the flu virus for these six decoctions was tested. Decoctions were prepared from *wildeals wynruit* and a combination of these two medicinal plants. The decoctions were also divided into the time taken to boil them, i.e. 15 minutes (weaker remedy) and 30 minutes (stronger remedy). Table 6.1 below summarises the main findings of phase 3.

Table 6.1: Main findings of the *in vitro* test outcomes of phase 3

Decoction	MIC of decoction boiled for 15 minutes	MIC of decoction boiled for 30 minutes
Wildeals	14 mm	11 mm
Wynruit	0 mm	10 mm
Wildeals/wynruit combination	8 mm	7 mm

Decoctions prepared from w*ildeals* alone and from the combination of *wildeals* and *wynruit*, were found to be effective for both preparations, boiled for 15 and 30 minutes each. *Wynruit* also showed to be effective when prepared through boiling for 30 minutes, while the weaker *wynruit* decoction, boiled for 15 minutes (highlighted in the table above) did not show any MIC and was this ascribed to possible contamination. The use of medicinal plants as single therapy is common practice. Nevertheless, Suliman *et al*. (2010:655-661) allude the use of

wildeals in polyherbal/combination preparations. The Griqua community also employs the same approach, whereby medicinal plants are mixed to treat certain conditions. The community also mixes *wildeals* and *wynruit*, and these decoctions are also be combined with Western medication, like Disprin (section 6.2.2). The mixing of medicinal plants had been used to this day by the indigenous people. However the mixing of *wildeals* and *wynruit* as being done in the Griqua community could not be found in the Lesotho community as well as from the literature.

6.4 Main findings from phase 4 (*in vivo* testing)

The main outcomes from this phase are summarised in table 6.2 below, and is followed by brief descriptions. The main focus of this phase was to test the research hypothesis on the effects of these medicinal plants on renal system. According to the findings in this phase the hypothesis is rejected because the decoctions showed to have effects on the treatment of common cold. However, *wynruit* weaker strength reading are taken with great caution as this could be due to contamination. The internal consistency among the collected data was measured by using Cronbach's alpha (α) coefficient (Burns &Grove, 2007:275). Table 6.2 below shows the internal consistency among the daily urea and creatinine concentrations recorded over 6 days per prepared decoction. The Cronbach α coefficient was expected to be above 0.06, in order for the data to be considered consistent.

Table 6.2: Data consistency test outcomes using Cronbach's α coefficient

Medicinal plant	Urea Cronbach's α	Data Consistent	Creatinine Cronbach's α	Data consistent
Wildeals	0.49	No	0.77	Yes
Wynruit	0.52	No	0.55	No
Wildeals/wynruit combination	0.36	No	0.71	Yes

Most of the captured data showed inconsistencies, as per recorded concentrations received from the laboratory. Although most of the concentrations were within the normal ranges, they were also quite inconsistent. The urine urea readings being highlighted in table 6.2 in red showed the most inconsistencies, compared to the urine creatinine concentrations, with over 50% of the data being consistent. Table 6.3 below summarises the hypothesis testing

outcomes, including the effects of the decoctions on the liver. The hypothesis testing results were also divided into two groups, according to the two strengths of the prepared decoctions, i.e. the three weaker preparations (boiled for 15 minutes) and the three stronger preparations (boiled for 30 minutes).

Table 6.3: *p*-value outcomes from the hypothesis testing

Medicinal Plant	Boiling times	Urine urea *p*-value	Signifi-cance	Urine creatinine *p*-value	Signifi-cance	Liver enzyme *p*-value	Signifi-cance
Wildeals	15 min	0.24	No	0.22	No	0.29	No
	30 min	0.49	No	0.06	No	0.24	No
Wynruit	15 min	0.28	No	0.09	No	0.26	No
	30 min	0.48	No	0.12	No	0.12	No
*Wildeals/wynruit*combination	15 min	0.18	No	0.05	No	0.09	No
	30 min	0.97	No	0.14	No	0.47	No

Despite the internal data showing inconsistencies, as indicated by the Cronbach α coefficient as summarised in table 6.2 above, the *p*-value used for the hypothesis testing (table 6.3) above , showed that the decoctions would not significantly affect the renal system, nor the liver. Significance during this study was tested by using the urine urea, urine creatinine and liver enzyme (AST) concentrations, of which the *p*-value had to be above 0.05 to indicate insignificant effects. The significance was tested on all of the prepared decoctions, boiled for 15 and 30 minutes, respectively. Table 6.3 indicates that the combination therapy, boiled for 15 minutes, equalled the *p*-value. The following paragraphs debate the occurrence of renal failure and its main causes.

6.5 Leading causes of acute renal failure (ARF)/acute kidney injury (AKI)

Globally, the leading causes of renal failure had been identified as diabetes mellitus, hypertension, trauma, non-steroidal anti-inflammatory drugs (NSAIDs), as well as *muthi* (a *Zulu* name for an African herbal preparation used to treat illnesses; *pitsa* in Sesotho). Renal failure is divided into acute and chronic phases (Daugirdas *et al*., 2001:3). For the purpose of this research, the focus was on the causes of acute renal failure. Acute renal failure is

described as a rapid reduction in the glomerular filtration rate, resulting in the retention of waste products, such as urea, creatinine and other uremic toxins, and may be accompanied by oliguria. Causes can further be divided into pre-renal (all that occurs before the kidney), which accounts for 35 -40% of patients, intra-renal (all that occurs within the kidney), which accounts for 55 -60% of patients, and post-renal (all that occurs after the kidney), representing 5% of patients (Barratt *et al*., 2009:3-4).

Although most Western health practitioners blame indigenous medication when an indigenous person experiences renal failure, co-morbid conditions, like diabetes and hypertension, top the list of as the leading causes of renal failure. NSAIDs are also classified as causing renal failure, to a higher extent than indigenous medications. NSAIDs, according to Greenstein and Gould (2009:148-150), are a large group of drugs, consisting of approximately fifty different drugs. In addition, they are mainly used to treat minor pains and headaches, and to control stiffness and pain in rheumatic arthritis and osteoarthritis. These medications are freely available as self-prescribed and self-administered doses. These medications are available in each family household to treat minor ailments.

Furthermore, medicines associated with ARF, were identified as aminoglycosides, pentamidine, acyclovir, foscarnet, amphotericin B, tenofovir and cidofovir (Naicker *et al*., 2008:348-353; Kalyesubula, 2010:1540). In support of the findings of the above authors, Morton and Fontaine (2009:758-760) found that about 7% of all hospitalised patients without renal conditions, ended up having acute tubular necrosis, which had begun with a concentration of the toxins in the renal tubules, which had caused necrosis of the renal tubule.

As observed by Naughton (2008:743-749), Western medicines (drugs, NSAIDs) cause approximately 20% of community and hospital acquired episodes of acute renal failure. It is further said that in older adults, the incidence of renal failure could be as high as 66% and this is due to the fact that older people have other cor-morbid conditions, like diabetes and/or hypertension that force them to take other chronic medications. Therefore, as cited above, the leading causes of renal failure could be attributed to chronic medications and self-dispensed medicines as indigenous people also have these other conditions that need them to take chronic medications.

Choudhury and Ahmed (2006:80-91) claim that toxic effects on the kidneys, related to medications, are both common and expected, given the kidney's roles in plasma filtration and the maintenance of metabolic homeostasis, because the renal vascular bed is exposed to a quarter of resting cardiac output. They further claim that given the above function,

glomerular, tubular as well as renal interstitial cells frequently encounter significant concentrations of medications and their metabolites, which can induce changes in kidney function and structure. It is further claimed that episodes of acute tubular necrosis (ATN), or acute interstitial nephritis due to medication, areas high as18.3%, whileabout 36% are caused by antibiotics, such as amino-glycosides.

The phase 4 of this research focused on accumulation of waste products, i.e. urea and creatinine, which were measured daily, given the functions of the kidneys. The urine results were used to determine whether there was an accumulation of the waste products in the body of rats or not by looking at the recorded reading. Where there was an accumulation of these waste products, the urine concentrations were expected to drop below the normal range, however the urine values received from the laboratory were within the normal range, although there were inconsistencies, as revealed by the Cronbach α coefficient test outcomes for internal data consistency. Given the results in table 6.3 above, and the above statements, it was concluded that the *wildeals* and *wynruit* as either mono-, or combined therapies, would be substantially safe for human use.

6.6 Testing the liver histopathology of rats

As alluded by Ramadori *et al*. (2008:107-117), the liver is the largest organ in the body and has amongst its functions, the uptake of potentially damaging substances that reach the blood stream, for the purpose of detoxifying them. It was for this reason that all the livers of the experimental rats were harvested, following the 6 days administration of the six decoctions, and taken to the laboratory for cell structure assessments. As presented in table 6.3 above, the decoctions prepared from the two medicinal plants, as either mono-, or combination therapy, had not significantly affected any of the test rats' livers.

6.7 Converging all of the findings from this research

This research, being a baseline, level one clinical study, had followed a mixed methods methodology, with a multiphase design, as described by Creswell and Plano Clark (2011:147). In following the multiphase design, a transformative strategy was used (Creswell, 2009:68; Creswell and Plano Clark, 2011:147). In realising the transformative strategy, this research project was further divided into four phases. The phase by phase findings had been discussed in the above paragraphs. The findings from phases 1 and 2 were inter-related, whereas the findings from phases 3 and 4 were dealt with separately.

Indigenous people own the knowledge that is not normally shared with non-indigenous community members some information is only shared within the family. The use of medicinal plants had been with indigenous people and they developed a trust in using them, as they consider the *veld* (field) as their chemist. The Griqua community had identified two commonly used medicinal plants that were tested in a Western laboratory. The community, from years of experience, knows the effectiveness of these medicinal plants and the aim of this research was not to prove to the community, but to the Western scientists that indigenous people have knowledge and wisdom.

The findings from phases 2 to 4 confirmed that the community is knowledgeable about medicinal plants. This was confirmed by the findings that, what the community had said in phase 1 about the preparation and administration of indigenous medicines was found similar to the outcomes of phase 2. The community's knowledge about these medicinal plants being effective in treating the signs and symptoms of common colds, was confirmed by the outcomes of the *in vitro* (phase 3) testing regarding the sensitivity of the influenza virus against the decoctions as prepared by the community, and the results indicated that these medicinal plants were effective against the influenza virus, in the same way that the community uses them. Phase 4 *(in vivo)* focused on the effects of these medicinal plants on the renal system. The aim of this phase was to authenticate the common statements made by Western health practitioners that indigenous medications cause renal failure, especially among the African descendants. The findings in this phase did not confirm these statements, but instead, the urine values, as well as the kidney histopathology results showed that these decoctions had had no effects on the renal system. The testing was extended to the liver as the detoxifying organ in the body, and the findings did not show any effects of these decoctions on the livers of the rats.

Based on the converging statements above, the use of the two medicinal plants, *wildeals* and *wynruit*, could be regarded as safe and effective in the treatment of common colds. However, care must be taken on how these medicinal plants are prepared in terms of measurements, as well as how these decoctions are administered to the person being treated. The findings of phase 4 were based on the urine values, kidneys and livers of the *Spraque-Dawley* rats used for this purpose.

6.7.1 The African indigenous *versus* the Western health practices knowledge gap

Jolles and Jolles (2000:230) are of the opinion that the knowledge gap that had existed between the indigenous and western healing systems had given rise to the myths that had led to Indigenous healers not being well accepted in the western world. These healers had been labelled as witches, and this had made it difficult for them to freely practice their knowledge, due to the promulgation of the Witchcraft Suppression Act of 1957 and the Witchcraft Suppression Amendment Act of 1970 that had been around since 1891.These authors further claim that such legislation had prohibited indigenous healers to practice freely in colonial Natal. Nevertheless, despite these laws, indigenous healing systems had remained resilient, and had continued to be practiced both in urban and rural areas, since they had been used by people of all educational and socio-economic levels (Felhaber, 2006:45-62). However, Richter (2003:4-5) argues that while most indigenous healers rightfully deserve the negative publicity from the media, due to disreputable conduct, these stories had contributed towards a negative sentiment being held towards all indigenous healers and their healing practices, making it even more difficult for real indigenous healers to practice publicly.

In an attempt to close the knowledge gap that exists between the indigenous and western healing systems, Steinglass (2003:32) alludes that the World Health Organization (WHO) had formally recognized the importance of collaborating indigenous and western healers in 1977, but the plan had failed to achieve its objective, as is the case to this day. In addition, the collaboration had aimed at enhancing consultation and at combining conferences, as well as at issuing guidelines on healing systems. This collaboration between biomedicines and indigenous healers was an attempt to contribute towards a good understanding and in working together (Timmermans, 2003:745). As stated in the Traditional Health Practitioners Act (2007) South Africa has also responded to the WHO call to collaborate the indigenous and western way of healing.

Based on the above, this study aimed at emphasizing the importance for western scientists and health care practitioners to understand indigenous health practices, rather than marginalising them, as this would help them to understand how the indigenous people had cared for and cured their sick in pre-colonial times and even today, since about 70% of South Africans still consult with indigenous healers before consulting Western trained health practitioners (Williams *et al*., 2011:1-32). The indigenous health and illness relationship and the indigenous medical practice are usually part of a wider system of knowledge regarding

health, illness and the relationship between humans and nature (Takeshita, 2001:8). In agreement, Mapara (2009:139-155) shares the same view in defining indigenous people as those natural communities that are characterised by complex kinship systems of relationships among people, animals, the earth and the cosmos, from which knowing emanates.

In contextualising the above statements, the Griqua community also alluded to the use of both healing systems in co-existence, but that western health care practitioners had been left behind on how the indigenous people live their lives. Such co-existence was identified when the community alluded to mixing decoctions with either Disprin, or Grandpa, when treating fevers of the sick. This practice had never and may not be easily accepted in the dominant western science world.

6.8 Contributory statements and insights derived from this research

Based on the findings of this research, the following contributory statements were formulated:

- Concluding from the qualitative phase of *makgotla* in chapter 3, the community stated the use of medicinal plant decoctions as combination therapy, in addition to single therapies, they trusted the medicinal purpose thereof, because of prolonged use, as well as due to the results being experienced and proven by them. This was supported by the statement *"…we have been using these plants for over 100 years…and they make us healthy…".* However, from a Western scientific perspective, these statements need to be proved quantitatively, hence the researcher performed baseline clinical experiments during this study to prove that these medicinal plants are working (chapter 5). The same findings, as shared by the community, emerged from the baseline experiments. The community therefore owns the knowledge that need not be undermined by anyone in the western health care practice.

- The mono decoctions that were prepared, *wildeals* showed to be effective against the flu virus, while *wynruit* had some growth around the filter paper disc (weaker strength). The combination decoction showed to be more effective against the same virus. Both the mono- and combination decoctions did not show any effects on the renal system, nor on the livers of the rats used in research. It was therefore concluded that the crude decoctions, prepared as either mono-, or combination

therapy, were effective against common cold causing virus. These findings were congruent with what the community already knows.

- Interaction between the researcher and the community has to be as respectful as expected by the community. This is based on the code of conduct as well memorandum of understanding as well as memorandum of agreement.

- In order to learn from the community, it is important for researchers to be at an equal level with the community, by showing respect and to allow the community to teach them without interference.

- Outcome of holistic use of plant versus extraction of single active ingredient. It is important to note that the crude decoctions being prepared by the community could be tested in western laboratories and yield the results known by the community, without any side effects.

- Realisation between western and indigenous sciences showing similar results. The information from the literature, and the *in vitro* and *in vivo* test outcomes, showed that there were no significant variances between the community knowledge and western science findings. It is therefore important to realise that the community has its own science and processes that must be noted..

- The six decoctions being prepared from the two medicinal plants, *wildeals* and *wynruit*, as chosen by the community, could be used for the treatment of common colds (flu), as they had shown to be effective against this virus as per the community long time usage and trust. This knowledge being owned by the Griqua community was confirmed by the outcomes of the *in vitro* testing which showed that these decoctions were effective against the flu virus. Although *wynruit* had some growth around the filter disc, this could have been attributed to contamination of either the decoction, or of the filter paper disc. However, the community knows and trusts that it works and this knowledge could not be ruled out by this finding, except when further research would prove the contrary, and the community also advised on cold chain storage of *wynruit.*

- These decoctions could be used safely, as they did not show any significant effects on the kidneys and livers of the test rats. It can therefore be concluded that these decoctions are safe for in the rats and human consumption safety cannot be guaranteed. These decoctions were safe in rats and have been used in humans but *wynruit* has to be used with extra care due to its toxicity (Chapter 4).

- Indigenous medicinal plants, as measured and prepared by the community, showed no toxicity towards the test rats, since the whole crude decoctions were used. This means that if the measurements and preparations of the medicinal plant decoctions are done by a person with knowledge of the measurements and readiness for use, toxic effects on the renal system and liver could be eliminated.

- The effects of the decoctions on the kidneys and liver were, tested on rats, however the risks of side effects or toxicity on human beings can therefore not be ruled out completely, despite the *in vivo* testing on the *Spraque-Dawley* rats having shown no side effects.

6.9 Definition and contextualisation of science illuminated in this research

In an attempt to define what science is and what can be considered scientific, a rhetoric question always needs to be answered, i.e. *'Is science standard or universal?'* As viewed by Sillitoe (2009:1), there is relativity that is divided into a physical scientist's notion, as well as a social scientist's notion. The physical scientist notion is global relevance, while that of the social scientist is local relevance.

As defined by the Oxford advanced learner's dictionary (2009:1307), science is knowledge about the structure and behaviour of the natural and physical world, and is based on facts that you can prove, for example through experiments. Furthermore, science is a systematic study of the nature and behaviour of the material and physical universe, based on observation, experimenting, measurement and formulation of laws to describe these facts in general terms, as well as obtaining knowledge through practice (Collins English Dictionary, 2011:1468).

African indigenous science is a different kind of knowledge that can be valued for its own merits, and plays a vital role in science education, as well as to maintain a position of independence, because it can critique the practices of science. Even more, western scientists had occasionally taken note of the nature of indigenous knowledge and it was labelled as ethno-science (Cobern & Loving, 2001:50-67).These authors therefore distinguish science as being descriptive knowledge of nature, developed through experience with nature and is it objective and empirically testable. In agreement, Sillitoe (2009:3) views local knowledge and experience through interaction with nature as local indigenous science. The author indicates that while local scientific knowledge may not be systematically

recorded, like global science, nor feature such prescribed theories, it is nonetheless formalised to varying extensions in the cultural heritage and context.

Applied to this research, based on the above definitions, science is viewed as a natural process that is based upon observations of the behaviour, cultural heritage, experiments and the owning of independence. Furthermore, in this study, science is viewed as a harmony within the scientific community in which it is based, which either could be local or global and could stand the test of time. It is therefore important to realise and acknowledge that science is a science where it is practiced, accepted, proven and trusted by the people using it, in a given environment.

6.9.1 Relationship statements between African Indigenous Sciences (AIS) and Western Sciences (WS)

Relationships exist between the local and global scientific knowledge, as both these knowledge generating bodies co-exist. In order to show these relationships, Sillitoe (2009:3-5) highlights the following points:

- The foundation, the principle and the methods of both these sciences are identical. These bodies of knowledge are built upon the same foundations by means of the same instruments of thoughts. Therefore, both these sciences must be respected and be given the same status. As much as western science is accepted without reservation by the population, indigenous science is also well accepted amongst the indigenous people, without any reservation.

- It is the author's believe that both these sciences are directly comparable. This means that these two sciences could be compared and found appropriate for the community it is intended to serve.

- It is also implied by this author that local practices may validate narrowly defined western knowledge, as in testing and adopting, or rejecting external advice. Western science may corroborate local knowledge, as in some ethno-scientific research. This was also supported by the findings of this study, in that the local scientific knowledge of treating the common cold was tested, using the western science approach and there were no significant variances. It was found from the systematic review that the uses of both these medicinal plants were having some safety in the animals. The community where the study was conducted confirmed the usage and safety of these

medicinal plants. This community has been using these medicinal plants with no adverse effects reported.

- The learning process should be a two-way that facilitates both the adoption of scientifically informed ideas by local communities, and also that of informing the scientific understanding with local knowledge. From the findings of this research, it could be concluded that the local knowledge had informed the western science about the combination therapy of *wildeals* and *wynruit* being effective. From the findings of this research, it was also found that not all medicinal plants used by indigenous people affect the renal system negatively.

- This author alludes that examples have shown that sometimes, when western science gets it wrong, the local people often get it right. It is for this reason that the locally based knowledge has to be respected and that western researchers have to be at the same level with the local community, so as to learn from them.

- The author also warns about the western science's assumptions that may distort local understandings. It is for this reason that both local and western scientists have to work together, to learn from each other, in an attempt to avoid knowledge distortion.

- The use of a hybrid methodology during this study revealed that agreement between local and global sciences, where the one borrowed the knowledge from the other, can yield acceptable results for both sciences. The Western science borrowed the methods of preparation and measurement, used by the indigenous science, to yield the results.

- The Griqua community arrived at the same outcome as the researcher about the usage of the combination therapy for common cold as well as their experience about toxicity by using their own human indigenous scientific processes. Rated from the western sciences perspective, the community approach seen as qualitative is rated very low in the hierarchy, whereas the clinical experience done by researcher is rated very high in the hierarchy of approaches because it is clinical research. Contrary to these ratings, the outcome of these two approaches proved to be the same in this research, and therefore challenges the "belief" of classical western science rating.

Based on the relationship statements above, it is recommended that an effort be made to promote the AIS and WS to co-exist, since both sciences can learn from each other. This was proven by the hybrid interactive approach being followed during this study, which

revealed that the same results were achieved from the western science, as had already been known by the indigenous science people.

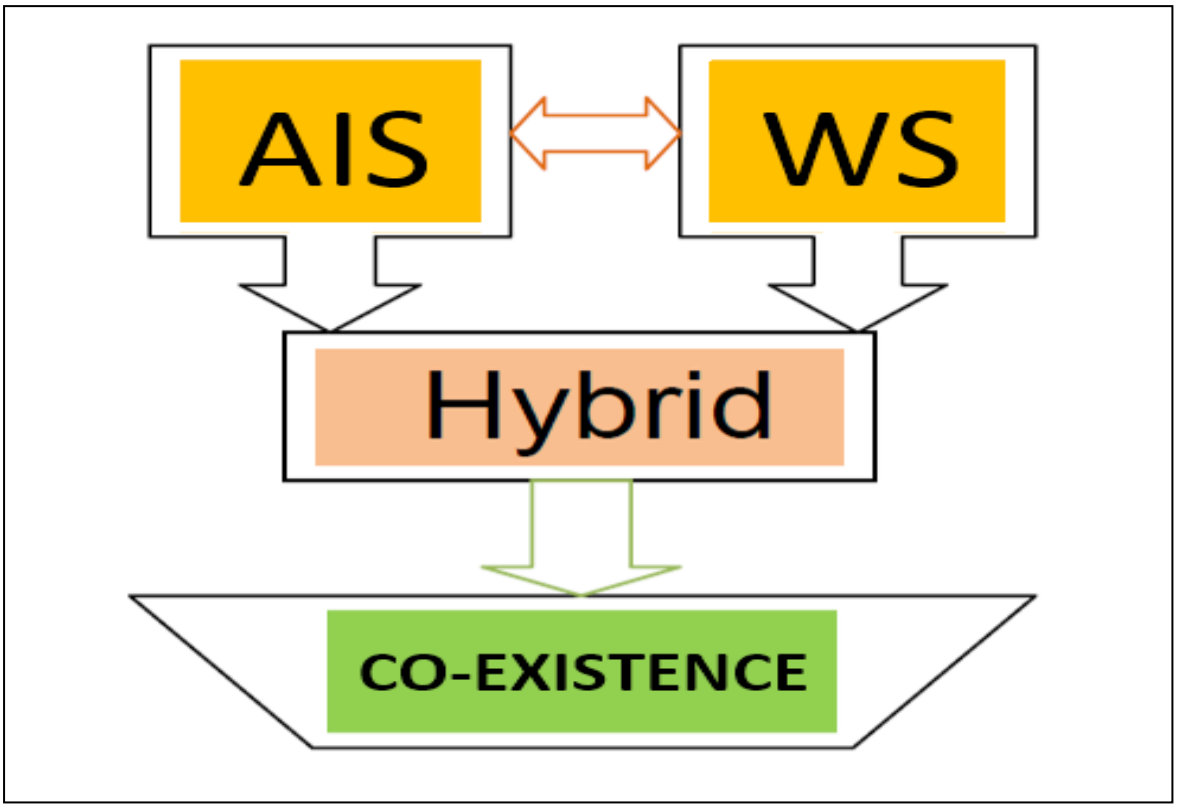

Figure 6.1 Representation of hybrid approach between African Indigenous Sciences and Western Sciences in promoting co-existence

The above figure 6.1 illustrates that either science can borrow knowledge from the other in order to create new knowledge. The borrowed knowledge can then be used in hybrid interaction (Pienaar, 2014:56-69; Sillitoe, 2009:10). This process will then enhance co-existence of the two sciences and appreciating the value added by the other.

6.10 Research recommendations

The following paragraphs discusses the recommendations made based on the outcomes from this research, with regards to community nursing practice, learning and teaching, as well as future research.

6.10.1 Recommendations regarding community nursing science

The following are recommendations with regards to community nursing are aimed at promoting co-existence between African and Western health practices, based on the findings of this research:

- As stated in chapter 1, the indigenous healing system has not been recognised like the western healing system. Therefore the Health Act (2003) call for recognition if previously disadvantaged healing approaches. Therefore this Act places a base for the integration of these two healing systems.
- Community health nurses must be aware that the community they work in has a wealth of essential knowledge that had sustained them (community) for a long time,
- The African indigenous health practice (AIHP) and Western health practice (WHP) can co-exists and both approaches should be used for the benefit of the community.
- African community nurses need to understand and be aware of the AIHPs and allow the community to make informed choices, without prejudice.
- The community must be consulted regarding issues affecting their health and not be told what to do, hence by forcing the western belief system about health would make them lose interest and trust in the health care practitioners being trained in western institutions. These practitioners can be viewed as being to westernised.
- As the community understands and uses both the approaches, it is important for the western trained health practitioners to understand the indigenous philosophy and approaches to health care.
- Community health nurses must have constant and frequent meetings with their community, to stay well informed about community expectations with regards to health as well as to be well informed about their values and systems.

- The community health nurses have to caution the community on the use of *wynruit* due to its anti-fertility and abortifacient properties (chapter 4, section 4.4.3.5 sub-sections c and d) as well as the likeliness to toxicity, as noted in the experiments.

- Nursing council to consider adding the indigenous health curriculum of the community and occupational health nursing sciences.

6.10.2 Recommendations regarding indigenous health

- Preparations of both the mono- and combination decoctions were found to be effective and is it recommended that this knowledge be advocated to the local people as scientific and that western science can learn from it.

- The measurements used by the community were unique and must be followed as demonstrated by the community. The use of local science by the community revealed the same findings (chapter 3).

- The use of *makgotla* as the method of inquiry had provided the necessary information in a relaxed environment. This method made the participants feel comfortable to discuss the issue at hand, as it was an open forum (Pienaar, 2004:4). The use of this approach is a non-threatening and free approach. The indigenous people are used to being in *makgotla* negotiations; therefore the *makgotla* conducted for this research were not new to them.

- The findings from both the *in vitro* and *in vivo* tests, although they are based on western science, were similar to the knowledge already known and held by the indigenous people.

- Safety in the usage of *wynruit* as an indigenous medicinal plant for common cold has to be taken into account as well as the storage of the *wynruit* decoction within a cold chain, as stated by the community.

- Based on the above statements, it is recommended that both indigenous health knowledge holders and western knowledge holders have to learn from each other, without undermining any science.

6.10.3 Recommendations regarding learning and teaching

The recommendations with regards to learning and teaching, based on the findings from this research are as follows:

- The initiation and approval of the African indigenous knowledge systems (AIKS), as part of the curriculum by the South African Nursing Council for student nurses doing the basic nursing course.

- Commencement of a post-graduate diploma course in AIKS be made compulsory for community health nursing, primary health care, as well as emergency and trauma nursing sciences.

- Planning of joint workshops, congresses, conferences and seminars between African indigenous knowledge holders and Western knowledge holders.

- Creation of a forum whereby AIS is revealed as science and must be given the same status as all other sciences.

6.10.4 Recommendations regarding future research

The findings from this research being conducted in the community on the anti-viral properties of decoctions, prepared from *wildeals* and *wynruit*, as either mono-, or combination therapy and their effects on the renal system, suggested the following recommendations.

- Equity between the community and researchers must be maintained at all times when researchers conduct research in the community, researchers must understand that they are learners who must allow the community to teach them.

- The community in which research is conducted must be respected and be treated as partners during the research study. It is important to understand the morals and values of the community in which the research is conducted.

- Respect for knowledge sharing by the community must be maintained at all times by making sure that all community based researched data is validated by the community it was collected from, and that acknowledgement for the community contribution is well stated.

- Legal and ethical rights of the community must be respected and be clearly communicated with the community. These rights include, amongst others, the respect of intellectual property (IP) rights, and the community's informed consent (universal consent), which can be provided by the chief or the gate keeper on behalf of the community. Furthermore, the researcher has to respect the participants by making sure that participation is voluntary and that no coercion was put on participants by the gate keeper/chief.

- Contract with the community must be signed by the researcher and the chief/gate keeper, for example, who must make sure that there is a memorandum of understanding with the community in relation to the control of the information supplied by the community.

- It is also recommended from this research that more research studies in the nursing profession should be conducted on AIKS, so as to make nurses aware of the knowledge base that is held by the community.

- Research to be conducted on storage (cold chain) of *wynruit* as it undergoes fermentation once prepared.

6.11 Final remarks

The final remarks of this research are based upon the proposed execution of the study, as discussed in chapter two. This research followed mixed method approach, consisting of a multiphase design, as described by Creswell and Plano Clark (2011:72-73). The final remarks for each phase are discussed hereunder.

6.11.1 Phase 1

This phase was completed by conducting *makgotla* within the Griqua and Lesotho communities. The community shared valuable information about how they had been using and trusting medicinal plants. This information, being local and being known by local people, and having stood the test of time, is also referred as local science, as described by Sillitoe (2009:1-18). This phase also revealed the heritage and wisdom that are located in the local science. The medicinal plants in the community are used as either mono-, or combination therapies to treat common colds.

The community also alluded to boiling the medicinal plants as the most common, but not the only way of preparing therapies from medicinal plants. The measurements used in the community are unique and individualised and also localised. The drinking of the decoctions was also the most common, but not the only method of administration used. The communities are well connected and trust mother earth for the supply to satisfy their needs.

6.11.2 Phase 2

This phase was completed by checking existing literature for available information about the two medicinal plants being investigated. The focus of the phase was on finding more information about the *wildeals* and *wynruit* plants. The data searching was guided by the use of the mnemonic, PIMOT, which stood for population, indications, methodology, outcomes and toxicity.

The literature also revealed that the common method of preparation was to boil the medicinal plants and to then drink the decoctions, which were referred to as teas, or infusions.

Information about both medicinal plants were searched for and they were found to be closely related and used for the treatment of common colds, as alluded by the community as well. These medicinal plants were also tested for treating other conditions and were they found to be effective. Less toxic effects were reported with regards to both medicinal plants.

The toxic effects of both medicinal plants had been observed in prior studies, during which tests were done on one of the extracts of the plant. Since the community uses the whole plant extract, any toxic effects are reduced, as cited by Mukinda (2005:16).

6.11.3 Phase 3

This phase was completed by testing the community prepared decoctions (both mono- and combination preparations) *in vitro* in a western laboratory. This phase tested the susceptibility of the flu virus to the mono- and combination *wildeals* and *wynruit* decoctions. Incubation lasted for about 18hours and the results were then determined by using the MIC scale as described in chapter 5.

It was found that the decoctions, prepared from *wildeals* as mono- and combination preparations, showed to be effective, according to the MIC results. However, the *wynruit* (weaker strength) decoction showed resistance by the virus, as there was growth around the

filter disc. This was attributed to possible contamination of the decoction during preparation, or during the plate's inoculation. The community attributed this finding to the cold chain breakage. The hypothesis was rejected as the decoctions had effects on the treatment of common cold.

6.11.4 Phase 4

This phase was accomplished by performing *in vivo* testing on the community prepared mono- and combination decoctions. These decoctions were administered to *Spraque-Dawley* rats twice a day. Urine samples were collected and analysed daily and at the end of the 6 days of testing, the rats were sacrificed, direct heart blood samples were taken for liver enzyme (specifically AST) determinations, including both kidneys and the liver of each rat. All of these specimens were sent to the laboratory for analysis and for establishment of possible effects of the administered decoctions on the kidneys and livers.

The hypothesis was accepted, as there were no effects on the kidneys and the livers of the rats after 6 days of testing. Although there were some inconsistencies about data, but it had no effect on findings. Each experimental group was compared with the control group, which also showed data inconsistencies. Although the rats were treated in a way that would keep their stress levels at the lowest possible, the inconsistency of data was attributed to a possible increase in stress levels.

6.12 Contribution of this research to the community

This research confirmed that the community's local science was comparable to the western global science. The knowledge that had been known by the community as local knowledge, compared well with the global knowledge. As viewed by Sillitoe (2009:4-6), experience tells us that more often the local people get it right, when western science sometimes gets it wrong. The author further states that local views, through sympathetic research, can enrich scientific understanding. This research had been enriched by the information offered by the community. Therefore, based on the findings of this research, the community could use their knowledge freely, as it was well supported by western scientific findings.

Based on the findings of this research, it is recommended that the community should apply for the intellectual property (IP) rights, as the creators of this knowledge that the mixture of *wildeals* and *wynruit* has positive effects on the treatment of common cold without any affecting the renal system adversely. Information on IP rights is given in chapter 3 (section

3.7.4). The community can use these findings as proof of the scientific evidence during the application of their IP rights.

6.13 Conclusion and final contributory statements

This chapter discussed and summarised the findings of this research. The contributory statements made here were based upon the findings of this research, as well as upon the physical interaction with the community. The recommendations following the findings of this research were made with regards to community nursing, learning and teaching, as well as future research.

It is hoped that the findings and recommendations from this research would contribute towards a more scientific approach when dealing with indigenous people. It is also hoped that the current cohort of community health practitioners would become aware of the knowledge held by the different communities they serve. The community's morals, values and their philosophies have to be respected all the time by anyone who enters the community.

The researchers have to respect the community by making sure that they have a memorandum of agreement with the community, especially in cases where sacred knowledge is expected to be shared. Lastly, it is hoped that more studies would be conducted by nurses with regards to level one clinical trial on issues affecting the AIKS and Western knowledge systems. It is also hoped that this research would contribute the initial step in promoting co-existence between the two main sciences in health practices, being African Indigenous Science (AIS) and Western Science (WS).

In conclusion, this baseline clinical research is the first to be undertaken by a nurse, as a contribution to the knowledge of nursing, indigenous health, as well as African and Western health research. This research had led to the development and understanding of the processes followed during the preparation of crude indigenous decoctions by the community.

Finally the ***core*** contribution of this research was confirmation by the indigenous community and validation to western researcher that ***the decoction*** prepared by the community as either ***mono-, or combination therapy*** for the treatment of common cold is ***effective*** and has ***no side effects*** on the renal system as found by this in-depth baseline clinical research.

This research have contributed to the community ,in that the knowledge that they own will be respected at all levels, notwithstanding the fact that findings of this research would be included in the IP of the Griqua community of the Northern Cape Province, South Africa.

> *"We are thankful for our mother, the earth, for she gives us all that we need for life. She sustains and supports us as our feet move upon her. We are joyful in knowing that she continues to care for us as she has from the beginning of time. To our mother, we send greetings and thanks. Now our minds are one".*
>
> Alfred, 2005

Bibliography

ACHARYA, T. (2013) Determination of minimum inhibitory concentrations. *Journal of Medical Microbiology*, 97(46) 1-19.

ACQUAVIVA, R.L., IAUK, V., SORRENTI, R., LANTERI, R., SANTANGELO, A. & LICATA, R. (2011) Oxidative profile in patients with colon cancer: effects of *Ruta chalepensis L*. *European Revision of Medical and Pharmaceutical Sciences*, 15:181-191.

AFRICAN COMMISSION ON HUMAN AND PEOPLE'S RIGHTS. (2006) Indigenous peoples in Africa: the forgotten peoples? *International Work Group for Indigenous Affairs*, 8-29.

AGEEL, A.M., MOSSA, J.S. AL-YAHYA, M.A., AL-SAID, M.S., & TARIQ, M. (1989) Experimental Studies on Antirheumatic Crude Drugs used in Saudi Traditional Medicine**.** *Drugs under experimental and clinical research [Journal].* Res. XV (8) 369-372

AL HEALI, F.M. & RAHEMO, Z. (2006) The combined effect of two aqueous extracts on the growth of *Trichomonas vaginalis*, *in vitro*. *Turkiye Parazitol Derg*, 30(4) 272-274.

ALSPACH, J.G. (2006) Core Curriculum for Critical Care Nursing (6th Ed). Missouri: Saunders Elsevier.

AMANZE, P.O. (2011) *African traditional medicine*. Bloomington: AuthorHouse.

ANDREWS, J.M. (2006). Determination of minimum inhibitory concentrations. *Journal of Antimicrobial Chemotherapy*, 48, Suppl. S1: 1-19.

ASGARPANAH, J. & KOSHKAM, R. (2012) Phytochemistry and pharmacological properties of *Ruta graveolens L*. *Journal of Medicinal Plants Research*, 6(22) 3942-3949.

AVULA, B., WANG, Y., SMILLIE, T.J., MABUSELA, W., VINCENT, L., WEITZ, F. & KHAN, I.A. (2009) Quantitative determination of flavonoids by column high-performance liquid chromatography with mass spectrometry and ultraviolet absorption detection in *Artemisia afra* and comparative studies with various species of *Artemisia* plants. *Journal of AOAC International*, 2(92) 633-644.

BADDOUR, L.M., YU, V.L., KLUGMAN, K.P., FELDMAN, C., ORTQVIST, A., RELLO, J., MORRIS, A.J., LUNA, C.M., SNYDMAN, D.R., KO, W.C., CHEDID, M.B.F., HUI, D.S., ANDREMONT, A., CHIOU, C.C.C. & INTERNATIONAL PNEUMONIA STUDY GROUP. (2004) Combination antibiotic therapy lowers mortality among severely Ill patients with *Pneumococcal bacteremia*. *American Journal of Respiratory and Critical Care Medicine*, 170:440-444.

BARIMA, K.B. & VAN TEIJLINGEN, E.R. (2008) The use of traditional medicine by Ghanaians in Canada. *BMC Complementary and Alternative Medicine*, 8:30.

BARRATT, J., HARRIS, K. & TOPHAM, P. (2009) Oxford desk reference: nephrology. Oxford Desk Reference Series.

BASSETT, C. (2004) *Qualitative research in health care*. Philadelphia: Whurr Publishers Ltd.

BERGNER, P. (2005) Antiviral botanicals in herbal medicine. *Medical Herbalism*, 14(3) 1-12.

BESTEN, M.P. (2011) *Envisioning ancestors: staging of the Khoi-San authenticity in South Africa*. Critical Arts Projects and Unisa Press, 175-191.

BLESS, C., HIGSON-SMITH, C. & KAGEE, A. (2006) Fundamentals of SOCIAL RESEARCH METHODS: An African Perspective (4th ed). Cape Town: Juta.

BOON, M. (1998) *The African way: the powers of interactive leadership*. Johannesburg: Zebra Press.

BOUNDLESS MICROBIOLOGY (2014). Minimal inhibitory concentration. [Online] www. *Boundless Microbiology*. Boundless [Accessed: 18 December 2014].

BROOME, B. & BROOME, R. (2007) Native Americans: traditional healing. *Journal of Urologic Nursing*, 27(2) 161-173.

BURNS, N. & GROVE, S.K. (2005) *The practice of nursing research*. 5th ed. St Louis: Elsevier Saunders.

BURNS, N. & GROVE, S.K. (2007) *Understanding nursing research*. Elsevier Saunders.

BURNS, N. & GROVE, S.K. (2009) *The practice of nursing research*. 6th ed. Appraisal, synthesis and generation of evidence. St Louis: Elsevier Saunders.

CARLBERG, C. (2013) *Statistical analysis; Microsoft Excel 2013, 2014*.: Pearson Education.

CARR, L., IACOBONI, M., DUBEAU, M.C., MAZZIOTTA, J.C. & LENZI, G.L. (2003) Neutral mechanisms of empathy in humans: a relay from neutral systems for imitation to limbic areas. *Procedure and National Academic Science USA*, 100:5497-5502.

CENTERS FOR DISEASE CONTROL AND PREVENTION. (2004) Department of Health and Human Services [Online] www.cdc.gov/flu [Accessed: 20 October 2012].

CENTRE FOR REVIEWS AND DISSEMINATION (CRD). (2008) *Systematic reviews: CRD's guidance for undertaking reviews in health care*. Layerthorpe: York Publishing.

CHINYAMA, R. (2009) Biological activities of medicinal plants traditionally used to treat septicaemia in the Eastern Cape, South Africa. M.Sc. thesis. Port Elizabeth: Nelson Mandela Metropolitan University.

CHIU, K.W. & FUNG, A.Y. (1997) The cardiovascular effects of green beans (*Phaseolus aureus)*, common rue (*Ruta graveolens*) and kelp (*Laminaria japonica*) in rats. *General Pharmacology*, 29:859-862.

CHOUDHURY, D. & AHMED, Z. (2006) Drug-associated renal dysfunction and injury. *Nature Clinical Practice Nephrology*, 2(2) 80-91.

COBERN, W.W. & LOVING, C.C. (2001) Defining "science" in a multicultural world: implications for science education. *Science and Education*, 85:50-67.

COCKS, M. & MOLLER, V. (2002) Use of indigenous and indigenised medicines to enhance personal well-being: a South African case study. *Social Science Medicine* 54(3)387-97

COLLINS CONCISE DICTIONARY. (2004) (21st Century Ed).

CRESWELL, J.W. & PLANO CLARK, V.L. (2011) *Designing and conducting mixed methods research* (2nd Ed). Thousand Oaks, CA: Sage.

CRESWELL, J.W. (2007) *Qualitative inquiry and research design: choosing among five traditions* (2nd Ed). Thousand Oaks, CA: Sage.

CRESWELL, J.W. (2009) *Research design: qualitative, quantitative and mixed methods approaches* (3rd Ed). London: Sage.

CONRAD, C. (2014) *Statistical Analysis, Microsoft Excel (69)* 2014. Pearson Education.

CRONIN, P., RYAN, F. & COUGHLAN, M. (2008) Undertaking a literature review: a step-by-step approach. *British Journal of Nursing*, 1(17) 38-43.

CROWTHER, M., LIM, W. & CROWTHER, M.A. (2010) Systematic review and meta-analysis methodology. *Blood*, 116(17) 3140-3146.

CUGNO, R.J. & THOMAS, K.A. (2009) A book review of Laura Ellingson's engaging crystallization in qualitative research: an introduction. *The Weekly Qualitative Report*, 2(19) 111-115.

DAUGIRDAS, J.T., BLAKE, P.G. & ING, T.S. (2001) *Handbook of dialysis*. Philadelphia: Lippincott.

DE FREITAS, T.G., AUGUSTO, P.M. & MONTANARI, T. (2004) Effect of *Ruta graveolens L*. on pregnant mice. *Contraception*, 71:74-77.

DE VOS, A.S., STRYDOM, H., FOUCHÉ, C.B. & DELPORT, C.S.L. (2008) *Research at grass roots: for the social sciences and human service professions*. Pretoria: Van Schaik.

DI CARLO, G., MASCOLO, N., IZZO, A.A., & CAPASSO, F. (1999) Flavonoids: Old and new aspects of a class of natural therapeutic drugs. *Life Sciences,* 4(65) 337-353.

DONGEN, A.J. (2001) Good clinical practice, a transparent way of life. A review. *Journal of Computerized Medical Imaging and Graphics*, 25 (2001) 213-216.

DUBE, A. (2006) The design, preparation and evaluation of *Artemisia afra* and placebos in tea bag dosage form suitable for use in clinical trials. M.Sc. dissertation. Bellville: University of the Western Cape.

DUBE, A., MANTHATA, L.N. & SYCE, J.A. (2007) The design and evaluation of placebo material for crude herbals: *Artemisia afra* herb as a model. *Phytotherapy Research*, 21:448-451.

DURIE, M.H. (2003) The health of indigenous peoples. *British Medical Journal*, 326(8) 510-511.

EZE, E.C. (2001) *African philosophy: an anthology*. Massachusetts: Blackwell Publishers.

FAISAL, M., AHMAD, N. & ANIS, M. (2005) *In vitro* regeneration and mass propagation of *Ruta graveolens L*.: a multipurpose shrub. *HortScience*, 40(5) 1478-1480.

FELHABER, T. (ed.) (2006) *South African traditional healers' primary health care handbook*. Pretoria: Kagiso Publishers.

FRASER, A. (2007) Interpretation of liver enzymes tests: A rapid guide- Continuing Medical Education. New Zealand Family Physician Journal, 34(3)194-196.

GADE, C. B. (2012) What is *Ubuntu*? Different interpretations among South Africans of African Descent. *South African Journal of Philosophy*, 31(3) 484-503.

GALLO, M. (2002) *Encyclopedia of public health: Food and Drug Administration: maximum tolerated dose toxicology*, Gale Cengage.

GANDHI, M., LAL, R., SANKARANARAYANA, A. & SHARMA, P.L. (1991) Post-coital antifertility action of *Ruta graveolens* in female rats and hamsters. *Journal of Ethnopharmacology*, 34(1991) 45-49.

3GEORGE, J.B. (2002) Nursing Theories**:** *The Base for Professional Nursing Practice.* Prentice Hall: New Jersey.

GRAVEN, E., WEBBER, L., VENTER, M. & GARDINER, J.B. (1990) The development of *Artemisia afra jacq*. as a new essential oil crop. *Journal of Essential Oil Research*, 2:215-220.

GREEF, A.P. & HOLTZKAMP, J. (2007) The prevalence of resilience in migrant families: *Family and Community Health*, 30(3) 189-200.

GREENSTEIN, B. & GOULD, D. (2009) *Trounce's clinical pharmacology for nurses*. Philadelphia: Churchhill Livingstone, Elsevier.

GUANTAI, A.N. & ADDAE-MENSAH, I. (1999) Cardiovascular effect of *Artemisia afra* and its constituents. *Pharmaceutical Biology*, 37:351-356.

GUIDELINES & PROTOCOLS (2011) Abnormal Liver Chemistry-Evaluation and Interpretation. http://www.bcquidelines.ca/alphabetical. [Accessed: August 2014] 1-5.

GUTIÉRREZ-PAJARES, J.L., ZÚÑIGA, L. & PINO, J. (2006) *Ruta graveolens* aqueous extract retards mouse preimplantation embryo development. *Reproductive Toxicology*, 17:667-672.

HEILMEYER, M. (2007) *Ancient herbs*. Lincoln: Francis Lincoln Publishers.

HEMINGWAY, P. & BRERETON, N. (2009) What is systematic review? *Evidence Based Medicine*, 2.

HENNING, E. (2007) *Finding your way in qualitative research*. Pretoria: Van Schaik.

HOFFMANN, T., BENNETT, S. & DEL MAR, C. (2010). *Evidence-based practice: across the health professions*. Sydney: Elsevier.

IVANOVA, A.B., MIKHOVA, H., NAJDENSKI, I., TSVETKOVA, I. & KOSTOVA, I. (2005) Antimicrobial and cytotoxic activity of *Ruta graveolens*. *Fitoterapia*, 76:344-347.

JENNET-SIEMS, K., KÖHLER, I., KRAFT, C., BEYER, G., MELZIG, M.F. & EICH, E. (2002) Cytotoxic constituents from *Exostema mexicanum* and *Artemisia afra*: two traditionally used plant remedies. *Pharmazie*, 57:351–352.

JOLLES, F. & JOLLES, S. (2000) Zulu ritual immunization in perspective in Africa. *Africa Journal,* 70 (2) 230.

KALYESUBULA, R. & PERAZELLA, M. A. (2010) Nephrotoxicity of HAART. AIDS Research and Treatment, *Review Article*. 2011: 1-11.

KANGWA, C. (2010) Traditional healing and Western medicine: segregation or integration? 1-16. Unpublished

KETTLES, A.M., CRESWELL, J.W. & ZHANG, W. (2011) Mixed methods research in mental health nursing. *Journal of Psychiatric and Mental Health Nursing*, 18:535-542.

KHAN, K.S., KUNZ, R., KLEIJNEN, J. & ANTES, G. (2003) Five steps to conducting a systematic review. *Journal of the Royal Society of Medicine*, 96(3) 118-121.

KHORI, V., NAYEBPOUR, M., SEMNANI, S., GOLALIPOUR, M.J. & MARJANI, A. (2008) A prolongation of AV nodal refractoriness by *Ruta graveolens* in isolated hearts: potential role as an anti-arrhythmic agent. *Saudi Medical Journal*, 29(3) 357-363.

KIRMAYER, L.J. (2004) The cultural diversity of healing: meaning, metaphor and mechanism. *British Medical Bulletin*, 69:33-48.

KIRMAYER, L.J. (2003) *Reflections on embodiment: social and cultural lives of immune systems*. New York: Routledge, 282-302.

KLINGNER, J.K. & BOARDMAN, A.G. (2011) Addressing the research gap in a special education environment through mixed methods: *Learning Disability Quarterly*, 34(3) 208-218.

KOK, A. (2013*)* Statement during "*Lekgotla"* gathering in Campbell, Griquastad. Unpublished

KÖHNE J.S & KREMER- KÖHNE S (1990) Results of a high density avocado planting. South African Avocado Growers' Association Yearbook 13; 57-62.

KRAFT, C., JENNET-SIEMS, K., JAKUPOVIC, J., MAVI, S., BIENZIL, U. & EICH, E. (2003) *In vitro* antiplasmodial evaluation of medicinal plants from Zimbabwe. *Phytotherapy Research*, 17:123-128.

KUBUKELI, P.S. (2000) Traditional healing practice using medicinal herbs: present and future. *The Lancet*, 354(4) siv24.

LACHENMEIER, D.W., EMMERT, J., KUBALLA, T. & SARTOR, G. (2006) Thujone-cause of absinthism? *Forensic Science International*, 158(1) 1-8.

LETSEKA, M. (2000) African philosophy and educational discourse. *Indilinga-African Journal of Indigenous Knowledge Systems*, 182-184.

LIAMPUTTONG, P. (2009) *Qualitative research methods*. Oxford: Oxford University Press.

LICHTMAN, M. (2013) *Qualitative research in education: a user's guide* (3rd Ed). Washington DC: Sage.

LIDDELL, C., LOUISE, B. & MOYA B. (2005) Indigenous representations of illness and AIDS in Sub-Saharan Africa. *Social Science & Medicine,* 60 (2005) 693-700.

LINCOLN, Y.S. & GUBA, E.A. (1995) *Naturalistic inquiry*. Beverly Hills, CA: Sage.

LIU, N.Q., CAO, M., FRÉDÉRICH, M., CHOI, Y.H., VERPOORTE, R. & VAN DER KOOY, F. (2010). Metabolomic investigation of the ethnopharmacological use of *Artemisia afra* with NMR spectroscopy and multivariate data analysis. *Journal of Ethnopharmacology*, 128:230-235.

LIU, N.Q., VAN DER KOOY, F. & VERPOORTE, R. (2008) *Artemisia afra*: a potential flagship for African medicinal plants? *South African Journal of Botany*, 75:185-195.

MANDER, M., DIEDERICHS, N., NTULI, L. & MAVUNDLA, K. (2007) Economics of the traditional Medicine Trade in South Africa. *South African Health Review,* 189-196.

MAPARA, J. (2009) Indigenous knowledge systems in Zimbabwe: juxtaposing postcolonial theory. *The Journal of Pan African Studies*, 3(1) 139-155.

MAREE, K. (2009) First Steps in Research. Pretoria: Van Schaik.

MARIEB, E.N. & HOWHN, K. (2010) *Human anatomy and physiology*. 8th ed. Cape Town: Benjamin Cummings.

MASIKA, P.J., VAN AVERBEKE, W. & SONANDI, A. (2000) Use of herbal remedies by small scale farmers to treat livestock diseases in central Eastern Cape Province, South Africa. *Journal of the South African Veterinary Association*, 71(2) 87-91.

MASOLO, D.A. (2005) *African philosophy in search of identity*. Nairobi: East African Educational Publishers.

MATIVANDLELA, S.P.N., MEYER, J.J.M., HUSSEIN, A.A., HOUGHTON, P.J., HAMILTON, C.J. & LALL, N. (2008). Activity against *Mycobacterium smegmatis* and *Mycobacterium tuberculosis* by extract of South African medicinal plants. *Phytotherapy Research*, 22(6) 841-845.

MAWERE, M. (2010) Indigenous knowledge systems (IKSs) potential for establishing a moral, virtuous society: lessons from selected IKSs in Zimbabwe and Mozambique. *Journal of Sustainable Development in Africa*, 7(12) 209-221.

MBEKI, T. (1999) AFRICA, The Time Has Come. *Selected speeches*. Tafelberg: Mafube.

McDAID, C., TROWMAN, R., GOLDER, S., HAWTON, K. & SOWDEN, A. (2008) *Report on systematic review of the effects of interventions for people bereaved by suicide*. Centre for Reviews and Dissemination. New York: University Press.

McGAW, L.J., JÄGER, A.K. & VAN STADEN, J. (2000) Antibacterial, anthelmintic and anti-amoebic activity in South African medicinal plants. *Journal of Ethnopharmacology*, 72:247-263.

McKEAN, S. (2007) Traditional medicine demand threatens vultures in Southern Africa: *Endangered Wildlife Trust*. *Media Release*, 27 July 2007.

MEEPAGALA, K.M., SCHRADER, K.K., WEDGE, D.E. & DUKE. S. (2005) Algicidal and antifungal compounds from the roots of *Ruta graveolens* and synthesis of their analogs. *Phytochemistry*, 66:2689-2695.

MIGUEL, E.S. (2003) Rue (*Ruta L., Rutaceae*) in traditional Spain: frequency and distribution of its medicinal and symbolic applications. *Economic Botany*, 57:231-144.

MINKER, E., BARTHA, C., KOLTAI, M., RÓZSA, Z., SZENDREI, K. & REISCH, J. (1980) Effect of secondary substances isolated from the *Ruta graveolens L*. on the coronary smooth muscle. *Acta Pharmaceutica Hungarica*, 50(1) 7-11.

MOHER, D., LIBERATI, A., TETZLAFF, J. & ALTMAN, D.G. (2009) The PRISMA Group. Preferred reporting items for systematic reviews and meta-analysis: The PRISMA statement. *PloS Medicine*, 6(6) e1000097.

MOUTON, P.G. & FONTAINE, D.K. (2009) Critical Care Nursing: *A Holistic Approach.* London: Lippincott Williams and Wilkins.

MOUTON, J. (2008) Understanding social research. Pretoria: Van Schaiks.

MPHUTHI, D.D. (2010) Coping behaviors of haemodialysed patients' families in private clinics in Gauteng. M.Cur. dissertation. Potchefstroom: North-West University.

MUKINDA, J.T. (2005) Acute and chronic toxicity of the flavonoid-containing plant, *Artemisia afra* in rodents. M.Sc. thesis. Bellville: University of the Western Cape.

MUKINDA, J.T. & SYCE, J.A. (2007) Acute and chronic toxicity of the aqueous extract of *Artemisia afra* in rodents. *Journal of Ethnopharmacology*, 112:138-144.

MUKINDA, J.T., SYCE, J.A., FISHER, D. & MEYER, M. (2010) Effect of the plant matrix on the uptake of luteolin derivatives-containing *Artemisia afra* aqueous-extract in caco-2 cells. *Journal of Ethnopharmacology*, 130:439-449.

MULATU, A. & MEKONNEN, Y. (2007) Spasmolytic effects of *Artemisia afra* and *Artemisia rehan* in tissue preparations. *Ethiopian Medical Journal*, 54(4) 371-376.

MULHOLLAND, D.A. & DREWES, S.E. (2004) Global phytochemistry: indigenous medicinal chemistry on track in Southern Africa. *Phytochemistry*, 65(7) 769-782.

MUROTA, K., SHIMIZU, S., MIYAMOTO, S., IZUMI, T., OBATA, A., KIKUCHI, M. & TERAO, J. (2002) Unique uptake and transport of isoflavoneaglycones by human intestinal caco-2 cell: comparison of isoflavonoids and flavonoids. *Journal of Nutrition*, 132:1956-1961.

NAICKER, S., ABOUD, O. & GHARBI, M.B. (2008) Epidemiology of acute kidney injury in Africa. *Nephrology*, 28:348-353.

NAIDOO, V., McGAW, L.J., BISSCHOP, S.P.R., DUNCAN, N. & ELOFF, J.N. (2008) The value of plant extracts with antioxidant activity in attenuating coccidiosis in broiler chickens. *Veterinary Parasitology*, 153:214-219.

NAUGHTON, C.A. (2008) Drug-induced nephrotoxicity. *American Academy of Family Physicians*, 78(6) 743-749.

NIELSEN, N.D., SANDAGER, M., STAFFORD, G.I., VAN STADEN, J. & JÄGER, A.K. (2004) Screening of indigenous plants from South Africa for affinity to the serotonin re-uptake transport protein. *Journal of Ethnopharmacology*, 94:159-163.

NORMANN, H., SNYMAN, I. & COHEN, M. (Eds.) (1996) *Indigenous knowledge and its uses in Southern Africa*. Pretoria: HSRC Publishers.

NTULELA, S., SMITH, P., MATIKA, L., MUKINDA, J., ARENDSE, H., ALLIE, N., MARK ESTES, D., MABUSELA, W., FOLB, P., JOHNSON, Q., FOLK, W.R., SYCE, J. & JACOBS, M. (2009) Efficacy of *Artemisia afra* phytotherapy in experimental tuberculosis. *Tuberculosis*, 89(1) s33-s40.

O'MATHÚNA, D.P. (2010) Tips and tricks: critical appraisal of systematic reviews: *International Journal of Nursing Practice*, 16:414-418.

OHENJO, N., WILLIS, R., JACKSON, D., NETTLETON, C., GOOD, K. & MUGARURA, B. (2006) Health of indigenous people in Africa: indigenous health 3. *The Lancet*, 367(10) 1937-1946.

OKOLI, C. & SCHABRAM, K. (2010) A guide to conducting a systematic literature review of information systems research: sprouts. *Working Papers on Information Systems*, 10(26) 1-10.

OYEDEJI, A.O., AFOLAYAN, A.J. & HUTCHINGS, A. (2009) Compositional variation of the essential oils of *Artemisia afra jacq*. From three provinces in South Africa: a case study of its safety. *Nat Prod Commun*, 4(6) 849-852.

PASCOE, D. (1983). Toxicology. England, London, Edward Arnold limited.1-60.

PATHAK, S., MULTANI, A.S., BANERJI, P. & BANERJI, P. (2003) Ruta 6 selectively induces cell death in brain cancer cells but proliferation in normal peripheral blood lymphocytes: a novel treatment for human brain cancer. *International Journal of Oncology*, 23:975-982.

PATTON (2002) (*In:* De Vos *et al*., 2008). *Research at grass roots: for the social sciences and human service professions*. Pretoria: Van Schaik.

PIENAAR, A. (2012) Kruidjie roer my. Cape Town: Umuzi.

PIENAAR, A.J. & MANAKA-MKWANAZI, I. (2004) (*In*: Uys, & Middleton,). *Mental health nursing: a South African perspective*. 4th ed. Cape Town: Juta.

PIENAAR, A.J. (2004) The development of an HIV/AIDS counselling approach for Africans. Ph.D. thesis. Durban: University of KwaZulu-Natal.

PIENAAR, A.J. (2014) African Indigenous Methodology in Qualitative Research: The Lekgotla, *A holistic approach of data collection and analysis intertwined*. 1-19: Unpublished.

PIENAAR, A.J. (2013) Mental health care in Africa: A practical, evidence-based approach. Pretoria: Van Schaik.

POLIT, D.F., BECK, C.T. & HUNGLER, B.P. (2001) *Essentials of nursing research methods: appraisal and utilization*. 5th ed. Philadelphia: Lippincott.

PREETHI, K.C., KUTTAN, G. & KUTTAN, R. (2006) Anti-tumour activity of *Ruta graveolens* extract. *Asian Pacific Journal of Cancer Prevention*, 7:439-443.

RAGHAV, S.K., GUPTA, B., AGRAWAL, C., GOSWAMI, K. & DAS, H.R. (2006) Anti-inflammatory effect of *Ruta graveolens L*. in murine macrophage cells. *Journal of Ethnography*, 104:234-239.

RAHIM, F., SAKI, G. & BAZRAFKAN, M. (2010) Effects of alcohol extracts of the *Ruta graveolens L*. on the count, mortality and *in vitro* fertilization capacity of rats' sperm. *Asian Journal of Plants Sciences*, 9(1) 63-66.

RAMADORI, G., MORICONI, F., MALIK, I. & DUDAS, J. (2008) Physiology and pathophysiology of liver inflammation, damage and repair. *Journal of Physiology and Pharmacology*, 59(1) 107-117.

RAMOSE, M. B. (2005) African philosophy through *Ubuntu.* Harare: Mond Books Publishers.

RANG, P., DALE, M.M. & RITTER, J.M. (2002) *Pharmacology*. 4th ed. London: Churchill Livingstone.

RATHEESH, M., SHYNI, G. L., SINDHU, G. & HELEN, A. (2010) Protective effects of isolated polyphenolic and alkaloid fractions of Ruta graveolens L. on acute and chronic models of inflammation. *Inflammation* 33 (1) 18-24

REEVES, S., KUPER, A. & HODGES, B.D. (2008) Qualitative research methodologies: ethnography. *British Medical Journal*, 337:511-512.

REPUBLIC OF SOUTH AFRICA. (1962) Animal Protection Act 71 (Act 71 of 1962). Pretoria: Government Printers.

REPUBLIC OF SOUTH AFRICA. (2008) Intellectual Property Rights from Publicly Financed Research and Development Act 51 (Act 51 of 2008). Pretoria: Government Printers.

REPUBLIC OF SOUTH AFRICA. (2003) National Health Act 61 (Act 61 of 2003). Pretoria: Government Printers.

REPUBLIC OF SOUTH AFRICA. (2005) South African Nursing Council Act 33 (Act 330f 2005). Pretoria: Government Printers.

REPUBLIC OF SOUTH AFRICA. (2007) Traditional Health Practitioners Act 22 (Act 22 of 2007). Pretoria: Government Printers.

REPUBLIC OF SOUTH AFRICA. (1970) Witchcraft Suppression Act 50 (Act 50 of 1970). Pretoria: Government Printers.

RETHY, B., ZUPCO, I., MINORICS, R., HOHMANN, J., OCSOVSZKI, I. & FALKAY, G. (2011) Investigation of cytotoxic activity on human cancer cell lines of arborinine and furanoacridones isolated from *Ruta graveolens*. *Planta Med*, 73(1) 41-48.

RICHTER, M. (2003) Traditional medicines and traditional healers in South Africa: *paper discussion for treatment action campaign and AIDS law project*. [Online] http://www.tac.org.za/Documents/ResearchPapers/ Traditional_Medicine_briefing.pdf [Accessed: October 2012], 4-28.

ROBERTS, M. (1990) *Indigenous healing plants*. Halfway House, Johannesburg: Southern Book Publishers.

ROEDERER, C. & MOELLENDORF, D. (2004). Jurisprudence. Lansdowne: Juta.

RUSSELL BERNARD, H. (2011) *Research methods in anthropology: qualitative and quantitative approaches*. 5th ed. Toronto: Altamira Press.

SAEED, P., MOHAMMAD, R.R., ABBAS, D., SEYED, V.R. & ALI, A.H. (2009) Inhibitory effect of *Ruta graveolens L*. extract on guinea pig liver and bovine milk xanthine oxidase. *Iranian Journal of Pharmaceutical Sciences, Summer*, 5(3) 163-170.

SALAH, S.M. & JÄGER, A.K. (2005) Screening of traditionally used Lebanese herbs for neurological activities. *Journal of Ethnopharmacology*, 97:145-149.

SINGH, N.P. & PRAKASH, A. (2008) Herbal Drugs and Acute Renal Injury. *Medicine Update*, 18:150-155.

SOUTH AFRICAN TRADITIONAL MEDICINES RESEARCH GROUP (SATMERG),. (2006) *Artemisia afra herba*. [Online] http://www.sahealthinfo.org/traditionalmeds/mongraphs/artemisia.htm. [Accessed: August 2012].

SAXENA, A.K. & PANBOTRA, B.R. (2003) Herbal remedies: renal tragedies. *Swiss Medical Weekly*, 133:188-189.

SAYYAH, M., NADJAFNIA, L. & KAMALINEJAD, M. (2004) Anti-convulsant activity and chemical composition of *Artemisia dracunculus L.* essential oil. *Journal of Ethnopharmacology*, 94:283-287.

SCHAPERA, I. (1953) (*In*: Pienaar, 2004). The development of an HIV/AIDS counselling approach for Africans. Ph.D. thesis. Durban: University of Kwazulu-Natal.

SCHAPERA, I. (1957) The sources of law in Tswana tribal courts: legislation and precedent. *Journal of African Law*, 1(3) 150-162.

SEAK, C. J. & LIN, C.C. (2007) Ruta Graveolens intoxication. *Clinical Toxicology (Phila)* 45(2)173-175

SEBOKA RESEARCH TEAM DOCUMENT (2010), The Integration of African Indigenous Health Knowledge in the Nursing Curriculum in Africa. South Africa. 1-45: Unpublished.

SEMALI, L.M. & KINCHELOE, J.L. (Eds.) (1999) *What is Indigenous knowledge and why should we study it*? 20-21.

SETH, R.B., SUN, L. & CHEN, Z.J. (2006) Antiviral innate immunity pathways. *Cell Research*, 16:141-147.

SHRESTRA, N. (2002) *Becoming a development category in Schech S: development: a cultural studies reader*. Oxford: Blackwell Publishing.

SILLITOE, P. (2009) LOCAL SCIENCE VS GLOBAL SCIENCE: Approaches to Indigenous Knowledge in International Development: Bergham Books.

SMELTZER, S.C. & BARE, B.G. (2000) *Textbook of medical-surgical nursing*. 9th ed. Philadelphia: Lippincott.

Spector R. (1991) *Cultural Diversity in Health and Illness.* Prentice Hall, Norwalk, Connecticut.

STAFFORD, G.I., JÄGER, A.K. & VAN STADEN, J. (2005) Activity of traditional South African sedative and potentially CNS-acting plants in the GABA-benzodiazepine receptor assay. *Journal of Ethnopharmacology*, 100:210-215.

STAHLER, G.J. & COHEN, E. (2000) Using ethnographic methodology in substance abuse treatment outcome research. *Journal of Substance Abuse Treatment*, 1-8.

STEINGLASS, M. (2003) It takes a village healer-anthropologist to believe traditional medicines can remedy Africa's AIDS crisis: are they right? *Lincua Franca*, 32.

STEWART, S., RIECKEN, T., SCOTT, T., TANAKA, M. & RIECKEN, J. (2008) Expanding health literacy: indigenous youth creating videos. *Journal of Health Psychology*, 13(2) 181-189.

STILLWELL, S.B., FINEOUT-OVERHOLT, E., MELNYK, B.M. & WILLIAMSON, K.M. (2010) Asking the clinical question: a key step in evidence-based practice. *American Journal of Nursing*, 110(3) 58-61.

STREET, T., SCHMIDT, S.T. & STAROS, E.B. (2014) *Antimicrobial susceptibility: medical microbiology and immunology*. New York: McGraw-Hill.

STRUTHERS, R., ESCHITI, V.S. & PATCHELL, B. (2004) Traditional indigenous healing: part I. *Complementary Therapies in Nursing and Midwifery*, 10:141-149.

SULIMAN, S., VAN VUUREN, S.F. & VILJOEN, A.M. (2010) Validating the *in vitro* antimicrobial activity of *Artemisia afra* in a polyherbal combination to treat respiratory infections. *South African Journal of Botany*, 76:655-661.

SUNMONU, T.O & AFOLAYAN, A.J. (2013) Evaluation of antidiabetic activity and associated toxicity of *Artemisia afra* aqueous extract in Wistar rats. *Evidence-Based Complimentary and Alternative Medicine*, 1-8.

TAKESHITA, C. (2001) Bio-prospecting and its discontents: indigenous resistances as legitimate politics. *Alternatives: Global, Local, Political*, 26:8.

TALBOT, A.L. (1995) *Principles and practice of nursing research*. Singapore: Mosby.

TERRE BLANCHE, M., DURRHEIM, K. & PAINTER, D. (2007) *Research in practice: applied methods for the social sciences*, Cape Town: UCT Press.

TERRILL, B. (2002) Renal Nursing. A Guide to Practice. Michigan: Radcliffe Medical Press.

THOMAS, N. (2008) *Renal nursing*. Toronto: Elsevier.

THRING, T.S.A. & WEITZ, F.M. (2006) Medicinal plant use in the Bredasdorp/Elim region of the Southern Overberg in the Western Cape Province of South Africa. *Journal of Ethnopharmacology*, 103:261-275.

TIMBRELL, J. (2002). *Introduction to toxicology* (3rd Ed). Taylor and Francis: London.

TIMMERMANS, K. (2003) Intellectual property rights and traditional medicine: policy dilemmas at the interface. *Social Science and Medicine*, 57:745-756.

TRACY, S.J. (2010) Qualitative quality: eight “big-tent” criteria for excellent qualitative research. *Qualitative Inquiry*, 16(10) 837-851.

VAN WYK, B.E., VAN OUDTSHOORN, B. & GERICKE, N. (1997) *Medicinal plants of South Africa*. Pretoria: Briza Publications

VAN WYK, B.E. (2008) A broad review of commercially important Southern African medicinal plants. *Journal of Ethnopharmacology*, 119:342-355.

VAN WYK, B.E., VAN OUDTSHOORN, B. & GERICKE, N. (2009) *Medicinal plants of Southern Africa*. Pretoria: Briza Publications. Southern and Eastern Africa. Livingstone: Edinburgh

VAN WYK, B.E. & GERICKE, N. (2000) *People's plants: a guide to useful plants of Southern Africa*. Pretoria: Briza Publications.

VIJAYANANTHAN, A. & NAWAWI, O. (2008) The importance of Good Clinical Practice guidelines and its role in clinical trials*. Biomedical Imaging and Intervention Journal,* 4(1)1-4.

WATT, J. M. & BREYER-BRANDWIJK, M.G. (1962) The medicinal and poisonous plants of Southern and Eastern Africa (2nd Ed). Livingstone: London.

WEDEL, J. (2009) Bridging the gap between Western and indigenous medicine in Eastern Nicaragua. *Anthropological Notebooks*, 15(1) 49-64.

WELMAN, C., KRUGER, F. & MITCHELL, B. (2011) *Research methodology* (3rd Ed). Cape Town: Oxford University Press.

WILLCOX, M. (2009) Artemisia species: from traditional medicines to modern antimalarials and back again. *Journal of Alternative Medicine*, 15(2) 101-109.

WILLEY, J.M., SHERWOOD, L.M. & WOOLVERTON, C.J. (2011) *Prescott's microbiology*. 8th ed. Singapore: McGraw-Hill international.

WILLIAMS, E., GUENTHER, J. & ARNOTT, A. (2011) Traditional healing: a review of literature: working paper series 2: evaluation and policy. (2011) 2:1-32.

WOOD, M.J. & ROSS-KERR, J.C. (2006) *Basic steps in planning nursing research: from question to proposal*. 6th ed. Toronto: Jones and Battlett.

WORLD HEALTH ORGANISATION (WHO). (2002-2005) Traditional medicine strategy. Document WHO/EDM/TRM/2002.1. Geneva.

World Health Organization (WHO). (2003) Intellectual property rights, innovation and public health. World health assembly document WHA 56.27. [Online] http://www.who.int [Accessed: March 2013].

Annexure A

Copy of Ethical Clearance Certificate

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To whom it may concern

19 July 2013

Dear Prof. Pienaar

Ethics Application: NWU-00052-13-S1

"Anti-viral properties of wildeals (Artemisia Afra) and wynruit (Ruta Graveolens) as combination therapy and its effects on the renal system"

All ethical concerns have been addressed and ethical approval is granted.

Yours sincerely

Prof. Minnie Greeff
Ethis Sub-committe Vice Chairperson

Original details: Prof. Minnie Greeff(10187308) C:\Users\13210572\Documents\ETIEK\2013 ETHICS\NWU-00052-13-S1 .docm
19 July 2013

File reference: NWU-00052-13-S1

Annexure B

Participant Information Letter

Name of principal investigator: Ditaba David Mphuthi

Name of organisation: North-West University

Name of sponsor: Seboka Project (DST/NRF & UNISA)

This informed consent form has two parts:

Part 1: Information sheet to share information about the research with you.

Part 2: Certificate of consent for signatures if you agree to take part.

PART I: Information Sheet

Introduction

I am Ditaba David Mphuthi, a PhD student at the North-West University. I am doing research on *wildeals* and *wynruit,* which are very commonly used in this community. I am going to give you information and invite you to be part of this research. You do not have to decide today, whether or not you will participate in the research. Before you decide, you can talk to anyone you feel comfortable with, about the planned research.

There may be some words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain. If you have questions later, you can ask me, the study group, or the chief.

TOPIC: The anti-viral properties of *wildeals* (*Artemisia Afra*) and *wynruit* (*Ruta graveolens*) as combination therapy and the effects on the renal system

Purpose of the research

Wildeals and *wynruit* are the two medicinal plants that are commonly used to treat common colds, either separately, or in combination. Despite the common usage of the *wildeals* and *wynruit* mixture, the anti-viral medicinal properties of this mixture to treat common colds with,

have not yet been tested. The effects that the decoctions, prepared from these plants, may have on the kidneys, separately, or in combination, have also not been established.

Type of research intervention

This research will involve a meeting, to which we are all invited. After the meeting, as a follow up, the researcher and the assistant will come and visit you in your houses, just to check how you as the community prepare and give the mixture to the sick.

Participant selection

I invite all adults, who prepare and administer *wildeals* and *wynruit*, to participate in this research.

***Question**: Can anyone of you tell me what this research is about?*

Voluntary participation

Your participation in this research is entirely voluntary. It is your choice whether you wish to participate, or not. Even if you choose to participate, you can always change your mind later, at any stage during the study. As a result, please feel free to make your choice. If you choose not to participate in this research project, you will still benefit from the information that will be generated from the research.

***Question**: If you decide not to take part in this research study, do you know what your options are? Do you have any questions?*

Description of the process

You will be called to the meeting by the chief, who will share the information with you. The meeting will be led by the chief. The researcher will be present, but he will not participate much in the meeting. This is to make sure that the chief is aware of what is being discussed. You will then be asked permission to allow the researcher, and/or his assistant into your homes for observations on how to prepare the decoctions.

Duration

The research will take place over at least one, to two weeks. During this time, it will be appreciated if you can make the researcher aware when you will be preparing *wildeals* or *wynruit*, whether in a single dose, or a combination.

Risks

There are no risks associated with participating in this research.

Benefits

Participation in this research will benefit the community, because the information that will be shared with the researcher will help him to make future plans about the use of these medicinal plants.

Confidentiality

We will not be sharing the identity of those people participating in the research. The information that we will collect from this research project will be kept confidential. Your name and house number will not be mentioned in any of the information that you will share, but we will use numbers instead. Only the researchers will know what your number is and will we lock that information up in a safe/an office. No information will be shared with, or given to anyone, except to the Seboka project personnel, who will have access to the information, because they are funding this project.

Sharing the results

The knowledge that we obtain from doing this research will be shared with you first through community meetings, before it is made available to the public. Confidential information will, however, not be shared. We will have small meetings in the community, and will these be announced beforehand. After these meetings, we will publish the results, so that other interested people may learn from our research.

Right to refuse or withdraw

You do not have to take part in this research, if you do not wish to do so. You may also stop participating in the research at any time you choose. It is your choice and all of your rights will be respected.

Who to contact

If you have any questions, you may ask them now, or later, even after the study has started. If you wish to ask questions later, you may contact me at any of the following:

Researcher: David Mphuthi

Cell number: 071 758 1222

Email address: davidmphuthi36@gmail.com

This proposal has been reviewed and approved by _____, who is a member of the Seboka committee, whose task it is to ensure that research participants are protected from any possible harm.

PART II: Certificate of Informed Consent

I read the foregoing information, or it was read to me. I had the opportunity to ask questions about it and any questions that I had were answered to my satisfaction. I consent voluntarily to participate as a participant in this research.

Print name of participant: _____

Signature of participant: _____ Date: _____

NOTE: In case the participant cannot read and write, a literate witness/guardian/chief should sign on behalf of the participant.

I witnessed the accurate reading of the consent form to the potential participant and the individual had the opportunity to ask questions. I confirm that the individual has given consent freely.

Print name of witness: _____ **AND** thumb print of participant

Signature of witness: _____Date: _____

Statement by the researcher/person taking the consent

I accurately read and explained the information sheet to the potential participant and ensured, to the best of my ability, that the participant understood that the following would be done:

Meetings with the chief in the presence of the researcher.

The researcher/researcher's assistant would visit the participant's home to observe how the wildeals / wynruit decoctions are prepared.

The researcher/assistant would not interfere with the normal house routine, including the preparation and administration of the natural decoctions, prepared from the medicinal plants.

I confirm that the participant was given the opportunity to ask questions about the study and that all of the questions asked by the participant were answered honestly and to the best of my ability. I confirm that the individual had not been coerced into giving consent and was the consent given freely and voluntarily.

A copy of this Informed Consent Form has been provided to the participant.

Print name of researcher/person taking the consent: _____

Signature of researcher /person taking the consent: _____

Date: _____

Annexure C

Guideline for use during *Makgotla* Discussions

Introduction

Introductions and welcomes.

Introduce the purpose of the gathering to the participants.

Inform the participants about the use of video and audiotape recorders and that no names would be used in the transcribed text and ask for permission for these.

Clarify the role of the researcher (observation).

Start of the session

Reaffirm the use of audio and visual tapes.

Introduce the topic for discussion as: *The preparation and use of wildeals and wynruit by the community.*

Main question

What is the importance of herbs to the community?

Follow up questions: These will be asked if not mentioned by the participants.

What types of herbs are important to the community and why?

Which diseases can be treated with the available herbs?

How are these herbs prepared?

How do you prepare wildeals and wynruit together?

What measurements do you use to measure how much should be given to the patient?

Closing the session

***Question**:* Is there anything else anyone would like to share that you think we did not discuss or ask?

Annexure D

Transcriptions of the *Lekgotla* held in 'Melesi, Lesotho between the Seboka Team and the Indigenous Healers, Facilitated by the Chief Indigenous Healer

Context: 'Melesi is one of the villages found in the rural parts of the capital of Lesotho which is Maseru. This village has a controlled mechanism of controlling the indigenous healers in their area. The village is well known for the best practices of indigenous healing practices. This village has the chief indigenous healer who controls the practices of the other healers.The planned *lekgotla* was negotiated in terms of standard indigenous protocol, whereby the researchers discussed the desired meeting with the different chiefs, by informing them of the intent and nature of the research and of the requested *lekgotla*. The chiefs then called upon the head of the traditional (indigenous) healers in Lesotho, who in turn called together all of the indigenous healers in and around 'Mmelesi and Maseru for the intended *lekgotla.*

During the negotiations, the researcher discussed the aims of the *lekgotla*, i.e. to obtain answers to the following two questions:

How important are medicinal herbs to this community and what are they used for?

How do you prepare these medicinal herbs and which ones do you use frequently?

The *lekgotla* being held with the invited indigenous healers was facilitated by the chief healer. The researcher and the chief indigenous healer had a meeting prior to the general meeting. The main focus was to remind the chief healer about what would be discussed. Both parties came to an agreement that the information was the same as what had been planned.

The researcher and the Seboka team members present introduced themselves to the invited community of healers. The chief indigenous healer facilitated the *lekgotla.* The chief healer made some introductory remarks and thanked the Seboka team for the invitation. There were plus minus 66 community members in the *lekgotla*, including the Seboka team members.

Abbreviations used: Chief indigenous healer **(CIH)**, healers **(H)**, researcher **(R)**.

Questions and Quotes	Concepts	Categories	Themes
CIH: I was given two questions to discuss with you. These questions directly relate to the plants that you use: *Bohlokoa ba meriana ea setho ke bofe sechabeng se sa lona?* How important are the medicinal herbs in this community and what are they used for? *Meriana ea setho eo le e sebelisang kamehla le e ritela kapa le e kopanya jwang?* How do you prepare these medicinal herbs, and which ones do you frequently use?	Two questions Important Medicinal herbs in this community Prepare these medicinal herbs Frequently used	Setting the scene Importance of medicinal plants in the current community How does this community prepare the frequently used medicinal plants?	Building a trusting relationship with the invited community members Prolonged engagement with medicinal plants Process of preparing the medicinal plants
H*:* The medicinal plants in this country are very important, because we believe in them and these plants, they make us healthy and in most of the cases we use them in mixtures. They are important also for healing and cleansing.	Medicinal plants Very important Believe in them They make us healthy	Emphasis of the importance Trust in plants regarding the power they have Plants are used in mixtures	Importance and value of medicinal plants in the community Process of preparing the medicinal plants Indications for using the

	Use them in mixtures Important in healing and cleansing	Plants are used for different purposes	medicinal plants
H: The types of plants that we use include *lengana, hloenya, phate ea ngaka*, *lekgala* (aloe), *poho tshehla* and *lero la tlholeho*. And then we have *kwena* (mint). *Lengana*: we have three types of *lengana*, but all of them are called *lengana*, because there are no different names for them. You must know which one you want to use, because some of them are very dangerous, as it can kill you.	Types of plants we use *Lengana, hloenya, phate ea ngaka*, *lekgala* (aloe), *poho tshehla, lero la tlholeho, kwena* (mint) and *lengana* We have three types of *lengana* but all of them are called *lengana*, because there are no different names for them You must know which one you want to use, because some of them are very dangerous, as it can kill you	Diverse types of medicinal plants that are commonly used by the community Three types of *lengana*, but all have the same name Knowledge of types of *lengana* is important, as some are dangerous	Prolonged engagement with medicinal plants and trust Importance and value of this medicinal plant in the community Trust and relative usage
R*:* How do you prepare this *lengana*?	How do you prepare this *lengana?*	Method of preparation	Preparation process of this medicinal plant
H: Normally, we boil them. We sometimes use green leaves and put them on the painful part. When somebody has common cold we put the green leaves in the nostrils, or under the pillow. Some people will even smoke the dried leaves single as *lengana,* or mixed with *kwena* leaves.	Normally we boil them Use green leaves, put them on the painful part Common cold: we put the	Medicinal plants can be boiled Raw leaves can be used on the painful part Use green leaves in the	Process of preparation (boiling method) Trust and relative usage of the medicinal plant in its raw state

	green leaves in the nostrils, or under the pillow Smoke the dried leaves single as *lengana*, or mixed with *kwena* leaves	nostrils, or under the pillow Dried medicinal plants can also be smoked	Trust and relative usage of the medicinal plant (smoking)
CIH: What conditions are commonly treated with the medicinal plants?	What conditions are commonly treated?	Common ailments treated in the community by medicinal plants	Indications (reasons) for usage of medicinal plants
H: We use these plants for common cold, treating of intestinal worms (*manyowa*), so we do deworming (*re bolaya manyowa ka tsona*), menstrual pains (*bohloko ba ho ea kgweding*), malaria, killing of germs (*di bolaya dikokwana-hloko*). These plants they also help the drivers and people doing sedentary types of work with their kidneys (*re phekola mafu a diphio*). We also use these plants against witchcraft (*boloi*).	Use these plants for: Common cold Treating of intestinal worms (*manyowa*) Menstrual pains (*bohloko ba ho ea kgweding*) Malaria Killing of germs (*di bolaya dikokwana-hloko*) Help the drivers and people doing sedentary types of work with their kidneys (*re phekola mafu a diphio*) We also use these plants against witchcraft (*boloi*)	Common cold Different conditions are treated with these medicinal plants Strong belief that medicinal plants can be used against witchcraft	Reasons for usage of medicinal plants Spiritual aspect of these medicinal plants
R: How do you measure, or what do you use to measure the amounts of these	How do you measure?	How do the indigenous healers measure the amounts of the	Measurement of medicinal plants (unprepared or

plants?	What do you use to measure the amount?	medicinal plants?	prepared)
H: We use the fingers to measure how much we need (demonstrating by show of fingers). Sometimes we make use of a full hand, or half-a-hand, once the decoction is prepared the measurement is done with a teaspoon, a tablespoon and/or cups. These medicinal plants should not be used more than a week for the same condition. You need to change your herbs if there is no improvement. The leaves are boiled until the water changes its colour and the person that is preparing the decoction is the one that will decide when the decoction is ready for use.	We use the fingers to measure Sometimes we make use of a full hand or half-a-hand The measurement is done with a teaspoon, a tablespoon and/or cups Not be used for longer than a week for the same condition The leaves are boiled until the water changes its colour and the person that is preparing the decoction is the one that will decide when the decoction is ready for use	Using different ways to measure the amount, as well as to determine the readiness for use The different measuring methods used for raw and cooked medicinal plants Individualised decision about the readiness of the decoction	Unique African ways of measuring the medicinal plants (unprepared) African unique ways of measuring the prepared medicinal plants Unique and individualised African ways of preparing the decoctions

Annexure E

Personal Interview with the Chief in Campbell

Context: The researchers arrived at the chief's house in Campbell and were welcomed by the chief's wife, as the chief was busy with arrangements for the *lekgotla* that had been planned to take place. When the chief arrived, the researchers were welcomed into the house. The researcher had a personal interview with the chief in the presence of the co-researcher. After the greetings and introductions, the chief informed the researcher that he was ready for the interview to start.

The researcher thanked the chief for making the time to speak with them, before commencement of the *lekgotla* at the community hall. The researcher and the chief agreed with regards to the proceedings of the main *lekgotla* in the community hall. The interview then started with the posing of a question.

Abbreviations used: Chief **(C)**, researcher **(R)**.

Questions and Quotes	Concepts	Categories	Themes
R: How do people use the medicinal plants in this community?	How do people use the medicinal plants in this community?	The way this community uses medicinal plants	Reason for usage of medicinal plants
C: They cook the plants as the most common method.	Cook the plants Most common method	Cooking the medicinal plants is common in this community	Process of preparation
R: Okay… (silence), you say they cook/boil them?	Silence...Cook/boil them?	Wait in anticipation Cooking and boiling used synonymously	Impact and value (respectful waiting)
C: Yes. They then drink the juice (*sap*) that comes from the cooking.	Yes. They then drink the juice (*sap*) that comes from the cooking	Cooking confirmed Making use of the juice/decoction from cooking/boiling	Process of preparation (method, cooking)
R: Ok…And then they drink the juice that comes from the cooking of the plant? **C:** Yes.	They drink the juice that comes from the cooking of the plant?	Confirming that the juice is taken orally	Appropriate usage of medicinal plants
R: Right! How long do they cook it?	How long do they cook it?	Duration of cooking the medicinal plant	Process of preparation
C: 1. Look, you will have to taste it in between. *Eeeeeehhhh*, sometimes 15 minutes or 30 minutes (*Hoe bitterder hy word,*	1. Have to taste it in between 2. Sometimes 15 minutes or 30 minutes	Readiness can be determined through different methods, like tasting and time frame	Unique and individualised African way of preparing the medicinal

how meer werk hy...). 2. Taste how bitter it becomes while cooking it, understand? The more bitter it becomes, the more value it will have. 3. Sometimes it must not only be cooked once, it dewaters each time. You keep the leaves that are at the bottom and then you cook it again and then they use it, but they probably use it about once, or twice. It is then used especially in the case of a fever and inflammation and those stuff, then they use it.	3. Taste how bitter it becomes while cooking 4. Sometimes it must not only be cooked once 5. Then you cook it again and then use it 6. Use it about once or twice 7. It is used in case of a fever and inflammation and those stuff	Confirming the readiness test Medicinal plants can only be cooked once or twice Indications for usage	plants Appropriate usage of medicinal plants
R: So, chief, are there other methods that they use on these plants, or is it only cooking, or is there any other method that you make use of?	Other methods that they use on these plants? Is it only cooking?	Any other ways of using the medicinal plants in this community	Appropriate usage of the medicinal plants
C: This is where the elders become involved today. You will hear there in the hall (*Dit is waar onse ou mense nou inkom, jy sal hoor daar by die saal later*). You know, some plants become used, for an example, for strong	Where the elders become involved today Strong headaches, where the	Elders know other methods (knowledge holders) Except for cooking, the plant is used raw	Prolonged engagement with the medicinal plants

headaches, where the plant will be put onto the head and wrapped around the head with a cloth (*Die plante word op die kop gesit en met 'n doek vasgedraai*). Now, if it is the same with *wildeals* and *wynruit,* I have no idea. That is for the elderly people (laughter). So, for those answers you will have to ask them. The other manner that I know precisely, they cook and they also mix both the *wildeals* and the *wynruit* together, whilst the cooking is happening; thereafter they then drink the juice (*Hulle kook en meng ook die wildeals en die wynruit en dan drink hulle net die sap*).	plant will be put onto the head and wrapped around the head with a cloth Now, if it is the same with *wildeals* and *wynruit,* I have no idea That is for the elderly people (laughter) For those answers you will have to ask them I know precisely, they cook and they also mix both the *wildeals* and the *wynruit* Thereafter they drink the juice	Put on the painful area for relief Other plants are used in different ways in this community Referring to the elders (knowledge holders) Respect for the elders and knowledge in the community Confident statement about mixing the two medicinal plants Emphasis is on cooking the medicinal plants and on administration	Trust and relative usage Prolonged engagement with the medicinal plants Trust and relative usage Process of preparation (method), trust and relative usage
R: When they mix, how do they measure, how do they know how much *wildeals* and how much *wynruit* to add in the mixture?	How do they measure, how do they know how much *wildeals* and how much *wynruit* to add in the mixture?	What measurement methods are used in this community?	Measurement of preparation
C: Look, they take the leaves of the plant, and use a handful of this and a handful of that, as long as it is evenly divided (*Handvol blaartjies van een plant hier en ook 'n handvol daar in gelyke hoeveelhede*) in the	They take the leaves of the plant and use a handful of this and a handful of that As long as it is evenly divided in	Hands used for measuring the amount to be used Equal portions of the medicinal plants are used when mixing	Unique and individualised African way of measurements

measurements as well, then they mix it like that.	measurements as well, then they mix it like that	them	
R: When they mix the plants, is the juice now much better, or is it the same as when they are not mixed?	When they mix the plants, is the juice now much better, or is it the same as when they are not mixed?	The reason for mixing the plants	Appropriate usage of medicinal plants
C: He is very stronger…very stronger and also much more bitter as well (laughter).	He is very stronger… Very stronger and also much more bitter as well (laughter)	Mixing the medicinal plants for better strength	Process of preparation
R: If a carer gives a sick person *wildeals* alone, and *wynruit* alone, does the person recover quicker than the person would if the two were combined?	*Wildeals* alone *Wynruit* alone Does the person recover quicker Than the person would if the two were combined?	Comparison between mono- and combination therapies	Trust and relative usage
C: 1. According to me it is much more effective when they are both mixed together, because then they have a quicker outcome. 2. Remember, sometimes to break the fever, they also utilise some Western medicines, like Grandpa or Disprin and mix it with the cooking plants, understand (*Onthou, om die koors te breek, hulle gebruik ook die Westerse medisyne, hulle voeg miskien Grandpa of Disprin in, verstaan jy*)? This helps with	More effective when they are both mixed together They have a quicker outcome Sometimes to break the fever They also utilise some Western medicines, like Grandpa or Disprin Mix it with the cooking plants, understand This helps with the quicker curing	Combination therapy better than mono therapy Double approach in the treatment of fever Emphasis on combination therapy	Trust and relative usage Process of preparation as combination therapy

the quicker curing of the fever.	of the fever		
R: The dosage, how do they give the juice when it has been pulled? In a cup, half-a-cup, etc?...	How do they give the juice when it has been pulled? In a cup, half-a-cup?	How much is given when a person is sick	Measurement of preparation
C: (*Ons drink maar bekers man*). We drink them out of mugs (Said in a humorous manner, laughter graces the room then a slight pause)… You know, some people do not like the bitterness, but there are also those who happen to enjoy the bitter taste of the juice, and you can therefore drink a mug, or half a glass, just any way you feel comfortable with. They add some other plants as well to that, like *wildekeer* and they are all cooked together.	We drink them out of mugs Some people do not like the bitterness, but there are also those who happen to enjoy the bitter taste of the juice Therefore drink a mug, or half a glass, just any way you feel comfortable with Add some other plants as well to that, like *wildekeer* and they are all cooked together	Measurement for administration is the use of mugs Volume is individual, depending upon and according to the bitterness of the decoction Emphasis on the use of mugs and now also glasses Individual preferences taken into account Emphasis on combining the medicinal plants for better outcomes	Unique and individualised African way of measurement Unique and individualised African way of measurement (prepared) Trust and relative usage
R: So that means that they can cook *wildeals wildekeer* and *wynruit* together?	They can cook *wildeals wildekeer* and *wynruit* together?	Emphasis on the importance of the combination therapy	Process of preparation (boiling) combination therapy
C: Yes, without it becoming poisonous, because we have not yet passed on (*Ons het nog nie doodgegaan nie*) (said in a humorous way and there is	Yes, without it becoming poisonous, because we have not yet passed on	Confirmation and confidence in the use of the combination therapy	Trust and relative usage

heavy laughter in the room).			
R: The other thing I wanted to find out from you is the frequency of the dosage. After how many hours do you give the same person medication of the cooked *wildeals* and *wynruit?*	The frequency of the dosage After how many hours do you give the same person medication?	The frequency of administration of the decoction in this community	Trust and relative usage
C: Look, because it is not divided into dosages, it is something that a person can consume at night before you go to bed. If you feel a little fever approaching during the day, they will give you a strong dosage and then you will have to cover yourself so that you are able to sweat, this eliminates the fever	It is not divided into dosages It is something that a person can consume at night before you go to bed Give you a strong dosage Cover yourself so that you can sweat, this eliminates the fever	Administration not dose dependent Mostly taken at night before sleeping Extended method of treatment	Unique and individualised African way of measurement Trust and relative usage

Annexure F

Transcriptions of the *Lekgotla* held in the Community Hall in Campbell, Facilitated by Chief

Context: The town of Campbell is about 100 km from Kimberley. This town is quiet and humble and on arrival one could hear a cock crowing and see goats running across the field. The running of the goats and the ants scurrying on the ground were early signs of imminent rain, along with the thunder clouds collecting in the distance. At the house of one of the community elders, a big pot of food was cooking over an open fire, spilling the appetising aroma, whilst ladies were busy kneeing dough for “roosterbrood” (a type of bread in the form of small buns that are placed on an open wire grid directly above warm coals and left to bake). The whole community was busy preparing for the feast to be held after the *lekgotla.* Campbell constituted the main population where the study was undertaken.

The *lekgotla* took place after the researchers had negotiated the proceedings with Chief of Campbell. Negotiations for the *lekgotla* took place in the humble residence of the chief and his wife. On arrival of the research team at the chief’s house, they enjoyed the view of the hills and the soccer field on which some goats were grazing. The researchers awaited the arrival of the chief, as he was at the community centre, making sure everything was ready for the research team. While waiting for the chief, the researcher enjoyed a conversation with chief’s wife on the porch.

On arrival of the chief, the researchers were invited into his house (a welcome cool relieve from the humidity and heat outside). After introductions and a cool drink, the researchers and the chief discussed the aims of the *lekgotla*, and what the researchers wished to discuss with the community.

Chief agreed to lead all of the proceedings, which would take place in the Campbell community centre. He gave the necessary permission for the *lekgotla* to be captured through video recordings and was permission also granted to take still pictures of the proceedings. Chief requested that the material be made available to him and that the material captured be used for the purpose of this research only and not for any commercial purposes. The researchers agreed to this requests.

Proceedings during the *lekgotla*

The Griqua tribe is a religious community, as they opened the *lekgotla* with the singing of a hymn and a prayer by the pastor, requesting that the eyes, ears and thoughts of the members of the *lekgotla* be opened. The pastor then blessed the members of the research team and the participants in the name of Jesus Christ, and thanked God that the members had arrived safely and asked that the researchers and research assistants would have a safe return journey.

The *lekgotla* proceedings took place in the Campbell Youth centre/community hall. It was a hot day and the sun was very bright, but later in the afternoon during the *lekgotla* proceedings, the rain clouds started forming. Loud roars of thunder were heard and the rain was imminent. The fall of rain during *lekgotla* was interpreted as blessings from God.

The *lekgotla* allowed for members of the community to freely enter and leave during the proceedings. As each participant entered, he/she was welcomed by the rest of the community. A total of 35 members attended the *lekgotla.*

Chief spoke about the uses of indigenous medicines and the role of the university in determining their efficacy. He emphasised that the purpose of the research was not to make *gxeigas* (healers) out of the community, but to shed more light on the medicines that the community had been using for so long, by exploring how the community uses and prepares these medicines.

The chief introduced the project leader to the participants, so that he could introduce the researcher and members of the Seboka team present. Once all of the introductions were complete, the community acknowledged the Seboka team, after which professor Pienaar left the stage for Chief to lead the proceedings.

The chief laid the platform by stating that medicinal plants had been used by their community for many years and had they enjoyed excellent results.

Abbreviations used: Chief **(C)**, community members **(CM)**, researchers **(R)**.

Questions and Quotes	Concepts	Categories	Themes
C: We have to be careful of the people that will give us a yellow carrot, instead of an orange carrot.	Yellow carrot, instead of an orange carrot	Figure of speech	Value for knowledge
CM: What are the legal implications regarding the intellectual property rights, about the disclosure of the information?	Legal Implications regarding the intellectual property	Fear of information disclosure	Trusting relationship build with the Seboka team
We have many different plants outside in the field that we use as medicine. Now the question arises: How important are these plants, this medicine for us as a community? How important is it? (A short pause follows before the next idea is mentioned)…	Many different plants outside in the field? (Various plants) We use as medicine How important are these plants?	Diverse medicinal plants available in the veld Medicinal usage of the plants The importance of the plants	Emphasis on the importance and value of medicinal plants Value of medicinal plants to the community
(The community members remain silent) Is it just there and you as an individual just go to the field and take it with you, just because you may feel like it and because you want to drink it, or, is it of utmost importance to the community?	How important is it? A light pause is taken Community members remain silent	Silence. Respectful waiting	Respectful waiting and inter-personal communication
	Just go to the field and take it with you Is it of utmost importance to the community	Appropriate usage of medicinal plants Emphasis on importance Cautious usage	Value and importance of medicinal plants
CM: A person shouts from the middle of the hall where the community members are	Community members are seated)… Yes, it is	Importance emphasised by the community	Emphasis on value and importance of medicinal

seated… Yes, it is important!!!	important!!!		plants
C: Yes, but, how important is it? (The chief replying to the comment by the man seated amongst the community members).	Yes, but, how important is it?	Need some form of clarification from community	More emphasis on the value and importance of medicinal plants to the community
CM's: The community members seated in the hall once again reply by saying… Yes, the plants are important!! 2. (The community members mumble amongst one another, probably trying to discuss among themselves what the chief might expect them to say and also what the chief might not like, indication of solemnity).	Community members seated Yes, the plants are important!! The community members mumble amongst one another	Importance emphasised, but still no clarification. Mumbling denotes inter-personal communication about the importance	Respectful silence Respectful waiting
C: How does it help? Everyone always and only says that it is important! Why do you say it is important? (In a much more formal and serious tone).	How does it help everyone? Say that it is important! Why do you say it is important?	Direct question as follow-up Emphasis on clarifying the importance (value)	Importance and value of medicinal plant to the community
CM: The attendees in the hall are silent for a while, as they seem to focus on finding the best possible answer to the question asked by the chief.	Thereafter a silence Community members seem to be attempting to focus on an answer	Respectful silence Engagement with question Chief had community thinking	Respectful waiting for the chief
C: (Asking countless times, the chief asks for the last time, as it seems that the community members are now focused on the task at hand, due to their realisation of the importance of their responses)… Why do you	Asking countless of times the chief asks for the last time Community members are now focused on the task at	Chief not satisfied, asking again (community aware that they are not answering) Education of importance and	Respectful waiting for the chief Importance and value of

say that these plants are important? What is the health outcome of the usage of these plants and does it make you healthy?	hand, due to their realisation of the importance of their responses Why do you say that these plants are important? What is the health outcome of the usage of these plants and does it make you healthy?	value Thinking comes together Sharing their ideas Preparation to give appropriate answer	medicinal plants to the community Respectful waiting
CM: (A man rises and there is a sudden silence in anticipation for what the man is going to say when he replies to the question. He seems to be one of the elders of the community and thus automatically when he has something to say, the people whom he addresses will listen with all intent)… Look, humanity has different types and forms of medicines. I will mention a couple that include the following: *Wildekeer*, *wit vergeet* for when you have stomach aches and also for when you have back pain. So, there is no cortisone. You only pull it and then you drink the water with all the pulled nutrients of the substance. So I do agree with that, there are no problems. (The community members mumble as if they are discussing what the elderly man has just mentioned in his reply to the question. It is as if everyone in the community would like to add something to that, but shyness got the better of them). **C:** Now, if you do not receive the pills there by the clinic, there is always an option to go to the veld. The reason why our plants are so important to us is that in the case that we	Sudden silence and anticipation Community elder Humanity has different types and forms I will mention a couple Stomach ache and also back aches Pull and drink the water with pulled nutrients of the substance Community members	Focusing on the anticipated answer Knowledge holders of the community Attention and respect for the elder Differences among medicinal plants Some of the indications to illustrate the importance Importance emphasised by way of preparation (nutrients) Engagement amongst the community. Either signifying agreement, or disagreement with what has been said	Respectful waiting Prolonged engagement with medicinal plants Respectful waiting Prolonged engagement with medicinal plants Indications for usage Process of preparation Inter-personal communication Respectful silence

cannot receive the medication we need, we can always go to the veld and get something there… (The chief allows the discussions among the members to continue, as this could be positive for the answering of the questions… the man seated at the back of the hall stands up as he has some information to share with the crowd regarding *bloue distels*. He is right, he speaks the right language. *Bloue distels*, and it is also medication. Now he knows what it is all about, so he might as well stand up and explain to us what the *bloue distels* are all about. Stand up brother!!! (This was said in a friendly Afrikaans manner: *"Staan op boeta").* The man has to explain to us, we also want to know. It is not a shame, so do not be embarrassed, we are all helping one another here. Silence, and listen carefully. *Bloue distels* are very healthy. You take the *bloue distels* and then you take the *rooistorm* and then you take *wildekeer* and then you take *wit vergeet* and then you throw it in and you cook it. It makes the man clean, his kidneys, his back and his whole body. It keeps you healthy. (The community claps enthusiastically after the very insightful address that was provided by the older lady. It's a joyous mood of the sound of a breakthrough, as the lady paved the way and showed that there is nothing to be afraid of and that the people of the community can	mumble as if they are discussing what the elderly man has just mentioned Everyone in the community would like to add something to that, but shyness got the better of them You do not receive the pills there by the clinic Always an option to go to the veld The reason why our plants are so important to us In the case that we cannot receive the medication we need, we can always go to the veld and get something there Chief allows the discussions among the members *Bloue distels*, and it is also medication	Western medication not available The veld has always been around and is always an option Emphases on importance in the absence of pills The medicinal plants in the veld are always available Inter-personal communication Another type of medicinal plant Acknowledgment of the community member's knowledge about medicinal plants Respect amongst the community members	Western system that disappoints Trust and relative usage Western system that disappoints (distrust) Trust and relative usage Respectful waiting by the chief Impact and value Prolonged engagement for years (spiritual) Respect of others in the community Respect from the community

share their insights about all the plants). Now I can understand, because if the man has jumped around every now and then you can use these plants (*Nou kan ek verstaan, want as die man nou bietjie uitgespring het, en jy gaan nou bietjie roukos eet…*). (Laughter from all four corners of the hall embraces the hall as the members of the community fill the joyous mood and now there is a much more open discussion about these plants and a much more accepted manner of sharing the knowledge and the jokes with the members involved). *Het jy die rou kos geniet?* Did you enjoy the "raw food"? (She asked the man in a very humorous manner. This evokes an ambiance of joy and happiness around the hall). An ??expression of seriousness that it can be the primary source of your death (*dit kan lei tot die dood),* as you sweat, and have all other things there as well as water, but when they use these *bloue distels*, it then makes you clean, as well as also breaks that blockage (*verstopping*) in the urinary tract that exists, it opens me up, yes… (Crowd claps with minor laughter in between).	Now he knows what it is all about Stand up brother!!! (This was said in a friendly Afrikaans manner, *"Staan op boeta"*). Not a shame, so do not be embarrassed, we are all helping one another here. *Bloue distels* are very healthy Take the *rooistorm* You take *wildekeer* You take *wit vergeet* Then you throw it in and you cook it It makes the man clean, his kidneys, his back and his whole body It keeps you healthy People of the community can share their insights about all of the plants If the man has jumped around every now and then you can use these plants	Support and encouragement amongst members. Listening skills and focus Importance emphasised Other types of medicinal plants used in the community Preparation method Indications for the usage Importance of medicinal plants Reassurance that the information can be shared freely in this session Figure of speech (respectful way of saying things) Community members are now free to discuss their	members Importance and value Prolonged engagement Process of preparation Indications for usage Importance and value of medicinal plants Trust and relationship with the Seboka team Community respect (language)

	Sharing the knowledge and the jokes with the members involved	knowledge	Respectful waiting and communication
	Did you enjoy the “raw food”? (Figure of speech)	Figure of speech (Avoiding to say things as they are; respect)	Respectful way of communication
	Primary source of your death	“Raw food” can be the source of death	Appropriate usage of medicinal plants
	It then makes you clean as well as it also breaks that blockage in the urinary tract	Indication after taking “raw food”	Appropriate usage of medicinal plants
C: Whilst we are still on the subject, we have now reached a point whereby we will have to indicate which plants are health related plants. Now… How important are the *wildeals* and the *wynruit* for us as a community? There are also important functions that each one does. (After the chief has made this statement, there are mumbles in the hall from the community members. A middle-aged lady	Which plants are health related plants? How important are the *wildeals* and the *wynruit* for us as a community?	Direct question related to health Importance of specific plants directly asked Importance emphasised	Trust and relative usage Prolonged engagement with

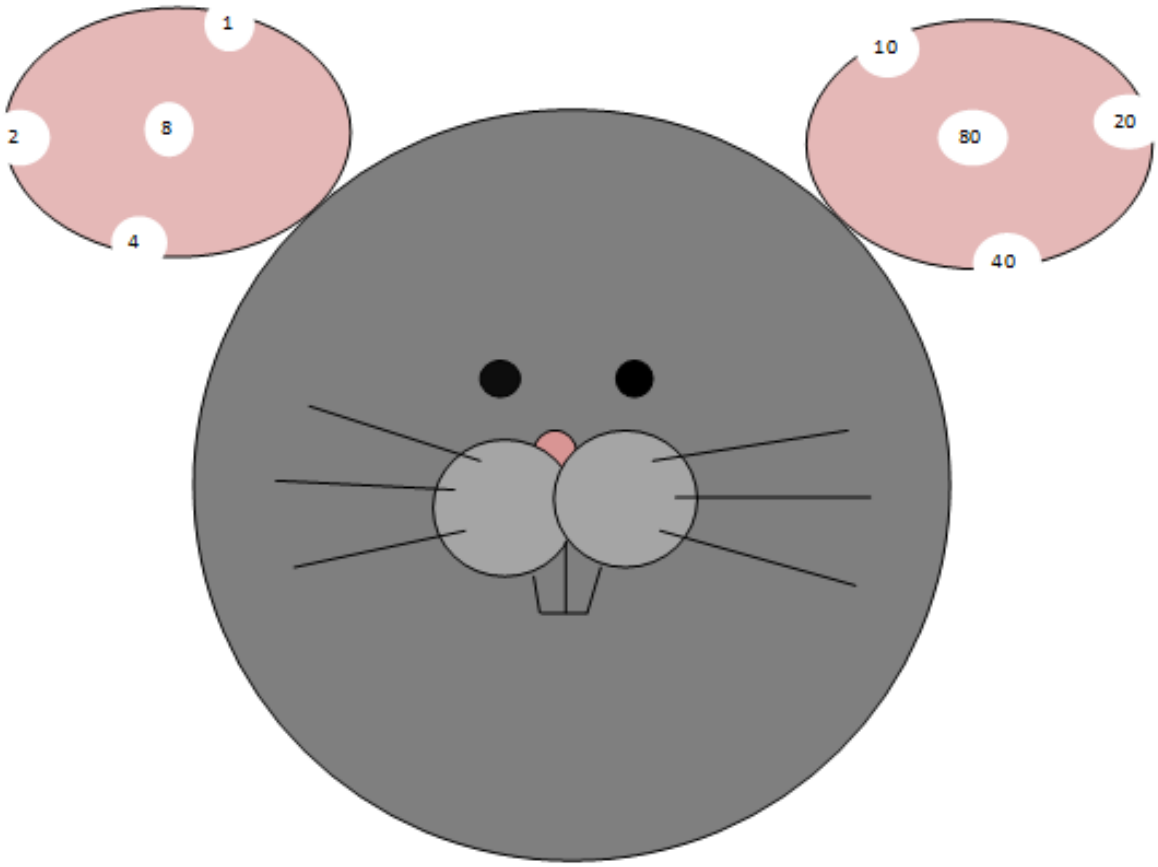
stands up and raises the next statement…).	Important functions that each one does Mumbles in the hall from the community members	again for specific medicinal plants Inter-personal engagement	medicinal plants Respectful waiting
CM: *Wynruit, wildekeer, wildeals* and *vaalbos* are for flu and fevers and you can also cook them and drink them for well-being within the chest. If you didn't receive any cough syrup or pills from the clinic, then you can use it to get rid of the flu conquering your body. The *bloue distel's* roots you can also use for tooth ache. You can use the plants' roots for a tooth pain.	*Wynruit, wildekeer, wildeals* and *vaalbos* For flu and fevers Well-being within the chest You didn't receive any cough syrup or pills from the clinic Use it to get rid of the flu conquering your body Roots for tooth ache	Types of medicinal plants related to health Conditions treated by these medicinal plants Other condition being chest related condition, which could refer to flu and fevers Another ailment treated with medicinal plants	Trust and relative usage Indications for usage Indications for usage Trust and indications for usage
C: What are you there at the back saying?	What are you there at the back saying?	Keeping the order of proceedings	Respect for the chief
C: What healthy outcome do these aids have?	Healthy outcomes of these aids?	Results of using the medicinal plants	Impact and value of medicinal plants
CM: Random shouts from the community: Yes!! (thereafter discussing some things amongst one another as the rain fell harder on the corrugated iron as a sign of blessings).	Shouts from the community Discussing some things amongst one another	Acknowledging and agreeing with the said statements	Trust and relative usage of medicinal plants
CM: Yeeeeeeeeeeeeeeeeeees…!!!!!	Yeeeeeeeeeeeees!!!!!	Enthusiastic reply	Impact and value
C: How much *wildeals* do we have to throw in	How much *wildeals*	Measuring of medicinal plants	Appropriate usage for

the mixture and also, how much *wynruit* do we have to throw in there?	How much *wynruit*		preparation
CM: You take the measurement with your finger length (illustrating with her own fingers for example). If it has small leaves, then you can just take those leaves if you are really sick. For the child, you make it a weaker mixture than the one the adult would drink, but for the adult, you would make it strong. Take the sticks as well as the leaves and cook the leaves separate from the stem sticks of the plant. You can also use *koebaga* and also you can use *krystal* and throw it in the mixture and make it a *mengelmoes,* then you should be healthy.	Measurement of your finger length Take those leaves if you are really sick For the child you make a weaker mixture For the adult, you would make it strong The leaves and cook the leaves Then you should be healthy	Ways used to measure the raw medicinal plants Method of using the medicinal plants Differences in strengths between a child and an adult Preparation of the decoction Expected outcome	Unique African way of measuring medicinal plants (unprepared) Process of preparation and administration Impact and value of medicinal plants
C: Is there anything you want to say maybe, that was left out? Anything that you may think is important about the medicinal plants in this community?	You may think it is important about the medicinal plants in this community?	Conclusion by reminding the community about the point of discussion	Impact and value of medicinal plants
CM: (Moment of silence… hmmmm amongst the community) No, I don't think so (lady from the community).	(Moment of silence…hmmmm amongst the community) No, I don't think so (lady from the community)	Moment of reflecting about what was said Everybody said what they wanted to say	Respectful waiting and silence
C: Thank you all for coming in this rainy weather.	Thank you all for coming	Chief thanks the community	Respect for the community shown by the chief

The researcher will communicate with you on a one on one basis, if there is something he wants. (Community claps hands in appreciation and respect of the chief).	Community claps hands in appreciation and respect of the chief	Sign of appreciation and acknowledgement	Significance of the respect the community has for the chief.

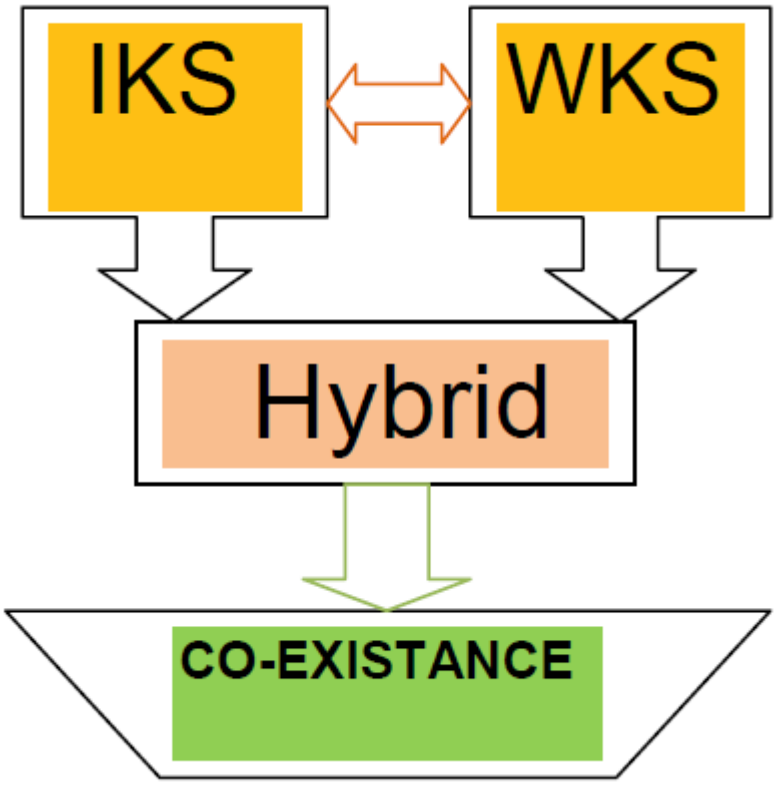
Annexure G

Illustration of rats numbering



Annexure H

Representation of the Ideal Science



Annexure I

Statistician Letter

23 February 2015

To whom it may concern

A few months ago, I was approached by David Mphuthi to assist him with the statistical analysis of the data that he had collected for his doctorate studies. I was referred to David by another PhD student, whom I had also successfully assisted.

I have gained my 15 years of experience in the statistical analysis of data through working as a researcher for two global research companies (Research International and IPSOS/Markinor), as well as currently for SARS.

My qualifications are as follows:

BSc (Hons) Genetics – UP

BA (Hons) Psychology – UP

MBA Strategic Marketing – University of Hull, UK

Sincerely,

Ilja de Boer

Annexure J

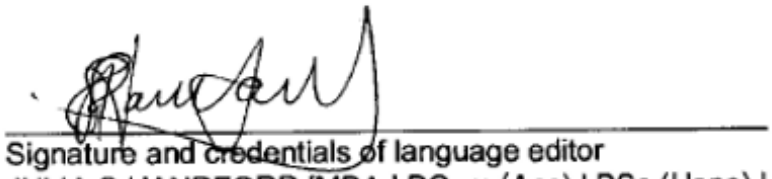
Declaration by the Language Editor

8 April 2015

To whom it may concern,

I, Julia Handford, hereby declare that I have language edited and technically cared for the thesis of **DITABA DAVID MPHUTHI** that is entitled: **Anti-viral properties of *wildeals* (*Artemisia afra*) and *wynruit* (*Ruta graveolens*) as combination therapy and its effects on the renal system**. The Griqua language character of both the Afrikaans and English transcriptions of the *lekgotla* meetings were, however, maintained.

Yours truly,



Signature and credentials of language editor
JULIA S HANDFORD [MBA | BCom (Acc) | BSc (Hons) | HED]

Annexure K

Memorandum of Understanding

THE GRIQUA ROYAL HOUSE
DIE GRIEKWA KONINGLIKE-HUIS

Administration Office: c/o 26th & Beardman Str, Faith Mission Centre Lavrisdale Elsies River 7490 PO Box 318 Elsies River 7490
Tel: 021 932 8801 Fax: 021 931 0488 Email: adamsdc@iafrica.co.za

MEMORANDUM OF UNDERSTANDING

This memorandum serves as an agreement reached between the Seboka Team under the leadership of Prof. Abel J. Pienaar and the Griqua Royal House. An appointed Seboka member will be expected to abide and respect the values and norms of the community while conducting research.

The following are the terms and conditions of agreement.

- The Seboka team is given the permission to conduct the research within the Griqua community, on a mutual capacity principle;
- The conducted research will be based on the Indigenous Knowledge Systems, of which the community will lead and guide the proceedings;
- The team (Seboka) will conduct the research using multiple research methodologies but the primary approach will be conducting "makgotla" with the assistance of a nominated member of the Griqua Royal House;
- The Seboka team will always respect the community and make sure that all the information is treated confidential;
- The research will be conducted by the appointed Seboka researcher, who will in turn sign the consent;
- Both parties also agree that the shared information remains the property of the Griqua Royal House unless otherwise stated;

This memorandum will be used as a global consent for conducting the research in the community. The participants' rights will also be taken into consideration and be respected while conducting the research. These rights are but not limited to the following:

- Autonomy and self-identification
- Privacy
- Confidentiality
- Justice
- Non-maleficence
- Voluntary participation
- Freedom of speech and movement as it will be an open forum

These conditions were discussed and agreed upon by the two parties (Community leader and Seboka Team leader). The terms and conditions discussed above are legal and bonding to the parties.

Signed at Rebonia on 27th February 2015

Seboka team leader : .....

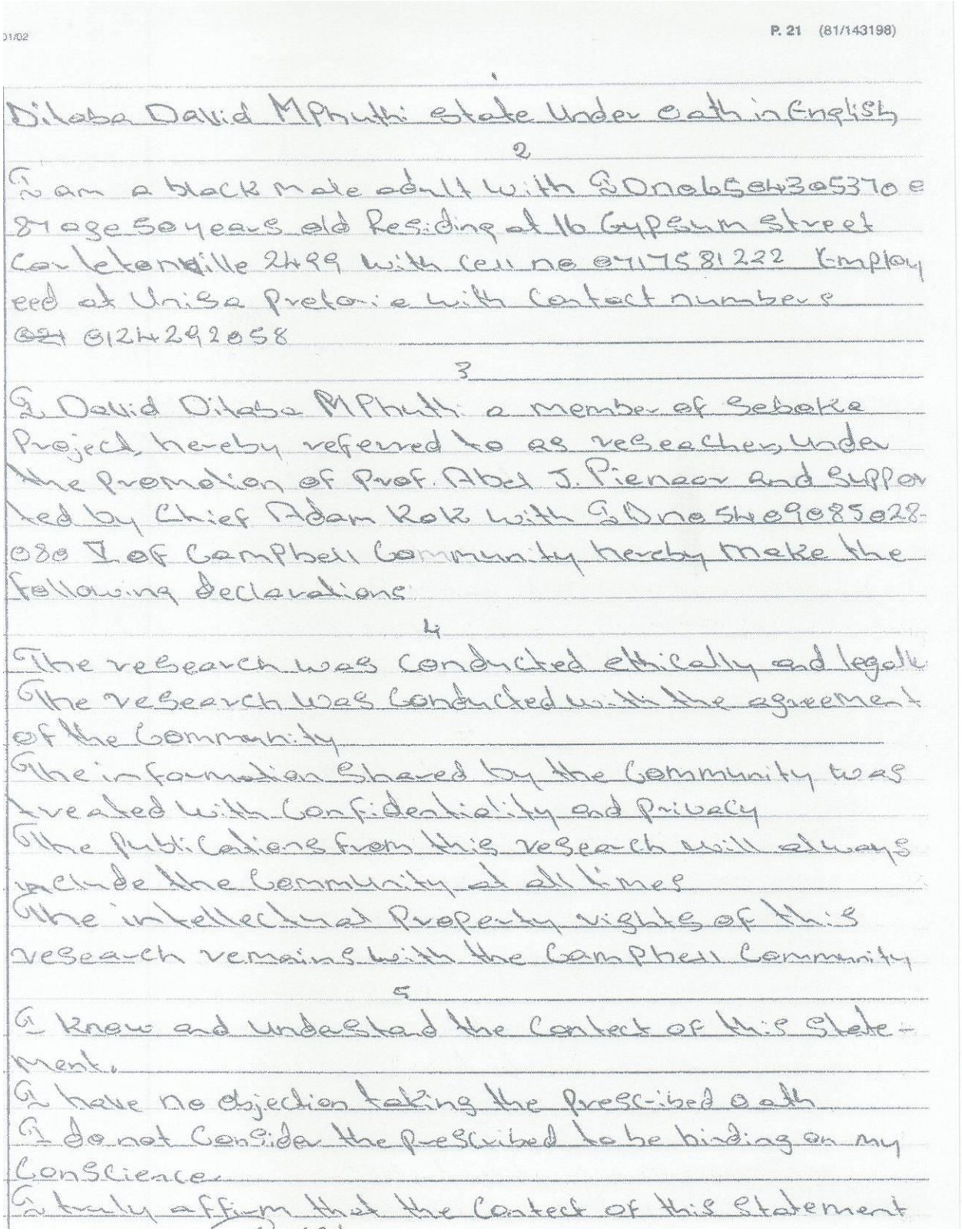
Griqua Royal House : .....

Researcher : .....

Copies to: Griqua Royal House, Seboka office and researcher

Annexure L

Memorandum of Agreement



01/02 P. 21 (81/143198)

Dikaba David Mphuthi state under oath in English

2

I am a black male adult with ID no 6506305370 e
8 age 50 years old Residing at 16 Gypsum street
Carletonville 2499 with cell no 0717581222 Employ
eed at Unisa Pretoria with Contact numbers
012 4292058

3

I David Dikaba Mphuthi a member of Sebake
Project, hereby referred to as researchers under
the promotion of Prof. Abel J. Pienaar and Suppor
ted by Chief Adam Rolz with ID no 5406285028-
080 I of Campbell Community hereby make the
following declarations

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The research was conducted ethically and legally
The research was conducted with the agreement
of the Community
The information shared by the Community was
revealed with confidentiality and Privacy
The publications from this research will always
include the Community at all times
The intellectual Property rights of this
research remains with the Campbell Community

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I know and understand the content of this State-
ment.
I have no objection taking the prescribed oath
I do not consider the prescribed to be binding on my
Conscience
I truly affirm that the content of this Statement

David Dikaba Mphuthi State further in English

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Signed at Campbell Police Station on 2019-02-07

time 17:01

1 David Mphuthi (Researcher)

2 Abel Pienaar (Promoter)

3, Chief Adam Kok (Campbell Chief)

Campbell 2019-02-07 om 17:01 te

[signature]

KOMMISSARIS VAN EDE
COMMISSIONER OF OATHS

Ursula Diekelmann Meton

FULL FIRST VAN DIE RUKSKRIF
NAME(S) IN BLOCK LETTERS

N2 Main Road Campbell

BUS STREET ADDRESS)

Campbell

Constable