Bioactive components and pharmacological effects of Canna indica- An overview

Article · January 2015

CITATIONS
104

READS
3,551

1 author:

Ali Esmail Al-Snafi
University of Thi-Qar - College of Medicine
333 PUBLICATIONS **9,751** CITATIONS

SEE PROFILE

e - ISSN - 2249-7668
Print ISSN - 2249-7676

International Journal of
Pharmacology & Toxicology

www.ijpt.org

BIOACTIVE COMPONENTS *AND* PHARMACOLOGICAL EFFECTS OF *CANNA INDICA*- AN OVERVIEW

Ali Esmail Al-Snafi

Department of Pharmacology, College of Medicine, Thiqar University, Nasiriyah, PO Box 42, Iraq.

ABSTRACT

Canna indica L. is a tropical herb belonging to the family Cannaceae. It has been widely used in traditional medicine for the treatment of many complains. The phytochemical analysis of *Canna indica* showed that it contained various phytochemicals including alkaloids, carbohydrates, proteins, flavonoids, terpenoids, cardiac glycosides, oils, steroids, tannins, saponins, anthocyanin pigments, phlobatinins and many other chemical compounds. The pharmacological studies showed that this plant exerted antibacterial, antiviral anthelmintic, molluscicidal, anti-inflammatory, analgesic immunmodulatory, antioxidant, cytotoxic, hemostatic, hepatoprotective, anti diarrheal and other effects. This review deals with highlight the chemical constituents and the pharmacological effects of *Canna indica*.

Keywords: *Canna indica*, Constituents, Pharmacology, Pharmacognosy.

INTRODUCTION

Healing with medicinal plants is as old as mankind itself. The connection between man and his search for drugs in nature dates from the far past. As a result of accumulated experience from the past generations, today, all the world's cultures have an extensive knowledge of herbal medicine. The previous treatment was not based on a true scientific knowledge. However, in the early nineteenth century, many sensitive ingredients were isolated and introduced in the medical practice. *Canna indica* is a tropical herb belonging to the family Cannaceae. It has been widely used in traditional medicine for the treatment of many complains. The phytochemical analysis of *Canna indica* showed that it contained various phytochemicals including alkaloids, carbohydrates, proteins, flavonoids, terpenoids, cardiac glycosides, oils, steroids, tannins, saponins, anthocyanin pigments, phlobatinins and many other chemical compounds. The pharmacological studies showed that this plant exerted antibacterial, antiviral anthelmintic, molluscicidal, anti-inflammatory, analgesic immunmodulatory, antioxidant,cytotoxic, hemostatic, hepatoprotective, anti diarrheal and other effects. The objective of thepresent review is to highlight the chemical constituents and the pharmacological and therapeutic effects of *Canna indica*.

Synonyms: *Canna coccinea* Mill, *Canna edulis* Ker-Gawl, *Canna lutea* Mill and *Canna achiras* Gilles[1-3]**.**

Common names

Arabic name: Canna Hindi, Muzwardi and Muzfahal; Andes: Achira; English: Canna Indian shot, Achira and Arrowroot; French: Balisier; Hindi: Sakasiri and Devkali; Marathi: Kardal; Sanskrit: Vankelee; Spanish: Chupaflor [1].

Distribution

It was distributed in the tropics and subtropics particularly of the western hemisphere. It was common in moist places along streams, springs, ditches, and the margins of woods. It may also be found in wet temperate, mountainous regions. It is commonly cultivated in flower

Corresponding Author:-**Ali Esmail Al-Snafi** Email:-aboahmad61@yahoo.com

gardens [4-5]. *Canna indica* was the first species of this genus introduced to Europe, which was imported from the East Indies, though the species originated from the America [6].

Traditional use

Canna indica was used for the treatment of malaria, as a cure for diarrhoea and dysentery and in the treatment of bruises and cut [7]. It was also used as diaphoretic, diuretic, and in treating fever and dropsy [8]. The root decoction was used for the treatment of fever, dropsy, and dyspepsia. Seed juice is used to relieve earaches. The flowers were said to cure eye diseases [9-10]. The large and much branched rootstocks were full of edible starch. The younger parts may be finely chopped and then boiled or pulverized into a meal. Mix in the young shoots of palm cabbage for flavoring [5]. The powdered tubers were used to thicken sauces and improve the texture of some prepared foods [3].

Part used: Leaves were used medicinally and the large and much branched rootstocks are edible [5].

Botanical Classification [1]
Kingdom: Plantae
Subkingdom: Tracheobiont
Superdivision: Spermatophyta
Division: Magnoliophyta
Class : Liliopsida
Subclass: Zingiberidae
Order: Zingiberales
Family: Cannaceae
Genus: *Canna*
Species: *indica.*

Description [1-2,5,11]

Canna indica is a coarse perennial herb, 90 centimeters to 3 meters tall. The plant grows from a large, thick, underground rootstock that is edible. Its large leaves resemble those of the banana plant but are not so large. The flowers of wild canna lily are usually small, relatively inconspicuous, and brightly colored reds, oranges, or yellows.

Leaves are lanceolate or ovate 10-30cm long, 10-20cm wide. Having large laminae up to 60cm long. Inflorescence is waxy-glucose erect peduncle about 30 cm long. Leaves are dark green with purplish brown margins and veins. They are carline, simple, alternate and spiral. The oblong leaves have their petioles extending downwards to form a sheathing base around the stem. The lamina is pinnately, parallely veined. Leaf margins appear smooth and wavy with acute apex. The leaves are large and foliaceous reaching up to 65-70cm in length and 30-35cm in width.

Flowers are red, solitary or in pair the bract about 1.3cm long. Sepals are 1 to 1.5cm long. Corolla tube about 1cm long being red or reddish 2.5 to 3cm long. The staminodes are bright red. Flowers are hermaphrodite.

Fruits are capsules, green oblong or aid, softly echinate (spiny) and 2 to 2.5cm long. Capsules about 40 x 25 mm, outer tepals (sepals) persistent at the apex.

Seeds initially white and when mature, black with chestnut brown spots are protected with a smooth coat.

Stem is a pseudo stem which reaches up to 1.5-2m in height. It is erect, herbaceous, sturdy and cylindrical enveloped by the sheathing leaf bases.

Rhizomes are yellowish white or pinkish on the outside and yellowish white within. At maturity, they turn brownish externally due to a thick outer covering. Rhizomes may be monopodial or sympodial, stoloniferous or tuberous. Rhizomes are sympodial with Y-shaped axes.

Roots are thick, cylindrical and creamy white in colour with a diameter of 2-5mm with numerous root hairs. Thinner primary and secondary lateral roots are also seen.

Physicochemical properties

PH value (ethanol, methanol and water) were 8.0, 4.0 and 6.0 respectively, loss of weight on drying 4.1%, total ash 17.98%, acid insoluble ash 69.2% and water insoluble ash 48%. Extractive value: alcohol soluble extractive 3.86% and water soluble extractive 6.31 % [12].

Chemical constituents

The phytochemical analysis of *Canna indica* L. flower showed that they contained various phytochemicals including alkaloids, carbohydrates, proteins, flavonoids, terpenoids, cardiac glycosides, steroids, tannins, saponins and phlobatinins [12].

Chemical analysis of aerial parts of *Canna indica* afforded betulinic acid, oleonolic acid and traraxer-14-en-3-one [4].

Flowers contain lutein, β–carotene, violxanthin. Leaves contained lignin, furfural and hemicelluloses. Rhizomes contained 5, 8- henicosdine, tetracosane and Tricosane [13-14].

Four anthocyanin pigments have been isolated from the red flowers of *Canna indica*. They were identified as Cyanidin-3-O-(6"-O-α-rhamnopyranosyl)-β-glucopyranoside,Cyanidin-3-O-(6"-O-α-rhamnopyranosyl) -β-galactopyranoside, Cyanidin-3-O-β-glucopyranoside and Cyanidin-O-β-galactopyranoside [15-16].

The hydrocarbons from petroleum ether extract of *Canna indica* rhizomes contained 5, 8-henicosdiene (3.27 %), 7- henicosyne (3.70 %), 3, 15- dihydroxy-2-octadecene (45.12%), 6- hydroxyeicosane (5.18 %), tricosane (2.40 %), and tetracosane (1.89 %) [17]. The flavonoids contents of *Canna indica* seeds methanolic

extract were 4.76µg/g, the total polyphenols were 13.79 µg/g[18].

The essential oil of the rhizome of *Canna indica* (yellow flower variety) has been isolated by hydrodistillation and analysed by GC and GC/MS. Forty-three compounds representing 95.32% of the oil have been identified. Percentage composition of the rhizome oil of *Canna indica*: hexanal 0.05, furfural 0.04, heptanol 0.06, α-pinene 0.73, camphene 0.48, β-pinene 3.13, 1,8-cineole 3.17,γ-terpinene 0.71, α-terpinolene 0.22, cis -sabinene hydrate 0.19, β-linalool 0.63, fenchol 0.46, trans -pinocarveol 0.40, 1-terpinen-4-ol 4.60, α-fenchyl acetate 3.26, bornyl acetate 0.52, 2,3-pinanediol 0.08, isobornyl acetate 2.56, geosmin 0.49, β-caryophyllene 2.00, α-caryophyllene 4.78, γ-selinene 5.23, selina-3,7(11)-diene 1.72, trans -nerolidol 3.23, carotol 2.72, caryophyllene oxide 4.96, δ-cadinol 6.33, γ-eudesmol 9.79, 9-cedranone 2.43, tridecanoic acid 2.14, α-acorenol 2.49, myristic acid 1.83, luciferin 5.05, palmitic acid 8.53, dibutyl phthalate 0.85, manool2.75, methyl linoleate 0.63, geranyl linalool 2.75, dodecenyl succinic anhydride 0.98, oleic acid 0.33, stearic acid 0.38, geranylgeraniol acetate 0.50 and 4,8,13-duvatriene-1,3-diol 1.14 [6].

The proximate nutritional and anti-nutritional composition of edible stems of *Canna indica* w*ere* moisture: 89.01%, crude protein: 6.34 ± 0.21 g100/g, crude lipid: 4.31 ± 0.11 g100/g, crude fiber: 5.78 ± 0.08 g100/g, ash: 3.14 ± 0.01 g100/g, nitrogen free extractives: 80.43 g100/g, and calorific value: 1611.54 kJ 100g-1 DM [19].

PHARMACOLOGICAL EFFECTS

Antioxidant effects

The methanolic extract of the aerial parts of the plant was studied for its *in vitro* antioxidant activity in different methods (DPPH radical scavenging assay, nitric oxide scavenging assay, hydrogen peroxide assay and hydroxyl radical scavenging assay). Its free radical scavenging activity was estimated for various concentrations 10 to 100 µg/ml. At 100 µg/ml, DPPH radical scavenging assay, hydroxyl radical scavenging assay, hydrogen peroxide assay and nitric oxide assay showed inhibition of 76.70%, 74.36%, 61.37% and 62.84% respectively(20).However, the DPPH antioxidant activity of the *Canna indica* seeds methanolic extract was 0.502 mg/g [18].

The anthocyanins [Cyanidin-3-O-(6"-O-α-rhamnopyranosyl)-β-glucopyranoside, Cyanidin -3-O-(6"-O-α-rhamnopyranosyl)-β-galactopyranoside, Cyanidin-3-O-β-glucopyranoside and Cyanidin-O-β-galactopyranoside] isolated from the red flowers of *Canna indica* also showed good antioxidant activity [15].

Anti-inflammatory, analgesic and immunomodulatory effects

The effect of *Canna indica* ethanolic extract (CIE) on productions of nitric oxide (NO), prostaglandin E2 (PGE2), and interleukin-1β (IL-1β) in lipopolysaccharide (LPS)-induced RAW 264.7 macrophages was investigated. In addition, the effects of CIE in high glucose (HG)-induced U937 monocytes on mRNA expressions of IL-8 and monocyte chemoattractant protein-1 (MCP-1), and regulation of mitogen-activated protein kinase (MAPK) pathways were also identified. CIE was found to inhibit the production of inflammatory mediators including NO, IL-1β, and PGE2 from LPS-induced RAW 264.7 macrophages. The increases in HG-induced mRNA expressions of IL-8 and MCP-1 were also significantly inhibited by CIE. Stimulation of HG in U937 monocytes resulted in activation of p38 MAPK, ERK1/2, and JNK. However, CIE treatment significantly decreased phosphorylation of p38 MAPK, ERK1/2, and JNK[21].

The effect of benzene and methanol extracts of various parts of *C. indica* on nociceptive response using writhing test and hot plate method in mice was examined. All the extracts of *C. indica* showed significant central and peripheral analgesic activity in hot plate method and acetic acid-induced writhing test respectively, at the dose of 50 mg/ kg ip. Methanolic extract of leaves of *C. induce* showed highest increase in reaction time in hot plate method, while benzene extract of leaves of *C. indica* showed more inhibitory effect on writhing induced by acetic acid [22].

Anti-diarrheal effect

The anti-diarrheal effect of *Canna indica* methanolic extract was evaluated in castor oil-induced diarrhoea, charcoal meal transit and acetylcholine-induced contractions of the isolated rat ileum models. In the castor oil induced diarrhoea, loperamide (5 mg/kg) and 50, 100 and 200 mg/kg of the extract were used and compared with a control (tween 80), while in the gastrointestinal transit, atropine (2.5 mg.kg) and 100 and 200 mg/kg of the extract were used and also compared with a control (tween 80). A dose of 10 mg/ml of the extract was used against acetylcholine induced contractions in the isolated ileum experiments. The extract of *Canna indica* was significantly ($p<0.050$) reduced both the castor oil induced diarrhoea and the charcoal plug transit time in a dose dependent manner. In the castor oil induced diarrhoea, the extract decreased the intraluminal fluid content in mice, with the highest reduction recorded at 200 mg/kg dose of the extract, though this was slightly better than that of loperamide. In the charcoal plug transit, both doses of the extract and atropine were significantly ($p<0.05$) decreased the distance travelled by the charcoal plug in the intestine of the mice, with the 200 mg/kg producing an inhibitory effect higher than that of atropine. The effect of *C indica* on the isolated rat ileum showed that the extract produced significant ($p<0.0001$) inhibitory effect on acetylcholine induced contraction [23].

Hemostatic effect

The hemostatic effect of *Canna indica* was evaluated in mice. The bleeding time (BT), clotting time (CT) and the permeability of abdominal capillary were measured. The results showed that *Canna indica* significantly reduce the BT, CT and the permeability of abdominal capillary [24].

Hepatoprotective activity

The hepatoprotective activity of methanol extract of aerial parts of *Canna indica* L. plant was evaluated against carbon tetrachloride induced hepatotoxicity. Extract at doses (100 and 200mg/kg) restored the levels of all serum parameters like SGPT, SGOT, TB which were elevated in CCl_4 administrated rats. A 10% liver homogenate was used for estimation of catalase, GSH content, LPO level for *in vivo* antioxidant status of liver. All LPO, reduced GSH and catalase levels were observed normal in extract treated rats. Histopathology demonstrated profound necrosis, lymphocytic infiltration was observed in hepatic architecture of carbon tetrachloride treated rats which were found to obtain near normalcy in extract plus carbon tetrachloride administrated rats [25].

Cytotoxic effects

The dichloromethane and ethanol extracts of the leaves of *Canna indica* were evaluated for brine shrimp toxicity. Their LC 50 value were 273.9(167.8-447.0) and>1000 µg/ml respectively [26].

Antibacterial and antiviral effects

Methanolic extract of *Canna indica* leaves and flowers showed antibacterial activity against *B subtilis*. Ethyl acetate extracts of flowers and stems/ barks also showed activity against *B subtilis*, while, hexane and distilled water extracts of *Canna indica* leaves, flowers and stems/ barks showed no antibacterial activity [27]. The oil showed good antibacterial activity against *Staphylococcus aureus* but mild activity against *Bacillus subtilis* [6]. A novel 10 kDa protein with anti-HIV-1 reverse transcriptase (RT) inhibitory activity was isolated from leaves of *Canna indica*L [8].

Anthelmintic effects

Anthelmintic activity of benzene and methanol extracts of various parts of *C. indica* was evaluated on *Pheritima posthuma*. Results showed that the methanolic extract of rhizomes of the plant took less time to cause paralysis of the earthworms [22].

Molluscicidal effects

The molluscicidal activity of ethanol, methanol, ether, chloroform and column purified fraction of *Canna indica* root extracts as well as root powder against the snail *Lymnaea acuminata* was studied. The molluscicidal activity of *C. indica* root was found to be time and dose dependent. The 24, 48, 72, 96 h LC50 of the column-purified root of *C. indica* was 6.54, 5.04, 4.07 and 1.84 mg/l respectively. Accordingly, *C. indica* may be used as potent molluscicides since the concentrations used to kill the snails were not toxic for the fish *Colisafasciatus*, which shares the same habitat with the snail *L. acuminate* [28].

Sublethal *in vivo* 24 h exposure to (40% and 80% of 24 h LC50) active fractions of *Canna indica* root, significantly inhibited the activity of acetyl cholinesterase, acid/alkaline phosphatase, Na+-K+-ATPase and lactic dehydrogenase in the nervous tissue of *Lymnaea acuminata*. The inhibition kinetics of these enzymes indicated that active fractions of the plants caused a competitive inhibition of AChE, LDH, ALP, ACP and Na+-K+-ATPase [29].

Other effects

The polyphenolic compounds from *Canna indica* L. Root increased glucose transport in cultured muscle cells [30].

CONCLUSION

The paper reviewed *Canna indica* as promising medicinal plant with wide range of pharmacological activities which could be utilized in several medical applications because of its effectiveness and safety.

REFERENCES

1. Mishra S, Yadav A, Singh SK. A review of *Canna indica* Linn: pharmacognostic and pharmacological profile. *Journal of Harmonized Research in Pharmacy*, 2(2), 2013, 131-144.
2. http://stuartxchange.com /Tikas.html
3. http://wildlifeofhawaii.com/flowers/1288/canna-indica-indian-shot/
4. Bachheti RK, Rawat GS, Joshi A and Pandey DP. Phytochemical investigation of aerial parts of *Canna indica* collected from Uttarakhand India. *International Journal of Pharm Tech Research*, 5(2), 2013, 294-300.
5. Launert E. Edible and Medicinal Plants. Hamlyn, 1989.
6. Indrayan AK, Bhojak NK, Kumar N , Shatru A and Gaura A. Chemical composition and antimicrobial activity of the essential oil from the rhizome of *Canna indica* Linn. *Indian Journal of Chemistry*, 50B, 2011, 1136-1139.

7. Odugbemi TO, Akinsulire RO, Aibinu IE and FabekuPO.Medicinal plant useful for malarial therapy in Okeigbo, OndoState,South west, Nigeria. *African Journal of Traditional, Complementary and Alternative Medicine*, 2, 2007, 191-198.
8. Thepouyporn A, Yoosook C, Chuakul W, Thirapanmethee K, Napaswad C and Wiwat C. Purification and characterization of anti-HIV-1 protein from *canna indica* leaves. *Southeast Asian J Trop Med Public Health*, 43(5), 2012, 1153-1160.
9. Kirtikar KR and Basu BD. Indian Medicinal Plants, 2nded, International Book Distributors, Dehradun, India, 4, 1987, 2450.
10. Nadkarni AK. Indian MateriaMedica, 3rded, Bombay Popular Prakashan, Bombay, India, 1, 1991, 255.
11. María de las Mercedes Ciciarelli Life Cycle in Natural Populations of *Canna indica* L. from Argentina, 101-114.
12. Lamaeswari G and Ananthi T. Preliminary phytochemical screening and physiochemical characterization of *Canna indica* L. *Int J Pharm Sci Rev Res*, 14(2), 2012, 76-79.
13. Deming RL and Tinoi J. Determination of major caratenoid constituents in Petal extract of Eight selected Flowering in the North of Thailand. *Chiang J Sciences*, 33(2), 2006, 327-334.
14. Kolhe NM, Nirmal SA and Pal SC. Nonpolar compounds from *Canna indica* rhizomes. *Physics, Chemistry and Technology*, 6(1), 2008, 141-146.
15. Srivastava J, Vankar PS. *Canna indica* flower: New source of anthocyanins. *Plant PhysiolBiochem*, 48(12), 2010, 1015-1019.
16. Srivastava J and Vankar PS. Methylated anthocyanidin glycosides from flowers of *Canna indica*. *Carbohydrate Research*, 345(14), 2010, 2023-2029.
17. Nirmal SA, Kolhe NM, Pal SC and Mandal SC. Non polar compounds from *Canna indica* rhizomes. *Physics, Chemistry and Technology*, 6(1), 2008, 141-144.
18. Atrooz OM. The incorporation effect of methanolic extracts of some plants seed on the stability phosphatidylcholine liposomes. *Pakistan Journal of Biological Science*, 10(10), 2007, 1643-1648.
19. Mohan VR and Kalidass C. Nutritional and antinutritional evaluation of some unconventional wild edible plants. *Tropical and Subtropical Agroecosystems*, 12, 2010, 495-506.
20. Joshi YM, Kadam VJ, Kaldhone PR.*In vitro* antioxidant activity of methanolic extract of aerial parts of *Canna indica* L. *Journal of Pharmacy Research*, 2(11), 2009, 1712-1715.
21. Chen HJ, Chen CN, Sung ML, Wu YC, Ko PL and Tso T. *Canna indica* L. attenuates high glucose and lipopolysaccharide-induced inflammatory mediators in monocyte/ macrophage. *Journal of Ethnopharmacology*, 48(1), 2013, 317-321.
22. Nirmal SA, Shelke SM, Gagare PB, Jadhav PR and Dethe PM. Antinociceptive and anthelmintic activity of *Canna indica*. *Natural Product Research*, 21(12), 2007, 1042-1047.
23. Josephine OO, Josephine OO and Cosmos OT. Evaluation of the antidiarrhoea activity of the methanolic extract of *Canna indica* leaf (Cannaceae). *International Journal of Pharmaceutical and Chemical Sciences*, 2(2), 2013, 669-674.
24. Lin ZL, Bai'e Z, Li H, Yun C. Hemostatic Effect of *Canna Indica* L. *Journal of Dali University*, 10(12), 2011, 24-26.
25. Joshi YM, Kadam VJ, Patil YV and Kaldhone PR. Investigation of Hepatoprotective activity of Aerial Parts of *Canna indica* L. on carbon tetrachloride treated rats. *Journal of Pharmacy Research*, 2(12), 2009, 1879-1882.
26. Moshi MJ, Innocent E, Magadula JJ, Otieno DF, Weisheit PK and Nondo RS. Brine shrimp toxicity of some plants used as traditional medicines in Kagera Region, north western Tanzania. *Tanzania Journal of Health Research*, 12(1), 2010, 63-67.
27. Abdullah E, Raus R, Aand Jamal P. Extraction and evaluation of antibacterial activity from selected flowering plants. *American Medical Journal*, 3(1), 2012, 27-32.
28. Tripathi SM and Singh DK. Molluscicidal activity of *Punicagranatum* bark and *Canna indica* root. *Braz J Med Biol Res*, 33(11), 2000, 1351-1353.
29. Tripathi SM, Singh VK, Singh S and Singh DK. Enzyme inhibition by the molluscicidal agent *Punicagranatum* Linn. bark and *Canna indica* Linn root. *Phytotherapy Research*, 18(7), 2004, 501-506.
30. Purintrapiban J, Suttajit M and Forsberg NE. Differential activation of glucose transport in cultured muscle cells by polyphenolic compounds from *Canna indica* L. root. *Biological & Pharmaceutical Bulletin*, 29, 2006, 1995-1998.