HIDDEN POTENTIAL OF CANNA INDICA- ANAMAZING ORNAMENTAL HERB

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Abstract- Canna indicaL.(family Cannaceae), an ornamental herb, possesses innumerable phytochemicals comprising of polyphenolic secondary metabolites flavonoids, isoprene polymers terpenoids, basic nitrogen containing organic molecules alkaloids, proteins, steroids, glycosides, oils, triterpene glycosides saponins, tannins, carbohydrates and pigmentsetc. in good proportions. Traditionally, it has been used as home remedy for different ailments. Studies conducted to explore the potential of this plant reveal that it demonstrates bactericidal, antiviral, anthelmintic, molluscicidal, anesthetic, immunomodulatory, cytotoxic, hemostatic, antihepatotoxicproperties. It also reduces inflammation, controls diarrhea and serves as antioxidant. This article offers details of chemical constituents which are responsible for pharmacological, non-pharmacological properties of Canna indica which may serve as a base to explore its pharmacognostic& pharmacological characteristics that can further be exploited for medicinal and non -medicinal purposes.

1. INTRODUCTION

Since time immemorial human beings are using medicinal/aromatic plants for curing different types of ailments. The connection between human and plants is like the two sides of the same coin. Both of them are dependent on each other for their existence. Man and his eagerness to search natural sources for his requirements are not new. Humans possess enough knowledge from their past experiences to utilize herbal plants as medicines. The latest science advancements in new materials, methods and machines have resulted into multifariousenhancement in exploring, recognizing and identifying new medicinal plants which finally results in isolating many vital and essential molecules for humankind [1]. Canna indica L. is also identified as Indian shot or cane or reed as per Greek origin. Genus Canna belongs to family Cannaceae which is having nineteen species of other flowering plants. Canna indica L. is an ornamental plant of medium height which originated in tropical regions of America. In a short span of time it spread in other parts of world [2].It is an excellent source of natural starch and various phytochemicals [3].

2. PLANT PROFILE

2.1 Botanical Classification

Canna indica belongs to kingdom-Plantae and subkingdom –Tracheobiont which falls in superdivision –Spermatophyta and division –Magnoliophyta. It has been put up in class -Liliopsida; subclass-Zingiberidae; order –Zingiberales which belongs to family-Cannaceae.

2.2 Vernacular Names

Several names have been apportioned in different languages. In English it is named as African arrowroot, Canna lily and Wild canna. French and Spanish people call it Balisier comestible and Chupaflor respectively. In different parts of India it is identified by different names such as Sarvajjaya, SakaSiri, Devkali (Hindi); Kardal (Marathi); Vankelee, Devakuli (Sanskrit); Krishna Tamara (Telugu); Puvalaikalvalai (Tamil); Laphoorit (Manipuri); Sarbajaya, Kalaboti (Bengali) and Kalahu (Kannada).

2.3 Habitat and Geographical Distribution

The Canna can grow in hot and humid environment in South America, Northern Argentina & Philippines,In India in waste places & near water settlements, river sides [6,7].The plant tolerate acidic, neutral & alkaline soils as well as sandy, loamy & clayey soils but they prefer well-drained and moist soil[8,9]. Canna indica develops fully in good sunshine to partial shade but in hot climates some shade at midday time is required.These plants are not very hard and can easily be uprooted. It can be easily promulgated by seeds or root cuttings[6].

2.4 Varieties of Canna species

Different varieties of Canna are Canna amabiss, Canna bangi, Canna coccinea, Canna compacta, Canna discolour, Canna flaccid, Canna glauca,Canna indica,Canna iridiflora,-Canna jaegeriana, Canna tuerckheimii, Canna liliiflora,Canna paniculata, Canna patens,Canna pedunculata,Canna plurituberosa,Canna stenantha,Canna speciosa & Canna jacobiniflora.

3. Traditional use

Canna indica has been utilized for the cure of malaria, stomach problem, dysentery, cuts, urine disorder, fever and dropsy [10,11]. The root extract has been reported for the management of fever, dropsy, and dyspepsia. Oily residue of seeds has been recommended to relieve earaches. The flowers were used as medication for eye related diseases

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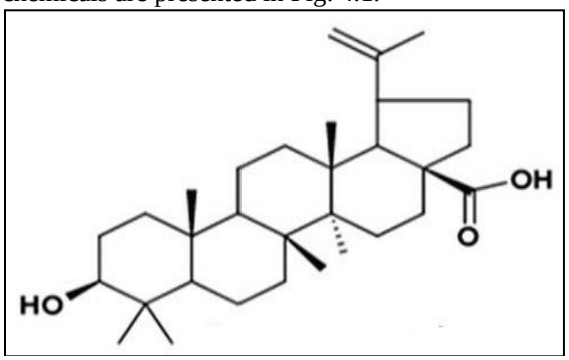
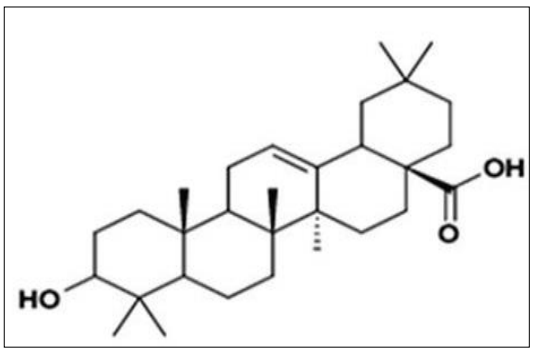
[12,13]. The root contains palatable natural starch and can be used for meal [14]. The powder of dried roots was used to enhance the thickness of sauces and improve the texture of foods [15].

4. PHYTOCONSTITUENTS OF CANNA INDICA

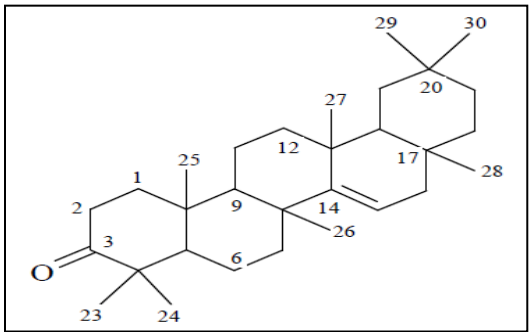
Major chemicals which are present in the plant are represented in Table 1, given below. Structure of some of the chemicals are presented in Fig. 4.1.



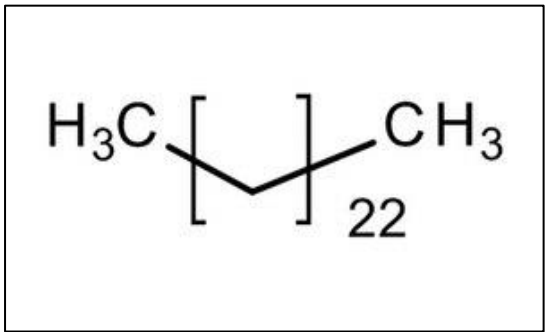
Betulinic acid,(M.P. 295-297°C)



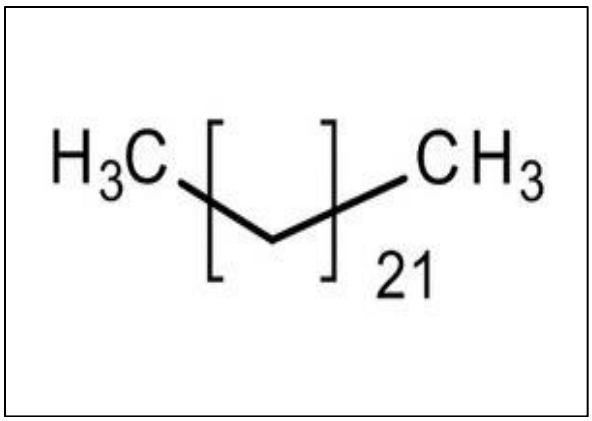
Oleonolic acid, (M.P. 305-306°C)



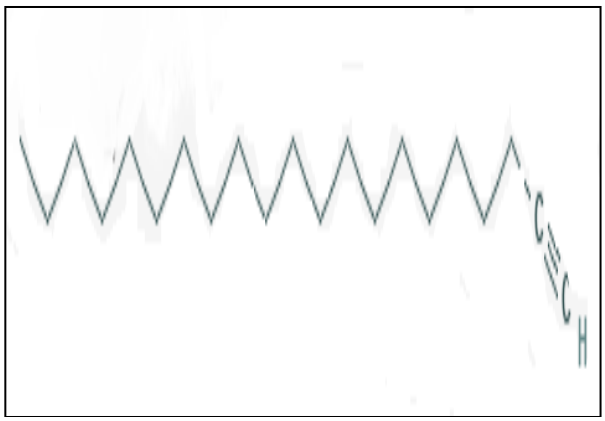
Taraxer-14-en-3-one,(M.P. 150-151°C)



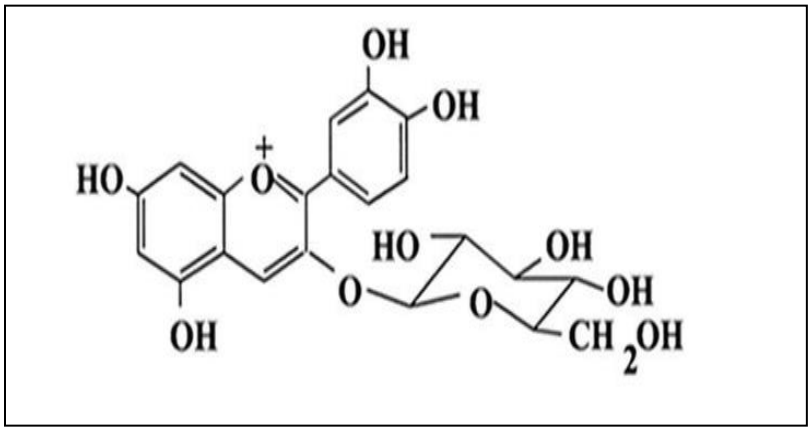
Tetracosane



Tricosane



Henicosine



Cyanidin-3-O-β-glucopyranoside

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Fig. 4.1 Structure of major chemical constituents [24]

Table-4.1 Nutritional and Anti-Nutritional Composition [25]

S. No.	Parameter	Percentage
1	Moisture	89.01 %
2	Crude Protein	6.34 %
3	Crude Lipid	4.31 %
4	Crude Fiber	5.78 %
5	Ash	3.14 %
6	Nitrogen Free Extractive	80.73%
7	Calorific Value	1644.54 KJ/ 100 gm

5. PHARMACOLOGICAL UTILIZATION

5.1 AIDS/HIV1-RT inhibition

Canna indica has been identified as curative herb which have been utilized for treatment of AIDS and has been checked for inhibiton of reverse transcriptase enzyme encoded with human immunodeficiency virus type 1 (HIV-1 RT). Canna indica rhizomes were extracted in water and 80% ethanol and have shown HIV-1 RT inhibition quotient more than 90%. Two proteins isolated from the plant show significant results on HIV-1 RT inhibition [26]. Aputativeplastocyanin protein of molecular weight 10 kDa sequestered from the leaves of Canna indica, exhibit anti-HIV-1 RT inhibitory activity[27].

5.2 Antibacterial

Canna indicaa leaves and flowers were extracted in methanol solvent and extract obtained enumerated bactericidal activity against Bacillus subtilis. Flowers and stems/bark extract in ethyl acetate showed positive response against Bacillus subtilis, whereas, extracts of Canna indica leaves, flowers, and stems in hexane and water solvents did not demonstrate any bactericidal effect [28].

The yellowish-brown oil obtained by root of Canna indica show substantial bactericidal action towards Staphylococcus aureus and slight action is observed for Bacillus subtilis [6].

5.3 Cytotoxicity

Stigmasterol and 6-beta-hydroxy stigmasta-4, 22-diene-3-one obtained from hexane extract of rhizomes of Canna indica L showed cytotoxicity against P388 leukemia cells [29].The extracts of the leaves of Canna indica in dichloromethane and ethanol also displayed anticancer properties[30].

5.4 Antidiarrheal

Antidiarrheal activity of Canna indica was studied by Josphine et. al.,2013. Leaves of this plant were extracted by using methanol by soxhlet extraction method and they have been found to exhibit antidiarrheal property as compared to atropine and loperamide. Even in small amount (10 mg/ml) it was effective in decreasing the fluid production, gastrointestinal motility and acetylcholine prompted shriveling [31].

5.5 Anti-inflammatory

Ethanolic extract of Canna indica was observed to impede the creation of inflammatory mediators including nitric oxide, prostaglandin E2, and interleukin-1β in lipopolysaccharide -induced RAW 264.7macrophages. [32].

5.6 Antinociceptive and anthelmintic

The aerial parts of Canna indica were dried, coarsely powdered and extracted with different organic solvents of having polarity i.e. benzene and methanol and were intraperitoneally evaluated for peripheral analgesic action in hot plate method and acetic acid-induced writhing test, respectively, at the dose of 50 mg/kg−1. It was experimentally observed that methanol extract displayed the maximum upsurge in response time in hot plate method. On the other hand benzene extractpresented the greater inhibition on writhing induced by acetic acid. Anthelmintic behavior of solvent excerpts was assessed on Earthworm. Outcomes revealed that rhizomes extract prepared in methanol took lesser time to bring about immobility of worms [33].

5.7 Antioxidant

Aerial parts of the plant was extracted in methanol and antioxidant behavior was studied by using 1, 1diphenyl-2-picryl hydrazyl [DPPH] radical scavenging assay, NO scavenging assay, hydrogen peroxide assay, and hydroxyl radical scavenging method under variable concentrations ranging from 10–100 μg/ml. It was observed that at a concentration of about 100 μg/ml, DPPH showed inhibition of 76.70 %, hydroxyl radical scavenging assay of 74.36 %, hydrogen peroxide assay of 61.37 %, and NO assay presented inhibition of 62.84%, [34]. It has also been reported Canna indica seed's methanolic extract exhibit antioxidant property[35].

The four anthocyanins extracted from red flowers of Canna indica have been separated and named as Cyanidin-3-O-(6''-O-α- rhamnopyranosyl)-β-glucopyranoside; Cyanidin -3-O-(6''O-α-rhamnopyranosyl)-β-galactopyranoside; Cyanidin-3O-β-glucopyranoside;Cyanidin-O-β-galactopyranosidewhich showed good antioxidant activity[22,24].

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Two new acylatedsucrosesand four other compounds were sequestered from root of Canna indica.in methanol are:

- (6-O-axetoxyl)-β-**D**-fructofuranosyl-(2→1)-(6-O-feruloyl-α- **D**-glucopyranoside
- (6-O-axetoxyl)-β-**D**-fructofuranosyl-(2→1)-(6-O-(E)-p-coumaroyl-α- **D**-glucopyranoside (3) 2-(3′,4′-dihydroxyphenyl)-1-propanol-4′-O-[4‴-hydroxy-3‴,5‴-dimethoxybenzoyl-(→6″)-β-**D**-fructofuranoside
- tryptophol glucoside
- corchonoside C
- (6) 2-hydroxy-5-(2-hydroxyethyl)phenyl β-**D**-fructofuranoside

All compounds were found to be potentially antioxidant [36].

5.8 Hemostatic

The extract of Canna indica was given to rats to study hemostatic effect. The time for blood loss and clot formation deceased as well as permeability of intestinal capillary have been found to be reduced [37].

5.9. Hepatoprotective

The above groundn parts of Canna indica were extracted in methanol and it was given to rats which showed a protective effect against carbon tetrachloride promptedliver toxicity. Necrosis and lymphocytic infiltration attained normalcy to some extent in the rats which were given the extract. The hydro-alcoholic extract also indicated a reasonably good antioxidant and hepatoprotective behavior against reference drug Silymarin [34].

5.10 Molluscicidal

The ether and chloroform extracts of root of Canna indica have been able to kill snails Biomophalairia alexandrina. Oily material extracted from dry plant contained steroids and cannagenin which displayed extremely synergistic influence on the death of snails [38].The molluscicidal behavior of Punica granatum L. and Canna indica L. was studied on snail Lymnaea acuminata. The ethanolic extract of P. granatum showed higher efficacy than that of Canna indica. P. granatum and Canna indica extract killed the snails but it has not been found noxious for the fish Colisa fasciatus, which resides in similar habitation as that of snail L. acuminata[17].

5.11 Nephroprotective

Ethanolic extract of Canna indica rhizomes showed nephroprotective action in gentamycin prompted kidney toxicity in rats.A dosage of 200 and 400 mg/kg was found to offer reasonable protective effect [39].

6. NON – PHARMACOLOGICAL UTILIZATION

6.1 Phytoremediation of Triazophos

Triazophos (O,O-diethyl-O-(1-phenyl-1,2,4-triazole-3-base) sulfur phosphate, (TAP) is an organophosphorus insecticide which goes into water and results in water toxicity for higher animals and fishes. Canna indica has been investigated for phytoremediation of TAP inhydroponic system.It has been found that Canna indica exhibited greater growth capacity under TAP stress. TAP may perhaps kindle the development of microbes and hinder the progression of fungi. Satisfactory association was established amongst the proportion of fungi to bacteria and TAP exclusion. Additionally, presence of gram negative microbes in the phytoremediation system alngwith Canna indica helped in the deterioration of TAP. This Study showed that TAP might encouragethe establishment of microorganisms in the hydroponic environment implanted with Canna indica, which led to the disparity of bacterial colonies and contributed in the phytoremediation.Canna indica potential for eradicating 2, 4, 6-Trichlorophenol (TCP) from water in a hydroponic system and it has been observed that it offers superior prospect for management of waste water for elimination of chlorinated contaminants. [40,41].

6.2 Development of artificial Ecosystem

Presence of nitrogen and phosphorous has been found to impact the development of Canna indica Linn. In miniature wetland. When plants were three months old, significant collaborative impact of N and P on the development and growth of plant was observed. Distribution of nitrogen to leaves and phosphorous to the stems occurred. The growth of the plant was interlinked with nutrient availability. These results revealed that in order to construct artificial wetland having nutrient (N&P) accessibility is essential to encourage for growing of Canna indica[42].

6.3 Translocation of heavy metals

Canna indica has been found to exhibit translocation potential to distribute diverse heavy metals like Cr, Fe, Cd, Cu, Ni, Zn, Mn and Pb to various portions of the plant when they were grown-up on industrial sludge-amended soil. The dissemination has been found to be reliant on time and doses of sludge. The metal distribution was found less in shoot than the roots. Canna indica was found to be appropriate for remediation of soil containing heavy metals [43].

6.4 Phytoremediation of BTEX adulterated soil

The Canna indica plant could amass and translocate benzene, toluene, ethylbenzene and xylenes (BTEX) in bio-accumulation experimentations from soil to the shoot.The Plant has a capacity to eliminate and translocate about 80% of BTEX in the root and rhizome zone soil in 3 weeks.Moreover, the removal efficacy was slightly greater in

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BTEX polluted soil with 40% water content as compared to soil with 20% water amount. These findings are suggestive of the fact that that the soil water ratio also played an important in phytoremediation[44].

6.5 Removal of nutrients from waste water

A study has been reported for removing contaminants from domestic waste water such as N (Nitrogen) and P (Phosphorous) by constructing wetlands vertically (VFCWs) using three different substrates blast furnace artificial slag, coal burn artificial slag, & midsized sand artificial slagwith the help of Canna indica L.[45].

6.6 Phytoremediation of fluoride from water

In a study,Canna indica was observed to absorb fluoride metal from water in greater concentration in the root than that in the soil in which it was planted [46].

6.7 Removal of Lead

An experiment was conducted to ascertain the potential of dried powder of stem of Canna indica was studied on the elimination of Pb(II)from lead nitrate solution and wastewater obtained from paint manufacturing units. The study revealed reduction in the concentration of Pb(II) when a small quantity of dried powder was treated with a higher concentration of lead nitrate($PbNO_3$).The experiment concluded that the best removal efficiencies were found 98% in aqueous solution and 70% in paint wastewater when performed at a pH of 5.5 . This experiment established an alternative natural source for absorbent [47].

6.8 Biosorption and phytotoxicity of chlorophenols

Adsorption and phytotoxicity of pentachlorophenols (PCP) and trichlorophenol(TCP) were probed by taking solutions to Canna indica.Chlorophenols produce chlorosis and necrosis in the plant.The outcomes of the investigation suggested that the biomass of the plant treated with TCP was higher than PCP and Canna indica had a higher degree of tolerance power or can convert more toxic to less toxic metabolites[48].

7. MECHANISM OF PHYTOREMEDIATION OF HEAVY METALS

Phytoremediation of heavy metals generally takes place with five processes they are-

- Phytoextraction: Accumulation by Plants
- Phytofiltration: Removal from water by plants
- Phytostabilization: Stabilizing at the sites of plant
- Phytovolatilization: Transforming less volatile to more volatile
- Phytodegradation: Degrading complex toxic organic material to less toxic form by enzymatic reaction[59].

Experiment was conducted to check the potential of Canna indica to remove heavy metals such as Cr, Fe, Cd, Cu, Ni, Zn, Mn and Pb. These are poorly bound to the matrix of soil and thus make them to translocate easily at the site of roots [60]. On the basis of usefulness they are grouped into essential (i.e. Fe, Cr, Ni. Cu, Zn, Mn) and non-essential Metals (i.e. Pb, Cd). Translocation of heavy metals involves many process such as making metal movement, root absorption, role of vascular tissue, transportation from root to shoot, location at cellular level and finally removal. The mechanisms behind the phytoremediation of insoluble heavy metals is that they gets converted into soluble form after a change of pH with exudates released from root[61].Heavy metals reacts with chelating agents like organic acids released from plants and forms complex molecules. It includes precipitate of carbonate, sulfate and phosphate[43,62].

CONCLUSION

Canna indica is a well-known ornamental plant which has not been much explored for its hidden prospects. Pharmacological andnon- pharmacological utilization of Canna indicahas been summarized in this reviewand it displayed wide range of usages reported so far.The investigations performed are not enough, if compared to other ornamental plants.The use of an ornament plant in phytoremediation of polluted water is a good option for economic and ecologicalpoint of view.Therefore, there is tremendous scope for further research in the near future to explore medicinal as well as non-medicinalusefulness of this plant.

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