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Review Article

A review on the Ethnopharmacological, phytochemical and pharmacological properties of *Hydnocarpus pentandra* (Buch.-Ham.) Oken: A medicinal plant

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Abstract

Hydnocarpus pentandra (Buch.-Ham.) Oken (Family Achariaceae) is a vital plant with numerous traditional significance commonly known as Chaulmoogra. Extracted seed oil (known as Chaulmoogra oil) is used for treating skin disorders, leprosy, verminous, constipation, blood disorders, inflammation, scabies, wound healing, dyspepsia, etc. The aim of the present review focuses on the Ethnopharmacological, Phytochemical constituents, and Pharmacological properties of *Hydnocarpus pentandra* (Buch.-Ham.) Oken. It has been used traditionally to treat skin-related disorders and Hansen's disease (also known as leprosy). The stem and leaf are reported to contain phytoconstituents such as alkaloids, glycosides, flavonoids, phenols, tannins, saponins, terpenoids, fixed oils, and sterols. Along with this, *Hydnocarpus pentandra* (Buch.-Ham.) Oken also has pharmacological activities such as anti-leprosy, anti-bacterial, anti-fungal, larvicidal, antioxidant, anticancer activities, anti-microbial, anti-inflammatory, and antiradical.

Keywords: Chaulmoogra oil, *Hydnocarpus pentandra*, Leprosy, Phytochemical, Pharmacological properties, Phytochemical properties.

INTRODUCTION

Ancient people have been using plants for medicinal purposes long before prehistoric times. Before the advent of modern clinical drugs, the plant material or plant derived extract has been used for treating serious illnesses. *Hydnocarpus pentandra* (Buch.-Ham.) Oken is one such medicinally important plant endemic to the Western Ghats and very commonly found in the south and central Sahyadris (Varghese et al., 2016). According to the IUCN Status, the plant is listed as Vulnerable (Sahoo et al., 2014).

It is a medium size medicinal evergreen tree is found mostly in moist deciduous and semi-evergreen forests of the Western Ghats of India (Joshi & Harijan, 2014). Leaves are simple and alternate; Fruits are spherical, woody, dark

brown in colour and have numerous seeds (Varghese et al., 2016).

In the Indian System of Medicine, the plant is primarily used for treating Hansen's disease (commonly known as leprosy), other minor and major skin disease conditions and also recommended for treating diabetes. Seed oil (Chaulmoogra oil) has good potent action against skin diseases but it also has strong inherent properties due to which the extraction of the oil should be done properly (Angadi & Bairy, 2014). Seed oil contains a characteristic class of cyclopentenyl fatty acids underlying the effect against leprosy (Sahoo et al., 2014). Seed oil also contains constituents such as sterols, flavonoids, triglycerides of fatty acids and flavonolignans. *Hydnocarpus pentandra* (Buch.-Ham.) Oken possesses various pharmacological properties.

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This article details the traditional ethnobotanical, phytochemical and pharmacological properties of the plant *H. pentandra*.

Traditional uses of *Hydnocarpus pentandra* (Buch.-Ham.) Oken:

In Ayurveda, *Hydnocarpus pentandra* (Buch.-Ham.) Oken is also known as Tuvaraka (Synonym- Katukapittha). Seeds of this plant are used for treating eczema, Hansen's disease, obesity, skin disorders, and wound healing.

Local tribes like Paniyan, Mulla kuruma and Kurichar tribes used *Hydnocarpus pentandra* (Buch.-Ham.) Oken for treating skin disease (Chitra & Pillai, 2021). Also, the crushed leaves extract of the plant was applied on to the scalp for inducing hair growth and for its cooling effect (Rajith & Ramachandran, 2010). Fruits as well as leaves of the plant were used as fish poison. Testa (i.e seed coat) were used to make lamps by the Kattunaikka tribe. Local name for the plant *Hydnocarpus pentandra* (Buch.-Ham.) Oken was Nerrubitte and the dried fruits and seeds of this plant were used as a source of income. Along with this, seed oil extracted was used in treating skin disease by the Kattunaikka tribes (Narayanan et al., 2011).

Hydnocarpus pentandra (Buch.-Ham.) Oken was used in Indian folk medicine, Ayurveda and Siddha. Tuvaraka is also recommended for conditions like hemorrhoids, itching, fever, constipation along with abdominal distension, minor and major skin diseases, abdominal diseases, ulcers, inflammation, blood disorders, cervical lymphadenitis, metabolic disorders, sprains, rheumatism and sciatica (Sahoo et al., 2014). Traditionally, 3-5 g of seeds or 5-10 drops of seed oil with honey or ghee or tea was taken orally as a cure for Hansen's disease (Sahoo et al., 2014).

Vernacular names of *Hydnocarpus pentandra* (Buch.-Ham.) Oken:

Kannada- Jangali Badami or Garudaphala

Tamil- Maravatta

Telugu- Adavibadamu

Sanskrit- Tuvaraka (Lucas, 2008).

Phytochemical of *Hydnocarpus pentandra* (Buch.-Ham.) Oken

Cyanogenic Glycosides derived from Cyclopentenyl Glycine - 6'-O- α -l-rhamnopyranosyl taraktophyllin and 6'-O- α -l-rhamnopyranosyl epivolkenin are found in *Hydnocarpus pentandra* (Buch.-Ham.) Oken (Yulvianti & Zidorn, 2021). Seeds of the plant contains two novel cyclopentenoid cyanohydrin glycosides, (1S, 4R) - and (1R, 4S)-1-(6-O-(α -L-rhamnopyranosyl) - β -D-glucopyranosyloxy) -4-hydroxy-2-cyclopentene-1-carbonitrile. Seeds of the plant are reported

to have small amounts of taraktophyllin and epivolkenin (Jaroszewski et al., 1988) and also, contain cyclopentyl mono-carboxylic acid, chaulmoogric acid, hydnocarpic acid, palmitic acid and garlic acid (Shirona & Rajendran, 2014) The plant contains six triterpenoids such as ursolic acid, betulinic acid, acetyl ursolic acid and acetyl betulinic acid (Varghese et al., 2016). Also, flavonoids and flavonolignans along with other compounds like Hydnocarpin, Hydnowitzin and neohydnocarpin are present in the plant *H. pentandra* (David & George, 2015).

Pharmacological activity

Hydnocarpus pentandra (Buch.-Ham.) Oken is very useful in the treatment of diseases such as skin disorders (minor as well as major), leprosy, diabetes, wound healing, body swelling, itching, scabies, fever, verminosis, inflammation, ulcers, metabolic disorder cases, blood disorders, constipation, rheumatic arthritis, bruises and chest infections.

Hydnocarpus pentandra (Buch.-Ham.) Oken has many pharmacological activities which are the result of the presence of diverse secondary metabolites. For screening this phytochemical, ethyl acetate extract of *H. pentandra* plant was used and it showed presence of carbohydrates, saponins, phenolics and glycosides in high amounts and a trace amount of proteins (Shirona & Rajendran, 2014). Also, a HPTLC analysis of methanolic leaf extract was conducted to screen the leaves of the *H. pentandra* for the presence of different secondary metabolites and the result showed presence of phytochemicals namely alkaloids, essential oils, tannins, saponins, flavonoids, triterpenes, flavonolignans, sterols and glycosides (David & George, 2015). The phytochemical screening of ethanolic root extract of *H. pentandra* showed presence of glycosides, flavonoids, carbohydrates, proteins, tannins, saponins, steroids and triterpenoids (Joshi & Harijan, 2014). Also, the physicochemical investigation for the *Hydnocarpus pentandra* (Buch.-Ham.) Oken root showed that the alcohol soluble extractive has presence of phenols, flavonoids, other polar constituents and the fluorescence study of root bark powder showed qualitative evaluation which can be used for identification of the pure root powder (Joshi & Harijan, 2014).

Antidiabetic activity

A work experiment on mice showed that the ethanolic extract of *H. pentandra* has antioxidant and antidiabetic activity (David & George, 2015).

Antioxidant activity

A study was conducted on the antioxidant properties of *H. pentandra* through Ferric thiocyanate (FTC) and DPPH assay showed ethyl acetate extract exhibited higher antioxidant

activity than the standard (α -tocopherol) and ethyl acetate extract showed excellent antioxidant and free radical scavenging activity than methanol and hexane extract respectively (Krishnan et al., 2013). The potent antioxidant property of the plant is due to the presence of high amount of phenolics present in the plant (Krishnan et al., 2013). Also, in a study, antioxidant activity of methanolic leaf extract of *H. Pentandra* and *E. triplinerve* were observed and it showed that leaf extract of *H. pentandra* had higher free radical scavenging activity indicating higher antioxidant activity than the other (Shirona & Rajendran, 2014).

Antimicrobial activity

Hydnocarpus pentandra (Buch.-Ham.) Oken has hydnocarpic acid which is responsible for antimicrobial effects by being an antagonist of biotin (Jacobsen & Levy, 1973).

Antibacterial activity

In a study, Antibacterial activity of methanolic leaf extract of *the plant* was studied against gram positive and gram negative bacteria and the result showed highest inhibitory activity against *B. cereus* and least against *S. typhimurium*. Here, maximum Inhibitory effect was seen against Gram positive bacteria rather than Gram negative bacteria due to presence of an outer membrane (TR et al., 2017). In another study, Antibacterial activity of methanolic leaf extract of *Hydnocarpus pentandra* (Buch.-Ham.) Oken and *E. triplinerve* against *E. coli* and *B. subtilis* and result of the experiment showed *H. pentandra* has higher antibacterial activity rather than *E. triplinerve* (Shirona & Rajendran, 2014).

Antifungal activity

Antifungal activity of aqueous leaf extract was seen against three seed-borne fungi namely *Curvularia sp.*, *Alternaria sp.* and *Fusarium sp.* where Highest and lowest inhibitory effect was observed against *Curvularia sp.* and *Fusarium sp.* (Karthik et al., 2017) and in previous work, the antifungal activity of *H. pentandra* was seen against *Candida tropicalis* (George et al., 2016). Also, in a study earlier on antifungal potential of *Harpullia arborea* and *Hydnocarpus pentandra* (Buch.-Ham.) Oken against 7 seed-borne fungi was observed by food poisoned techniques and results showed that 1mg/ml concentration of methanolic leaf extract inhibited all fungi except for *Penicillium sp.* up to > 50% (TR & KS, 2017).

Insecticidal activity

Insecticidal activity for different methanolic leaf extract against II and IV instar larvae of *A. aegyptii* was observed. More than 50% mortality rate was observed for 1.00 mg/ml and 2.00 mg/ml extract concentration (TR et al., 2017). In Earlier work, 500 ppm concentration of chloroform extract of seeds of *Hydnocarpus pentandra* (Buch.-Ham.) Oken, was

found to be the most effective larvicide against III instar stage larvae of *Aedes aegypti* and *Culex quinquefasciatus* (Sivaraman et al., 2014).

Biodiesel production

In a study, neat *H. pentandra* (Marotti) or Marotti Oil Methyl Ester (MOME) was prepared using raw *H. pentandra* oil which was transesterified by adding along methanol and a base catalyst and this was compared with neat diesel on a direct injection diesel engine. The result showed that it could be used as a suitable DI diesel engine with no further modification on the existing condition (Karthikeyan et al., 2013).

Nanoparticle synthesis

H. pentandra leaf extract was used for green synthesis of spherical silver nanoparticles which was confirmed using UV-visible spectra analysis and SEM Analysis (Kumar et al., 2018). This nanoparticle was tested for its antioxidant by DPPH assay and results showed that the nanoparticles have good antioxidant activity in a dose dependent manner (Kumar et al., 2018).

Anticancer activity

The green synthesized silver nanoparticles from leaf extract of *Hydnocarpus pentandra* (Buch.-Ham.) Oken was tested for in-vitro cytotoxic activity against human breast cancer (MCF-7) cell lines and using MTT assay, the result showed viability of Tumor cells were reduced in a dose-dependent manner (Kumar et al., 2018). Also, in a work aqueous seed extract of the plant *H. pentandra* was studied against ehrlich ascites carcinoma cell lines through Trypan Blue Dye exclusion method and MTT assay method (in-vitro) and using EAC tumor model (for in-vivo) respectively (Rengaraju & Gurunagarajan, 2017). For in-vitro assay, results showed cytotoxic nature against the EAC cell lines at different concentrations and for in-vivo assay, dose-dependent oral administration showed increase in survival time along with decrease in body weight and viable cell count in mice with tumors and overall, suggesting that the seed extract of the plant has anticancer activity against EAC cell lines.

Charcoal production for absorption of dye

Fruits peel of *Hydnocarpus pentandra* (Buch.-Ham.) Oken was used to produce aqueous solvent of activated charcoal which absorbed methylene blue dye. This method provided an alternative and cheap source for adsorption of various dyes from the industries which are responsible for various pollution (Nayak et al., 2021).

Propagation techniques

As discussed above the plant *H. pentandra* had diverse characteristics, medicinal uses and application which led to

its over-exploited. Also, the natural process of germination of the plant is very slow because of its long juvenile phase, woody nature of the tree and the species being dioecious in nature (Bhat et al., 2020). All this led to decline in the population and making it now as one of the vulnerable plants. Hence, there is an urgent need to regenerate the plant through other methods.

In a study, shoot tips were used in tissue culture techniques i.e. callus induction which produces a great number of planting material and the observation showed that some explant showed callus formation and then shoots were produced while in others shoots were directly formed excluding callus formation. Also, the combination of BAP (1 mg/l) and TDZ (0.5 mg/l) gave the maximum number of shoot per explant and also highest shoot length (Bhat et al., 2020). In another work, pre-sowing treatment was given to the seed and it was seen that when seeds were soaked in hot water or cold water for more time or when seeds were treated with sulphuric acid, it showed a decreasing trend in germination or no germination at all. Also, GA treated seed without seed coat showed higher germination rate than GA treated seed with seed coat (Navale & Channabasappa, 2013). Above two methods can be used to produce a maximum number of quality planting materials and to increase the population of the plant to meet today's need for the same plant.

CONCLUSION

Hydnocarpus pentandra (Buch.-Ham.) Oken. is a vital plant used as medicine with many pharmacological activities such as anti-bacterial, anti-cancer, antiradical, anti-inflammatory, anti-microbial, antidiabetic, etc. and have extended use in Ayurveda, Siddha and the Indian folk medicine. Leaf, fruit, seed and root of the plant are of medicinal or other applicational use. Traditionally it is used as medicine to cure leprosy. *H. pentandra* emphasizes on controlling various diseases but cytotoxicity of the plant is not well studied which needs to be further established. Also, further detailed clinical research work on therapeutic potential is needed to establish it as a standard drug.

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