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Botanical features, phytochemical and pharmacological overviews of *Oldenlandia corymbosa* Linn.: A brief review

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Abstract

Since times long folklore medicinal treatment has been used in healthcare system. Herbal medicines are cost effective, inexpensive and have minimum side effects.

Oldenlandia corymbosa Linn. (Family-Rubiaceae) is an annual herb, found in various parts of India. Common name of the plant in English is White Diamond Flower and in Bengali locally it is known as Khet Papra. The plant is also known to deal with heat and different toxic products; it activates blood circulation and diuresis. It is also work against diseases like appendicitis, hepatitis, pneumonia, urinary problems, cellulites and snake bites. In Chinese traditional medicinal practices the plant is used to cure skin infections, ulcers, cold, cough, bronchitis, female disorders and in various inflammations. The plant possesses secondary metabolite substances like flavones, polyphenols, anthocyanidins, iridoids, tannins, various anti-oxidants and alkaloids. Various pharmacological studies concluded some notable activities of the plant such as hepatoprotective, cytotoxic, anti-oxidant, anti-microbial, and abortifacient effects. This review aims to explain the overviews of the various uses and prospects of the plant as well as botanical, taxonomical, phytochemical, pharmacological and toxicological reports and areas of the *Oldenlandia corymbosa*.

Keywords: *Oldenlandia corymbosa*, Khet Papra, traditional medicine, pharmacology

Introduction

Oldenlandia corymbosa Linn. is a plant of flowering plants groups and it belongs to the family of Rubiaceae. It is widely distributed in the tropical and temperate parts of both the hemispheres. It is also found in the Himalayas at an altitude upto 2000 meters. *Oldenlandia* genus has about 240 different species worldwide. *Oldenlandia corymbosa* is an annual herbaceous medicinal weed, found during monsoon in fields, waste places, lawn and some settled areas in countries like India, Sri Lanka, East Asia, and Java Island and in the Philippines [1, 2, 3, 4, 5].

The plant has ascending or erect stems which are 4-angled. Leaves are 1-4 cm in length and 1-6 mm in width, almost stalk less and elliptical or linearly oblong or obovate, with prominent midribs. Flowers contain slender stalks ranging from 3-9 mm, and flowers white or slightly pinkish to purple. Flower tube consists of 4 petals and is about 1.5-2 mm in length. Just above the base of the tube, stamens are inserted. Capsule is about 2x2 mm; it is flattened at the apex region, and slightly compressed.

The plant is known to remove toxic materials, activate blood circulation, promote diuresis and relieve urinary obstructions. It possesses certain properties that prevent tumors of the digestive tract lymph sarcoma and carcinoma of the liver and larynx. It is also active against diseases like appendicitis, hepatitis, pneumonia, cholecystitis, urinary infection, cellulites, snake bite, skin diseases, ulcers, cough, cold, bronchitis, gynaecologic infections and also deals with pelvic inflammatory diseases [6, 7, 8, 9]. In case of the liver diseases, heat burn, vitiated conditions of pitta, hyperdipsia, dyspepsia, flatulence, constipation, helminthiasis, leprosy, skin infections, cold, cough, bronchitis, necrosis, nervous depression caused by deranged bile and hepatopathy, this plant works as an effective curative agent [10]. Different important drugs preparations also happened with the *Oldenlandia corymbosa* which is used to cure various diseases. This medicine preparation concept was developed from folklore medicinal practices. The ayurvedic drugs prepared from the plant are Amritarishtam, Chandanasavam, Mahathikthakam, Jatyadi tailam, Aranyatulyasyadi etc. [11].

Taxonomical Highlights

Domain : Eukaryota
 Kingdom : Plantae
 Phylum : Tracheophyta
 Class : Magnoliopsida
 Order : Rubiales
 Family : Rubiaceae
 Genus : Oldenlandia
 Species : *Oldenlandia Corymbosa*

Botanical Name: *Oldenlandia corymbosa* Linn.
Common Name: Khet Papra, White Diamond Flower
Synonyms: *Hedyotis corymbosa* Linn., *Oldenlandia scabrida* DC.

Botanical Features

Habitat: Grassland, crop field, mountain scrub, shallow soil on rocks, lawn, garden, waste places, roadsides, cultivated and disturbed ground (Fig. 1), at elevations from sea level to 2000 meters [12].



Fig 1: Natural habitat of *Oldenlandia corymbosa*

Growth: It is an annual slender herbaceous weed upto 50 cm tall (Fig. 2).



Fig 2: The plant of *Oldenlandia corymbosa*

Stem: Stem (Fig. 3) of the plant is 4-angled to flat glabrous and angles are thick to wing.



Fig 3: Stem

Leaves: Leaves (Fig. 4) of *Oldenlandia corymbosa* are simple, sub-sessile or has a very short petiole. Leaves are linear, narrowly or finely lanceolate, oblong or obovate or elliptical. Leaves are 1-4 cm in length and 1-6 mm in width, with prominent midribs. The base and apex is acute, margin of leaf is entire, secondary veins are sometimes or not at all visible; stipules are fused to petiole bases.



Fig 4: Leaves

Flower: Inflorescence (Fig. 5) axillary, cymose and contains 2-5 flowers (Fig. 5). Pedicels are slender and 3-11 mm long. Calyx is glabrous. Hypanthium portion is sub-globose or ellipsoid, 0.4-0.8 mm. Limb lobes are essential to base. Lobes are slightly triangular, ranging from 0.6-1.2 mm, entire to ciliate. Corolla is white or pinkish to purple in colour, funnel form to rotate, tube 0.6-1mm, inside pubescent or glabrous. Anthers and stigma are 0.2-0.6 mm and 0.2-0.5 mm long of the flower, respectively.



Fig 5: Inflorescence & Flowers

Fruits & Seeds: Fruit (Fig. 6) capsular, sub-globose, ovoid, 1-2 mm in size, dehiscent through flat to broadly rounded

apex, beak when present to 0.5 mm, as the fruit develops the peduncles and pedicels usually elongates rapidly. Seeds (Fig. 7) are smooth and dark brown^[13, 14].



Fig 6: Fruits



Fig 7: Seeds

Folklore Uses

Edible Uses: The young fresh leaves and stems are cooked with different vegetables like *Amaranthus* and *Cucurbita*, and act as a softener for other cooked vegetables. These are the huge with source of Ascorbic acid. The leaves and stems can be burnt, the ash mixed with water then filtered, and the resultant liquid used as a tenderizer with cooking other vegetables materials^[12].

Ethnomedicinal Uses: The leaves are pounded, soaked in warm water and the liquid used as drink to cure stomach problems. They are applied to treat sore eyes. The entire plant is used as an anthelmintic, anti-rheumatic, depurative, digestive, diuretic, pectoral and stomachic. In India, the plant is a common ingredient in mixtures used internally to cure remittent fevers, gastric irritation, and as a tonic. It is also used to treat jaundice. In African countries it is used in the childbirth. The decoction of the plant is applied to the hands and feet to cool them when the patient has a high fever. The roots are reported to have vermifuge properties. They are used as a tincture^[12, 15, 16].

Other Uses: The root of the plant yields a green dye known as 'gerancine' after mixing with a mordant^[17].

Phytochemical Compounds

A Various phytochemical investigation of *Oldenlandia corymbosa* shows the presence of proteins, polysaccharides, polyphenols, tannins, flavanoids, saponins, steroids, triterpene and glycosides. Some of the isolated compounds from the plants are geniposide, iridoid glycosides, 6, alpha-hydroxygeniposide, scandoside methyl ester, 10-o-benzoylscandoside methyl ester, asperulosidic acid, asperuloside, deacteyl asperuloside, 10-o-p-hydroxy benzoyl scandoside methyl ester, rutin-an-lyoniresinol-3-alpha -o-beta glucopyranoside^[18]. *Oldenlandia corymbosa* contains urosilic acid, oleanolic acid and gamma sitosterol. It was found that the plant contains upto 0.12% of alkaloids-bifloron (yellow crystalline powder) and biflorin (White crystalline powder). These two alkaloids are inter-convertible among each other. *Oldenlandia corymbosa* contains 13.55% of ash content and this compound is mainly responsible for its cooling properties^[19].

Ghosh *et al.* (2018) studied the total plant pigments through a research investigation of different herbs which are basically Indian traditional medicinal plants. The research study found that plant pigments concentration may vary with the different biological parameters. The research study showed that different herbs total plant pigments (chlorophyll-a, chlorophyll-b, total chlorophyll and total carotenoids) concentration may vary with the major environmental or ecological or biogeochemical factors like air pollution and it may vary with different seasonal changes as well. From that study it may be possible that *Oldenlandia corymbosa* total pigment concentration also may be varying by the above mentioned factors. As the plant pigments has huge medicinal importance in traditional medicine system. These plant pigments act as anti-oxidants, anti-cancer agents also. They have different kinds of curative properties^[20, 21, 22].

Pharmacological Effects

Anti-bacterial Activity

Methanol decoctions of *Oldenlandia corymbosa* show anti-bacterial properties against microbes. The powdered plant decoction of the plant was tested for the anti-microbial activities using disc diffusion assay. The extracts of roots, stems, and leaves of the plant was applied to immune-suppressed persons with bacterial or fungal diseases and it showed significant inhibition of growth of bacteria, which proofs that the plant possessed anti-microbial activity. The maximum anti-bacterial activity was observed against *Klebsiella pneumoniae* while maximum anti-fungal effect was found against *Candida albicans*^[23].

Hepato-protective Activity

The hepato-protective properties of the methanol decoctions of the whole plant of *Oldenlandia corymbosa* against paracetamol over dose induced liver damage in animal model were studied. The methanol decoctions of the plant produced prominent hepato-protective properties as evidenced by reduction of serum enzyme activities, SGPT, SGOT, and serum bilirubin, in tested groups, compared to the controlled group. Besides showing prominent anti-lipid peroxidant property *in vitro*, hexobarbitone-induced sleeping time in animal was done by *Oldenlandia corymbosa*. The results thus support the use of *Oldenlandia corymbosa* as a hepato-

protective curative agent in from ancient time periods. Different bio-guided fractionations of ethanol decoctions of the plant in carbon tetrachloride intoxication were also used to investigate the hepato-protective property of the plant. Intoxication with carbon tetrachloride increased the levels of SGOT and SGPT of the liver was concluded as per the results of the experiments carried out. In a research study the ether and butanol fractions at $P < 0.001$ and butanone and ethanol at $P < 0.05$ significantly reduced the elevated levels of SGOT and SGPT, on the other hand no significant reduction with petroleum ether and ethyl acetate decoctions were recorded [24, 25].

Anti-malarial Activity

In a research investigation methanol decoctions of *Oldenlandia corymbosa* was treated *in vitro* on chloroquine sensitive (MRC-pf-20) and resistant (MRC-pf-303) strains of *Plasmodium falciparum* for showing its anti-malarial property. Various concentrations of the plant decoctions on synchronized *Plasmodium falciparum* cultures at the ring stage were used to observe the growth inhibition. The 50% inhibitory concentration (IC₅₀) of *Oldenlandia corymbosa* was found 10.8 µg/ml. In a genuine combination of *Oldenlandia corymbosa* and *Andrographis paniculata* concluded substantial increase in their anti-malarial property [26].

Anti-oxidant Activity

To observe the anti-oxidant activities of the plant chemicals and assays such as 2, 2-diphenyl-1-picryl hydrozyl (DPPH) inhibition assay and 2, 2'-azinobis-3-ethylbenzothiazoline-6-sulfonic acid (ABTS) cation decolorization method, ferric reducing power (FRAP), scavenging capacity towards hydroxyl ion (OH^{*}) radicals and nitric oxide (NO) radical inhibition activity was used. These methods established the presence of anti-oxidant property of the plant in the methanol extract of different parts of *Oldenlandia corymbosa*. Basically these are the screen assays which were used by the researchers to know the anti-oxidants activities. Determination of total polyphenols and flavonoid contents was also carried out by many researchers. High anti-radical property was determined against DPPH, ABTS, nitric oxide and hydroxyl radicals with EC₅₀ value of 82, 150, 130, and 170 µg/ml, respectively. With increasing concentrations of the plant sample with the FRAP was also increased and the results were observed. The anti-oxidant effects of the decoctions of the plant and that of the standard butylated hydroxyl toluene (BHT) were also compared and the results were showed prominent anti-oxidant effects. Total Polyphenolic contents were indicated as the main anti-oxidant components from the high degree of correlation found between total polyphenolics/flavonoids content [27].

Abortifacient Activity

For observing the abortifacient activity force and frequency of contractions were studied and the results were recorded after adding cumulative doses of plant extracts to rat uterine tissue in an organ bath. In this research study acetylcholine was used as positive control. *Oldenlandia corymbosa* plant extract showed the strongest contractions which was compared to the maximum response [28].

Anti-diabetic Activity

A research investigation was carried out to determine the anti-diabetic potentiality of *Oldenlandia corymbosa*. The research

study clearly indicates that the ethanolic extracts of the plant have higher inhibition activities towards alpha-glucosidase. The results showed that 90% reduction in alpha-glucosidase activity. From that *in vitro* study it was concluded that extract of the aerial parts of the plant has significant anti-diabetic activity [29].

Toxicity Reports

Acute-oral Toxicity Test

To observe the safe dose for oral consumption, the toxicity test of water decoctions of *Oldenlandia corymbosa* was done in a research investigation. Five groups of six mice were taken into account for the research purposes. Thirty male and non-pregnant female Swiss albino mice weighing 20 g each were used for these research investigations. They were separately divided into the controlled and treated groups. Each every group except the control group was further separated into four sub-groups of six mice. After 12 hours of fasting, oral administration of the water extract of the plant was applied at the dose of 5, 10, 20 and 40 g/kg body weight. LD₅₀ was obtained by using Thompson and Finney method. LD₅₀ of water decoctions of the plant was 14.14 +/- 0.27 and 10.56 +/- 0.20, respectively [30].

Cytotoxic Effect

Cytotoxic property and its effect in combination with doxorubicin against MCF-7 breast cancer cell line as cell model of doxorubicin resistance were determined from the ethanol decoctions of the plant. To examine the IC (Inhibition concentration) and CI (Combination Index), cell viability tests of EOC, doxorubicin and the combination of EOC and doxorubicin treatments were carried out by MTT assay. Apoptosis assay was carried out by ethidium bromide-acridine orange DNA staining method. Immuno-cytochemistry test was used for investigating the Bcl-2 expression. Cell growth against MCF-7 with IC of 77 µg/ml and 349 nm (0, 19 µg/mL) was inhibited by EOC and doxorubicin respectively. Synergistic properties (CI 0.66-0.99) were shown by Combination of 50 EOC and doxorubicin. Apoptosis was induced by Combination of 25 µg/ml EOC-200 nm doxorubicin and decreased Bcl-2 expression but showed no cell accumulation on cell cycle. Doxorubicin induced high cell accumulation in G2 /M phase, but EOC at the concentration of 25 µg/ml had a low activity in the G1 phase, and EOC IC did not induce cell accumulation otherwise apoptosis. These experimental results showed that cell cycle arrest and non-cell cycle arrest mediates the apoptosis 50 mechanism of combination doxorubicin-ERM. Therefore EOC has a potential property to be developed as co-chemotherapeutic or cancer curative agent [31].

Conclusion

Oldenlandia corymbosa Linn. Possesses various aspects of botanical, phytochemical, pharmacological, therapeutic and nutritional activities. This is an important flowering plant which is used in traditional medicine from ancient time. The review also highlights on the different ethno medicinal, biological, taxonomical and other important biological or biochemical features of *Oldenlandia corymbosa*. The phytochemical and pharmacological study of the plant parts proves its usefulness in clinical studies and for the commercial drug development prospects. The review finds the loop holes of future work as well.

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Conflict of Interest

The authors declare no conflict of interest.

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