Uttaranchal Journal of Applied and Life Sciences
U. J. App. Life. Sci. Vol: 3 (1): 150-164 Dec 2022

Assessment of Ethnopharmacological properties of *Oroxylum indicum*(L.) Kurz: A mini-review

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Received: (20 Oct 2022) Revised: (06 Nov 2022) Accepted: (18 Dec 2022)

Abstract:

In Asian ethnomedical system, *Oroxylum indicum* (L.) Kurz have been used to treat various diseases such as hepatic troubles like jaundice, cardiac diseases, rheumatic and arthritic troubles, ulcers, respiratory problems, gastro-intestinal ailments, headaches, wounds, burns, snake bite and scorpion stings. The present work summarizes the scientific evidences that support therapeutic potential of *O. indicum*. The mini-review is based on the information available on pharmacological and ethnobotanical data of *O. indicum* from various research articles, review papers and book chapters. Various experimental studies have verified the presence of flavonoids, tannins, alkaloids, cardio glycosides, phenols,saponins, sterols and other phytochemicals in *O. indicum*. Numerous active principles have been isolated from different parts of this plant of which most abundant and promising are oroxylin A, Baicalein, Chrysin and Scutellarin. In in vivo and in vitro preclinical models, the plant is found to act against varied microbial infections, gastrointestinal, respiratory, hepatic and cardiac disorders. It is also found to have anti-cancer properties and is also competent in the treatment of diabetes, obesity, wound healing etc

Keywords:

O. indicum,baicalein, anti-cancer, anti-microbial, anti-diabetic

1. INTRODUCTION:

Oroxylumindicum, also known as Indian trumpet tree or midnight horror, is a plant species belonging to the family Bignoniaceae.The plant species has other scientific synonyms viz., *Bignonia indica* L., *Bignonia lugubris*Salisb., *Arthrophyllumreticulatum* Blume ex Miq., *Bignonia pentandra* Lour., *Bignonia tripinnata* Noronha, *Bignonia tuberculata*Roxb. ex DC., and *Calosanthes indica* (L.) Blume**(Jagetia, 2021).**The plant have been used in ethnomedical preparations to treat various ailments ranging from high fever, stomach ache, respiratory diseases, cardiac diseases, digestive ailments to snake bite and scorpion sting. The medicinal wonders of this plant is possible due to the presence of numerous phytochemicals of which oroxylin A, baicalein etc are most widely researched and have major function in anti-cancer activity of the plant

1.1.Plant morphology:

Deciduous, sparingly branched, height upto20 m; Trunk about 45 cm in diameter, outer bark light brown to greyish-brown, soft, corky lenticels present. Innerbark golden-yellow colored(hence the name Sonapatha) **(Kirtikar and Basu, 2001; Paranjpe, 2005).**Leaves crowded, upto2 m long, 3–4 pinnately compound, petiole long, exstipulate, leaf blade ovate – oblong, leaflets 4–18 cm x4–10 cm cuneate base. Inflorescence terminal raceme,25–150 cm long. Flowers bisexual, bracteolate. Calyx coriaceous.Buds upto 5 cm long, brown - dirty violet color, The corolla infundibuliform, about 8 cm long, 5 lobes, subequal, reddish outside, and yellowishto pinkish colored inside. Stamen 5, inserted, hairy atbase. Ovarysuperior, numerous ovules **(Jagetia, 2021).**

1.2.Vernacular names:

English : O. indicum is also known as Tree of Damocles, broken bones, Indian trumpet, and Indian caper**(Jagetia, 2021).**

Hindi: Sonapatha ,Shyonak, Patrorna, Kutannat, Shallaka, , Bhut-Vriksha, Putivriksha Sauna, Shuran, Son, Aralu, Urru, Dirghavrinta,**(Jagetia, 2021).**

Sanskrit :Shyonaka, Simba, Nat,Tuntuka, Dirghavrinta,Sukanasa, Katammar, Mandukparana, Bhalluka, Patroma, **(Jagetia, 2021).**

Gujarati :Mayurjangha,Aralu**(Jagetia, 2021).**

Kannada: Sonepatta, Tigadu,Tattuna, Tattuna. **(Jagetia, 2021).**

Telugu: Dundilamu, Chettu,,Mandukaparamu,Pampena, Pampini, Nemali, Suka-nasamu**(Jagetia, 2021).**

Tamil: Achi, Vengamaram, Palagaipayani,Pana, Pei-maram,Peiarlanke, Peruvaagai, Vangam**(Jagetia, 2021).**

Marathi: Tetu**(Jagetia, 2021).**

Malayalam: Palaqapayyani, Vashrppathiri, Vellapathiri**(Jagetia, 2021).**

Mizo: Archangkawm**(Jagetia, 2021).**

1.3.Geographical Distribution:

It is a deciduous tree found in the tropical and subtropical regions of Asia, including India, China, and Southeast Asia.

1.4. Chemical constituents:

O. indicum contains a wide range of bioactive compounds, including flavonoids, coumarins, alkaloids, terpenoids, and lignans, responsible for its various pharmacological properties. Few of the major bioactive compounds identified in *O. indicum* include chrysin, baicalein, oroxylin A, β-sitosterol, lupeol,scutellarein, quercetin, anthraquinone, aloeemodin, dihydrobaicalein, beta-sitosterol, prunetin, alkaloid, tannic acid, galactose, pterocarpan, rhodioside**(Khare, 2007; Zhong et al, 2007; Dey et al., 1978; Lawania et al., 2010)**

2. ETHNOMEDICAL UTILITIES

O. indicum has a long history of use in traditional medicine systems, including Ayurveda, Siddha, and Unani. These compounds exhibit antioxidant, anti-inflammatory, analgesic, antimicrobial, hepatoprotective, antidiabetic, and anticancer activities (**Dinda et al., 2014**) Various parts of the plant such as bark, flowers, leavesand seeds are used in Ayurveda, the ancient Indian system of medicine, to treat various diseases such as cough, bronchitis, asthma, fever, and liver disorders. **(Sharma et al., 2018).**

Table 1. Ethnobotanical uses of *O. indicum*

Plant part utilized	Ethnomedical use	References
	Hepatoprotective and treatment	**Jamir and Takatemjen (2010);**

Root and/or Root bark	of Jaundice	**Rasadah (2001)**
	Treatment of diarrhoea	**Lawania et al., 2010**
	Treatment of diabetes	**Libman et al. (2006)**
	Treatment of rheumatism	**Lawania et al., 2010**
	Treatment of urinary disorders	**Sreedevi et al., (2011)**
	Treatment of biliousness, Intestinal worms, anal problems	**Lawania et al., 2010**
Stem and/or Stem bark	Hepatoprotective and treatment of Jaundice	**Das and Choudhury, 2012; Sharma et al., 2012,**
	Treatment of cardiac diseases	**Sarkar and Das (2010)**
	Treatment of diabetes	**Chhetri et al. (2005**
	Treatment of arthritic and rheumatic pain	**Laupattarakasem et al. (2003)**
	Treatment of wounds and burns	**Gaur and Sharma (2011**
	Treatment of bronchitis and other respiratory ailments	**Lawania et al., 2010**
	Treatment of malaria	**Shankar et al. (2012)**
	Treatment of menstrual problems	**Majumdar and Datta (2007)**
	Treatment of dermatitis (allergic)	**Rasadah (2001)**
Leaf	Treatment of Aches (headache, toothache etc.)	**Lawania et al., 2010**
	Treatment of snake bite	**Lawania et al., 2010**
	Treatment of scorpion sting	**Naturu et al. (2013)**
Fruits and seeds	Treatment of intestinal worms	**Drury (2006)**
	Hepatoprotective and treatment of Jaundice	**Das and Choudhury, 2012**
	Treatment of bronchitis	**Lawania et al., 2010**

	Treatment of cardiac problems	**Lawania et al., 2010**
	Treatment of epilepsy	**Sharma et al. (2013)**
	Treatment of gastritis	**Lawania et al., 2010**
	Treatment of diarrhoea	**Palasuwan et al. (2005); Gairola et al. (2013)**
	Treatment of pneumonia	**Pradhan and Badola (2008)**

3. PHARMACOLOGICAL ACTIVITIES:

3.1.Antimicrobial activity:

O. indicum has been reported to exhibit significant antimicrobial activity against a range of microorganisms, including bacteria, fungi, and viruses. Several studies have investigated the antibacterial properties of the plant, and the results indicate that it has potential as a natural source of antimicrobial agents.

Dichloromethane extract of *O. indicum* was studied for its antimicrobial activity against bothGram-negativeand Gram positive bacteria. It was found that the extract inhibited the growth of both Gram positive and Gram-negative bacteria**. (Rasadah et al., 1998).**Extract of *O.indicum* in dichloromethane also found to inhibit the growth of wood root fungi and dermatophytes**. (Rasadah et al., 1998).**Alcoholic extract of root and stem of*O.indicum* is also found to repress the growth of , *Escherichia coli, Klebsiella, Proteus, Staphylococcus aureus*and *Pseudomonas***(Radhika et al., 2011).**The methanol extract of stem bark of *O. indicum* has also been found to show activity against various Gram positive bacteria viz., *Bacillus subtilis, Bacillus megaterium,* and Gram negative bacteria viz., *Escherichia coli, Pseudomonas aeruginosa, Salmonella typhi, Shigella dysenteriae,Vibrio parahemolyticus*. *Vibrio mimicus.* The extract was also found to supress the growth of certain fungi viz.,*Aspergillus niger,Saccharomyces cerevisiae* and *Candida albicans***(Islam et al., 2010).** The stem extract of *O. indicum* in ether, dichloromethane, methanol and ether were found to show activity against number of microorganisms including bacteria (*Bacillus cereus, Klebsiella pneumoniae,Bacillus subtilis, Pseudomonas aeruginosa, Escherichia coli,* and *Staphylococcus aureus* bacteria) and fungi (*Aspergillus flavus, Macrofominaphaeolina* and*Aspergillus fumigatus*)**(Moirangthem, 2013)**. A significant reduction in the growth of *Bacillus cereus, Bacillus subtilis, Staphylococcus aureus,* and *Staphylococcus albu*s is reported in the hydroalcoholic extract of stem bark of *O.*

indicum(**Samatha et al., 2011).**The stem bark extract of *O.indicum*in chloroform, hexane, water and ethyl acetate have reported an increased antimicrobial activity against*Bacillus subtilis, Escherichia coli,Staphylococcus aureus,Pseudomonas aeruginosa,* and *Candida albicans***(Kumar et al., 2011).**

In a study by Sithisarn et al., *O. indicum* fruits were gathered from various regions of Thailand. 95% ethanol and Distilled water respectively were used to extract the bioactive components. Using a disc diffusion assay, the in vitro antibacterial properties of both extracts were evaluated against the clinical isolates *S. suis* and *S. intermedius*. They discovered that ethanol-macerated extracts induced stronger antibacterial activity than water-macerated extracts. The half maximal inhibitory concentrations (IC50) of *O. indicum* fruits ethanol extract was reported to be 1.30, 7.81, 39.20, and 66.85 mg/mL against four types of clinically isolated bacteria, namely *S. intermedius, S. suis, P. aeruginosa,* and *E. coli* respectively, while the IC50 of *O. indicum* fruits water extract against these four types of bacteria were 7.81, >250, >125, and >250 mg. The ethanol extract had greater antibacterial potential than the water extract because ethanol extract had a substantially higher flavonoid concentration (baicalein) than the water extract. The researchdemonstrated that the biological activities of baicalein showeddirectly proportional relationship with the antibacterial ability of *O. indicum* extract**(Sithisarn, 2016).**

3.2.Antidiabetic Effect

Increased blood glucose level is indicative of Diabetes mellitus (hyperglycemia). Singh et al., (2013) investigated the effect of compound baicalein in 50% aqueous ethanolic *O. indicum* stem bark extract. Anti-diabetic effects were reported in both in vivo and in vitro which were the result of inhibition of activity of enzyme α-glucosidase. the primary function of α-glucosidase is that it catalyses the hydrolysis of the dietary carbohydrates and starch into glucose. Therefore, inhibition of function of enzyme α-glucosidase might delay the production of glucose which is presumed to be the mode of action of baicalein. In the study it was found that extract of *O. indicum* exhibit the effect of inhibition of enzyme α -glucosidase which is comparable to the effect of acarbose wbich is standard α -glucosidase inhibitor**(Singh et al., 2013)**

Administering 300 and 500 mg/kg b. wt. of ethanolic and aqueous extract of *O. indicum* for 21 days was found to considerably decrease the serum glucose level in Wister rats. **(Tamboli et al.,**

2011).Insulin sensitivity seen in cultured 3T3-L1 mature adipocytes was found to be improved by *O. indicum* extract. 28 days post-treatment of *O. indicum* extract in streptozotocin-induced diabetic rat serum aconsiderablereduction in fasting blood glucose, low density lipo-protein (LDL), Hidh density lipoprotein (HDL) and glycosylated hemoglobin (HbA1c) has been observed. **(Singh et al., 2013)**. Inhibition of intestinal GAA activity in rat has been reported by administration of extract of seeds of *O. indicum* in 90% ethanol. A non-significant decrease in glucose level in fasting alloxan-induced diabetic mice has been reported on administration of 50 and 250 mg/kg b. wt. of alcoholic extract of seeds of *O. indicum*. However, in combination with acarbose, a synergistic effect has been obseverved where a considerable decrease in fasting glucose level has been observed**(Zhang et al., 2017).**Glucose level in streptozotocin-induced diabetic mice has been significantly reduced on administering a combination of 90% ethanol seed extract of *O. indicum* at a dose of 50 and 200 mg/kg b. wt. and acarbose**(Sun et al., 2017).**

3.3.Anticancer Effect

In this study, the mechanisms of action underlying the effects of *O. indicum* leaf and fruit extracts on the migration and viability of MCF-7 breast cancer cells was investigated. Using the assays like sulforhodamine B, caspase 3 activity assays, colony formation, and Western blotting, evaluation of MCF-7 cells that were treated with the extracts was performed. The proliferation of MCF-7 cells was found to be inhibited by *O. indicum* extracts in a concentration- and time-dependent manner, with 48 h IC50 values for leaf and fruit extracts of 57.02 2.85 g/mL and 131.3 19.2 g/mL, respectively. In conclusion, *O. indicum* leaf and fruit extracts inhibit the proliferation, migration and viability of breast cancer cells. Therefore, the components of *O. indicum* might be helpful for boosting the efficacy of chemotherapeutic medicines used in the treatment of breast cancer. **(Buranrat*et al.*, 2020)**. In a studyperformed by Rahman *et al.*, the potential of *O. indicum* extract was determined for increased radiosensitivity towards radiotherapy and it was reported that there was the induction of radiosensitization in HeLa cancer cells by *O. indicum* extract when irradiated by high voltage photon beams which validated the potential of *O. indicum* as radiosensitizer to improve the therapeutic efficacy in radiation therapy**(Rahman et al., 2019)** In the study conducted by Nagasaka*et al.*, a library of 700 wild plant extract from Myanmar was utilized to identify the small molecules with the property to induce p53 transcriptional activity. p53 is a tumor suppressor gene also known as “the genome guardian” which plays a crucial role in cell cycle regulation and in apoptosis thereby averting the development of cancer. The study revealed

that ethanol extract of *O. indicum* bark increases the p53 transcriptional activity. The active component in the *O. indicum* bark extract was found to be Chrysin. It was also revealed in the study that in absence of DNA damage, chrysin activated ATM-Chk2 pathway. These results suggested the potential of *O. indicum* bark extract as anti- cancer drug**(Nagasaka et al., 2018).** Apoptosis is induced in Human breast carcinoma (MDA-MB-435S), human hepatic carcinoma (Hep3B), andhuman prostate cancer(PC-3) on administering aqueous and methanol extracts of *O. indicum***(Rajkumar et al., 2011).** XTT assay reported Dose dependent toxicity in MDA-MB-231 and MCF-7 breast cancer cells in chloroform and petroleum stem bark extract of *O. indicum*. DNA fragmentation also indicated the induction of apoptosis which was measured by ELISA**(Kumar et al., 2012).** The methanolic extract of *O. indicum* leaves have proven the cytotoxic impact on HeLa cells with an IC50 of 3.87 µg/mL, however, no cytotoxicity was observed in normal Vero cells and MDCK cells. The leaf extract of *O. indicum*in methanol is reported to initiate apoptosis, which is characterised by the presence of apoptotic bodies, nuclear fragmentation and condensation**(Jagetia,2021).**

3.4.Wound Healing Effect

In a study conducted by Singh *et al.*, methanolic extract of *O. indicum* root bark has been reported to treat burn injury in mice. The extract was topically applied with the ointment containing 1 and 2.5% of the extract. The wound healing time was found to be reduced and the extract was found to increase collagen synthesis. On histological evaluation it was found that formation of dermis and re-epithelialization have time dependent progression**(Singh et al., 2011)**

3.5.Antiobesity Effect

Obesity is a growing concern among world population since it leads to type II diabetes, cardiovascular diseases etc. It is a major health issue affecting almost 13% of human population. Administering *O. indicum* has shown a reduction in obesity.

Mangal *et al*., in their study found that on treating 3T3-L1 adipocytes with bark extract of O. indicum in dichloromethane, methanol, hexane and ethyl acetate inhibited the accumulation of lipid and reduced the lipase activity. Among all the extracts utilized, ethyl acetate extract was most promising**(Mangal et al., 2017).**Likewise, on exposing 3T3-L1 adipocytes to ethanol fruit extract of *Oroxylum indicum* at 50, 100, 150 or 200 µg/mL of 95% for 2 days and 10 days, the

build-up of lipids as well as the activity of lipase was found to be suppressed in concentration dependent manner. The administration of extract also shows a reduction in carbohydrates, glycogen, nucleic acid, lipids, lipid esters in 3T3-L1 adipocytes **(Hengpratom et al., 2018).**

3.6.Cardioprotective Effect

In the study carried by Menon *et al*., root bark extract of *O. indicum* was studied for its cardioprotective efficacy in Sprague Dawley rats which were doxorubicin-treated.In the study, it was found that rats were resistant towards doxorubicin-induced cardiotoxicity when they were orally administered with 200 and 400 mg/kg b. wt. O. indicum extract for 14 days.It was observed that the methanol extract of O. indicum normalized the ECG, QRS complex and ST-segment depression in the hearts of subject mice. Also, there was a significant reduction in the serum marker enzymes like LDH. On observing the histopathological evaluation, it was found that there has been a significant reduction in the disorganization of myofibrils, fragmentation, focal degeneration and necrotic change in the heart tissue of subject mice after administering them with *O. indicum* extract**(Menon et al., 2019)**.

3.7.Effect against COVID-19 Infection

The entry of COVID-19 in the host cell is facilitated by specific binding of enzyme called angiotensin-converting enzyme II (ACE2) receptors of human organs to corona virus spike protein(s). Thus, the entry of covid 19 can be resisted by blocking ACE2. The study revealed that Oroxylin A present in *O. indicum* have potential to supress the entry of SARS-CoV-2-spiked pseudotyped virus into ACE2 cells since the compound oroxylin A attaches itself to ACE2, thereby obstructing its availability for COVID-19**(Gao et al., 2021).**It was also found that baicalein which is another constituent of *O. indicum* have the potential to inhibit covid 19 virus replication. And it is also found to reduce injury induced by SARS-CoV-2 in cultured Vero cells**(Song et al., 2021)**. In the study by Shah *et al*., it was found by the studies ofmolecular docking opposite the SARS-CoV-2 virus replication, that out of eighteen constituents of *O. indicum*, four of them had the capacityto impede the activity of enzyme main protease thereby restraining COVID-19 infection **(Shah et al., 2021).**

4. RESULTS:

*O. indicum*is traditionally used to treat a wide range of humanhealth ailments and disorders. The scientific assessment of this plant species has demonstrated its cardioprotective, anticancer, hepatoprotective,antimicrobial, anti-obesity, analgesic,antidiabetic,anti-inflammatory,anthelmintic, gastroprotective, wound healing efficacy etc. in variousin vitro and in vivomodels.

5. CONCLUSION:

Historically, *Oroxylum indicum* hasbeen utilized as useful medicinalplantina number of nations since times immemorial. The plant frequently finds its use for its edible and medicinal value inIndiaandChina since it is ethnobotanically utilized as the remedyof range of ailments in the ethnomedical system.

As discussedinthismini - review,thepropertiesof *Oroxylumindicum* (L.) Kurzwouldbeacknowledgedby furtherresearchesin this speciesforthe commercialdevelopment. Althoughnumerouspharmacologicalactivitieshave been already reported butadditionalresearchis required to investigate theethnomedicalpreparationsandextracts and isolatesforthe applicationof this plant species in the manufacturing of effectivedrugs.

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