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OROXYLUMINDICUM: A REVIEW

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ABSTRACT

Oroxylumindicum (Bignoniaceae), also known as Sonapatha or Shyonaka is commonly used herbal medicinein Ayurvedic system. Roots, leaves and stems of *Oroxylumindicum* have been used as a single drug or as acomponent of certain compound drug preparations in the Indian Ayurvedic system of medicine for treatmen to fvarious disorders as well as used as atonic and Rasayana drug. It contains flavonoids like chrysine, baicaleinand Oroxylin -A.Various studies indicated that sonapatha possesses anticancer, antioxidant, hepato protective and immune modulatory properties mainly. Variouso there effects like antibacterial, analgesic and gastro-protective properties of sonapatha have also been reported. It is a tree that is found generally in damp region. In the present review an attempt thasbeen made to compile and critically analyse various published reportson *Oroxylumindicum A*

INTRODUCTION

Oroxylumindicum also known as 'Sonapatha' is an important herb in Ayurvedic medicine and indigeno us medical system for over thousands of years.[1] *Oroxylumindicum* has been used asasingle drug orasa component of certain poly-herbal drug preparations in Indian systemof medicine ie. Ayurveda. It is active ingredient of well known Ayurvedic formulations like Chyavanprash, Dashmularisthaetc.[2] The root bark and stembarkpossess antiallergic properties and are used in treatingallergic disease, urticaria, jaundice, asthma, sore throat, laryngitis, hoarseness, gastralgia, diarrhoea, dysentery, infantile, erythema and measles.[3–4] The normal doseis reported 8 to 16 g of bark in the form of decoction, extract or powder.[4–5] The seeds are active in chroniccough and gastralgia: 5 to 10 g daily in the form of adecoction or powder and al so used as purgative. Analcoholic maceration of fresh bark is applied externally forlacquer allergic dermatitis. The fruits of *Oroxylumindicum*are acrid, sweet, stomachic, anthelmintic, and good indiseases of the heart and the throat, piles, bronchitis,used as an expectorant, improves the appetite, useful inleucoderma.[2,6–10]

BOTANICALDESCRIPTION

It is a tree which can attain a height of 12 meter (40feet). The large leaf stalks wither and fall off the tree andcollect near the base of the trunk, appearing to look likea pile of broken limb bones. The tree is a night-bloomerand flowers are adapted to natural pollination by bats.They form enormous seed pods that hang down frombare branches. Those long fruits curve downward andresemble the wings of a large bird or dangling sickles orswords in the night. The seeds are round with paperywings. Bark is off brown in color. Leaves are 2 to 4 inchlong, broad, leaflets are 5 inch long and 3 to 4 inch broad havings harpedges. The flowers stal kisone feet long. The flowers are purpleincolor. Fruitsare 1 to 3 footlong, 2 to 4 inchbroad. Seeds are flatandare 3 inch in length and 2 inch in width. The flowers are born in rainy season and fruit appears in December to March.[2–3,5]

GEOGRAPHICAL DISTRIBUTION

Oroxylumindicum is native to the Indian subcontinent, in the Himalayan foothills with a part extending to Bhutan and southern China, in Indo-China and the Malaysia ecozone. It is diversely available in the forest of National Parkin Assam, India, reported from SriLanka(Ceylon).[5]

TAXONOMICALCLASSIFICATION[4]

Kingdom	:	Plantae
Division	:	Magnoliophyta
Class	:	Magnoliopsida

Order	:	Lamiales
Family	:	Bignoniaceae
Genus	:	*Oroxylum*
Species	:	*indicum*

SYNONYMS[9–10]

Sansk	:	Prthsuimba,Katvanga
Hindi	:	Sonapatha,Syonak,Tentoo
Eng	:	Indiantrumpletflower
Beng	:	Sonagachh
Guj	:	Tentoo
Punj	:	Tatpaling,Talvarphali
Mar	:	Tentoo
Tamil	:	Peruvaagai

According to Ayurveda it contains[11–13]
Gunna (Properties) – laghu (light), tikshan (sharp) and ruksha (dry). Rasa(Taste) – madhur (sweet), tikta (bitter)
Virya (Potency) – ushan (hot)

CHEMICAL CONSTITUENTS

The chemical constituents of *Oroxylumindicum*are alwaysof an interest for the researcher. A number of secondary metabolites like flavonoids, glycosides, alkaloids, tannins, terpenoids etc. have been reported from various parts oftheplant.

The leaves have been reported containing flavones and theirglycosides baicaleinand scutellarein. Leavesalsocontainananthraquinone, aloe-emodin.[9,17]

FIGURE1: *LOWERSOFOROXYLUMINDICUM*.

FIGURE2: *LEAVESOFOROXYLUMINDICUM*.

FIGURE3: *FRUITOFOROXYLUMINDICUM*.

- Bark of the root is reported with chrysin, baicaleinand oroxylin-A. Bark also gave dihydrobaicalein. Heart wood yield edbeta-sitosterolandaniso-flavone, prunetin. The bark also contains traces of analkaloid, tannicacid, sitosterolandgalactose.[14–15]
- Its root and stem contains three flavones namedoroxylin A (5, 7-dihydroxy-6-methoxyflavone), baicalein (5, 6, 7-trihydroxyflavone) and chrysin (5,7-dihydroxyflavone). It also contains ptero carpan and rhodioside with p-hydroxyphenylethanols andcyclohexanols.[16–18]
- Four flavonoids, chrysin, baicalein, baicalein-7-*O*-glucoside, baicalein-7-*O*-diglucoside (OroxylinB) and one unknown flavonoid have also been is olated from the seeds of *Oroxylumindicum*.[19] Seeds also contains hiny oil, the yield of which was20%.[2]
- In Indian system of medicine the root, bark, stem and leaf are prescribed for snake bite.[2]
- Leaves are used externally to treatanen larged spleen and also to alleviate headaches and ulcersand also reported for its analgesic and anti microbial activity.[20]
- In various tribes of India, bark and seeds of theplant are used in fever, pneumonia and repir at orytroubles.[21–22] It is also used to cure various stomach disorders.[23]
- In Nepal a root decoction is used in diarrhea and dysentery. Seeds are used as adigestive. Aseed paste is applied to treat boils and wounds.The root is used as astringent, anti-inflammatory, aphrodisiac, expectorant, anthelmintic and tonic. The bark is diuretic and stomachic and useful indiarrhoea and dysentery. Root bark and seeds are carminative, stomachic, tonic, diaphoretic and astringent. Root barkis al soused totreatbile problems, cough, diarrhoea, and dysentery.[24] Itis also used in a formulation used for nootropicacitvity.[25]

PHARMACOLOGICALREPORTS

Al though al otof pharmacological and nonpharmacological investigations have been carried out on the plant and its phyto constituents. A summary of the findings of the sestudies is present ed below.

ETHNOMEDICINALUSES

- The root barko fplanti sacrid, bitter, pungent; astringent to the bowels, cooling, aphrodisiac, tonic, increase appetite, useful in "vata", biliousness, fevers, bronchitis, intestinal worms, vomiting, dysentery, leucoderma, asthma, in flammation, analtroubles. It is used to treat diarrhea, dysentery, diaphoretic,and rheumatism.[2–3] Paste prepared from sesameoil (*Sesamumindicum*) and the powdered bark ofthe root is given as digestive tonic. The seeds are purgative and take no rally to treat throat infections and hypertension.[20]
- Thefruitsareacrid, sweet; stomachic, anthelmintic; effective in diseases of the throat and heart, piles, bronchitis, used as an expectorant; improves theappetite; useful inleucoderma.[6–9]

ANTI-INFLAMMATORY ACTIVITY

The aqueous extract of leaves of *Oroxylumindicum* has been reported to possess significant anti-inflammatory activity. The anti-inflammatory activity has been studied*in vivo* in carageenan induced rat paw edema model andit was report ed that aqueous sex tract of *Oroxylumindicum* leaves exhibited significant anti-inflammatory activity at adose level of 150mg/ kg body weight and 300mg/kg body weight. *Oroxylumindicum*aqueous extract at adose of 300 mg/kg body weight showed maximum anti-inflammatory activity. Howeverthe activity producedby both the dose was less effective than the reference standard diclofenac sodium. Extract at both doses show ed significant anti-inflammatory activity at 5hr. against carrageenan injection suggesting that the extract predominantly inhibit there lease of prostaglandin like substances. Inconclusion, leaves of *Oroxylumindicum*showed anti-inflammatory activity which may beattri but edto the presence of different chemical constituents present within.[26] A number of flavonoidal compounds have al sobeen report ed previous lyasanti- Inflammat or yagentand flavonoids present in plant maybe responsible for this activity.

Aqueous and alcoholic extract swere test educing three different *in vitro* systems for effect srelevant toanti-inflammatory activity of stem bark of *Oroxylumindicum*.The aqueous extracts of *O. indicum* significantly reducedmyeloperoxide release. In the rat hind paw edema test, extract al so show ed significantactivity.[27] All these find ingssuggest, *Oroxylumindicum* may be use ful inmanagement of chronic in flammatory conditions like arthiritis.

ANTI-HEPATOTOXICACTIVITY

Leaves of *Oroxylumindicum* are widely use dasaprophy laxis for liver disorders in Indian system of medicine. Tenpe*et al*. reproted anti-hepatotoxic activity of various extracts of *Oroxylumindicum* Vent. Against CCl_4 induced hepatotoxicity. Petether, chloroform, ethanolandaqueous extract swere administer edtodiseased animals (rats) at a dose of 300 mg/kg body weight andserum enzymes levels were observed. All the test groupsshowed a significant reduction in SGOT, SGPT, ALP, totalbilirubin content and a significant increase in the level oftotal protein was observed in CCl_4 and *Oroxylumindicum* treatedrats. Among all the extract set hanolicextract was found to be more effective.[28] Free redical scavenging activity was also report edandhepato protective action of these extracts was likely to be due to its ability to scavengefree radicals and induce microsomal enzymes there by inhibition of the lipid peroxidation induced by CCl_4. Thestudy scientifically proved the folklore use of *Oroxylumindicum* in liver disorders and as an ingredient in various Ayurvedic formulations use din liver disorders.

ANTHELMINTICACTIVITY

Jessica *et al*. evaluated the anthelmintic cactivity of *Oroxylumindicum* agains tequine strongyleeggs *in vitro* and compare dittoivermect in, one of the most effective deworming agents. At a dose of 2×10^{-5}g/mLand greater, hatching of the strongyle eggs was delayedusing *Oroxylumindicum*. 0% hatching was achieved at2×10^{-1} g/mL *Oroxylumindicum*. At a dose of 2×10^{-4} g/Ml and greater, 0% vi ability of the strongy leeggs and larvae was achieved. The results of the study suggested that *Oroxylumindicum* may be an appropriate an the lminticag ainstequine strongyles.[29]

ANTI CANCER ACTIVITY

Various studieshave proved anticancer potential of *Oroxylumindicum* using various models. Narisa *et al.* extracted *Oroxylumindicum* with 95% et hanol and tested forcytotoxic effects determingtheanti-proliferative effects on Hep2 cell lines. Cell proliferation was measure dusingacolori metric method based on the ability of metabolic active cells to cleave the yellow tetrazolium salt XTT to an orange for mazandye and soluble for mazandye was directly quantified using a scanning multi wall spectrophoto meter (ELIS Aplatereader). Ethanolexhibited cytotoxic activity against the Hep2 cell lines ataconcentrationof0.05%.[30]

Roy*etal*. Reported the *in vitro* effects of baicale in on the vi ability and induction of apoptosis in the HL-60 cellline was investigated. The cell vi ability after treating with baicale in for 24h was quantified by counting viable cell susingtrypan bluestaining. The results showed that baicalein caused a 50% inhibition of HL-60cell satc on centrations of 25–30 micro M. The inhibition of proliferation of HL-60 cells due to 36–48h exposure to 10 or 20 micro M baicalein was associated with the accumulation of cell sat Sor G2 Mphases. However, proli feration inhibition at a higher dose maybe associated with induction by apoptosis and terminal deoxynucleotidyl transferase-mediatedd UTP nickendlabeling (TUNEL). The results indicate that baicalein hasanti-tumor effect son human can cercells, and *Oroxylumindicum* extract could be used in supplementary can certherapy.[31]

Nakahara *et al*. reported that methanolic extract of *Oroxylumindicum* strong lyinhibited the mutagenicity of Trp-P-1inan Ames test. The major antimutagenic constituent was identified as baicalein with an IC_{50} value of 2.78+/−0.15 microM. The potentantimutagenicity of the extract was correlated with the high content (3.95+/−0.43%, dry weight) of baicalein. Baicalein act ed as ad esmutagen since itinhibited the N-hydroxylation of Trp-P-2.[32]

Tepsuwan *et al*. report ed the *in vivo* geno toxi cactivity and cell proli ferative activity in stomach mucosa ofmale F344 rats by *in vivo* short-term methods after oral administration of an itrosated *Oroxylumindicum* Ventfraction, which had been found to be mutagenic with out S9 mixto Salmone llatyphimurium TA 98 and TA 100. Administration of the nitrosated *Oroxylumindicum* Vent. fraction at doses of 1 and 2 g/kg body weight induceddose-dependent DNA single-strand scission in the stomach pyloric mucosa 2 h after its administration: adose of 2 g/kg body weight induced an 18-fold increasein the DNA elution rate constant. Administration of then itrosated *Oroxylumindicum* fraction at doses of 0.7-2.8g/kg body weight also induced dose-dependent increases,upto11-fold, inreplicative DNA synthesis in the stomachpy loricmucosa 16 hafter its administration. Moreover administration of the nitrosated *Oroxylumindicum* fraction at doses of 0.25-2.0 g/kg body weight induceddose-dependent increases, up to 100-fold, in or nith inedecarboxy lase activity in the stomachpy loricmuco saw itha maximum 4h after its administration. These results demonstrate that the nitrosated *Oroxylumindicum* fraction has genotoxic and cell proliferative activity in the pyloricmucosao fratstomach *in vivo.*[33]

Leticia *et al*. reported that extract of *Oroxylumindicum* show ed the toxicity ontumorcell lines tested, with anIC_{50} value 19.6µg/ml for CEM, 14.2µg/mlforHL-60, 17.2µg/ml for B-16 and 32.5µg/ml for HCT-8. On the seaurchin eggs, it also inhibit the progression of cell cyclesince the frist cleavage (IC_{50} = 13.5 µg/ml). On the basis of all these finding sit can be concluded that extracts of *Oroxylumindicum*, could be considered as potential sources of anti cancer compounds.[34]

IMMUNOSTIMULATINGACTIVITY

The immune modulatory activity and the mechanism of action of then-but anolfraction (100mg/ kgbody weight, per os, once daily for 22 consecutive days) of the root bark of *Oroxylumindicum*, was reported by Zaveri *et al.* in rats using measures of immune responses to sheepred blood cells (SRBC haemagglutinating antibody [HA] titer) and delayed-type hyper sensitivity (DTH) reactions. Inresponseto SRBC, treatment with then-but anolfraction caused a significant rise in circulating HA titers during secondary antibody responses, indicating apotentiation of certain aspects of the humoral response. The treatment also resulted in a significant rise inpawedema formation, indicating increased host DTH response. Additionally, the antioxidant potential of thedrug was exhibited by significant reductions in whole blood malondialdehyde content along with a rise in the activities/ levels of super oxidedismutase, catalaseand reduced glutathione. Furthermore, histopathologicanalysis oflymphoidt issues show edan increase incellularity, e.g., T-lymphocytes and sinusoids, in the treatment group. Inatripleantigen-mediated immunological edemamodel, the exten to fedemaraised in drug-treated rats was greater compared to thatin control rats, thus confirming enhanced DTH reactionsin response to the drug treatment. Based on the all thesefindings, thereported immunomodulatory activity ofanactivefractionof*O. indicum* might beat tributedtoits ability to enhance specific immune responses (both humoralandcell-mediated) as well as its antioxidant potential.[35] This study also justifies the use of plant in various immunomodulatory formulations of Ayurveda like Chyavanprash etc.

ANTI MICROBIAL ACTIVITY

The anti-microbial activity of various extracts of *Oroxylumindicum*has been screened against fourteen pathogenic bacteria (five gram-positive and ninegram-negative) and seven pathogenic fungi by Kawsar*et al.* using disk diffusion method. The crudeethy lacetate extract show ed mild to moderate activity against all bacteria and fungi where as the methanolic extract show ed little activity against bacteria but moderate activity against fungi. The minimum inhibitory concentration of two isolatedflavonoid compounds from *O. indicum*were

determinedagainst *Bacillus subtilis*, *Staphylococcus aureus*, *Escherichiacoli* and *Shigelladysenteriae* and the values were found to be between 64–128µg/ml. Astudy by That oi *et al.* further confirmed the activity by using different strains.[36–37] Ali*et al.* (1998) studied the effect of dichloromethane extractof *Oroxylumindicum*against dermatophytes and wood rot fungi and reported a strong antifungal activity indichl or omethane extract of *Oroxylumindicum*.[38]

GASTRO-PROTECTIVE ACTIVITY

Zaveri*et al.* reported the gastroprotective activity of 50%alcoholic extract of root bark of *Oroxylumindicum* and itsdifferent fractions viz. petroleum ether, chloroform, ethylacetate and *n*-butanol fractions in ethanol-induced gastri cmucos al damage. *n*-butan ol fraction was al so studied in Water Immersion Plus Restraint Stress (WIRS)-model. Alcoholic extract (300mg/kg) and its different fractions (at a dose of 100–300 mg/kg) showed significant reduction in gastri culceration against ethanol-induced gastric damage. Out of all these fractions, *n*-but anol fraction showed significant maximum inhibition of gastric lesions.InWIRS-model,pretreatmentwith*n*-butanol fractions howed significant antiulcer and antioxidant activity in gastric mucosal homogenates, where it reversed the increase in ulcer index, lipid peroxidation and decrease in superoxidedismutase, catalase and reduced glutathione levels induced by stress. This study reveals significant gastro protective effect of*n*-butanol fraction against both ethanol and WIRS-induced gastri culcersinrats.[39] Flavonoids present in *Oroxylumindicum* Vent. Was found to be responsible for its gastro-protectiveactivity.[40]

CONCLUSION

Oroxylumindicum is a highly placed drugin the Ayurvedic medicine. It is one of the most versatile plants having a wide spectrum of medicinal activities. This medicinal plant is the unique source of various types of compounds having diverse chemical structure and nature. Quite less scientific work has been conducted onthe possible medicinal applications of these compounds and hence extensive investigation is desirable to exploit their therapeutic utility. Although crude extracts fromvarious parts of *Oroxylumindicum* have been assigned various medicinal applications from time immemorial, the probability of converting these promising activities into modern drugs can be explored further only after extensive investigation of its bio activity of responsible constituents, mechanism of action, and toxicity andafter proper standardization. As this approach would bein line with the global scenario which is now changing towards the use of plant products, that are backed byethno traditional medicinal use, which are comparatively non toxic than currently available marketed drugs of other systems.

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