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RESEARCH ARTICLE

A PHYTO-PHARMACOLOGICAL OVERVIEW ON *OROXYLUM INDICUM* (LINN.) VENT.

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Abstract

Oroxylumindicum (Linn.)Vent. is a popular Indian medicinal plant has long been commonly in traditional system of medicine The plant has the importance as its name "Shyonaaka" (An active ingredient of Dashamoola traditional medicine preparation) in history of traditional Indian medicine. The plant has been found to possess diverse number of pharmacological activities. The present paper gives an account of updated information on its phytochemical and pharmacological activities. Present review reveals that the wide range of phytochemical constituent have been isolated from the plant and plant possess important pharmacological activities like antifungal, anathematic, antibacterial, antidiarrhoeal, anticancer, antimutagenic, anti-inflammatory, antitubercular, antihyperglycaemic activity, antioxidant and active against abdominal pain, mouth ulcer, and throat infection. Today, *Oroxylum indicum* is perhaps the most popular herbal medicine in China and Thailand for their medicinal values. These all parameter are very encouraging and indicate the plant should be studied more extensively for its therapeutic benefits.

Introduction:-

Recently, a significant amount of attention has been paid to prevent and cure various human diseases, by using biodegradable plant-based products. In the view of unfavorable and harmful effects of synthetic drugs the western population is searching for some natural counteracts which are effective and have no negative coefficients [1]. Different forms of medicinal herbs have been used in India under innate systems of medicines like Ayurveda, Sidha and Unnai. India is also one of the twelve-mega biodiversity countries in the entire world and interestingly about 45,000 of plants species of all groups have been recorded from India. India is also rich in diverse numbers of flora and fauna in Indian-subcontinent due to the varied climatic conditions [2]. The medicinal history of *Oroxylum indicum* is very vast and also played an important role in medicine in Japan, India and China. It is famous for its treatment in various physical malfunctions like antifungal, antibacterial, etc. It is also believed that it consists anti – inflammatory properties [3].

Synonyms:-

Oroxylum indicum (Linn.) Vent. (Family-Bignoniaceae) the Indian trade name in Hindi is Sonapatha. It is commonly known as Sona, Nasona (Bengali) and Indian trumpet tree (English), Aralu (Gujarati), Shyonaaka (Snaskrit), Tatmorang, Mulin (Punjabi) in different languages and regions of India [4].

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Taxonomical Description:-

Tree *Oroxylum indicum* taxonomically described in following manner [5].

Kingdom:	Plantae
Division:	Magnoliophyta
Order:	Lamiales
Class:	Magnoliopsida
Family:	Bignoniaceae
Genus:	Oroxylum
Species:	indicum

Botanical Description:-

The market samples of *Oroxylum indicum* however, were found to consist of mainly the stem bark pieces and not the root and root bark. Hence a detailed pharmacognostical investigation of the root and stem bark was undertaken. Macroscopically, the root bark is 3-8 mm thick, initially sweet in taste without any offensive smell, rough, greenish to buff colour, with craks and fissures and circular and somewhat vertically elongated leticles on the external surface. The stem bark is greenish yellow, having slight mucilaginous and sweetish taste and seen with patches of brown colour tissue and transversely elongated or circular lenticels. Microscopically the mature root bark is characterizes by the presence of a wide zone of cork cells, groups of stone cells in the phelloderm, secondary phloem occupying the major part of the bark comprising rider triseriate to octaseriate medularry rays in the inner and multiseriate rays in the outer region, phloem fibers which are short, T or Y shaped have bulgings at places. The stem bark however, consist of a narrower zone cork cells, larger groups of stone cells, narrower tri to tetraseriate medullary rays in the inner region and multiseriate rays in the outer region. The phloem fibres are longer, more or less strate and tapering with occasional bulgings and peg like out growths. The two barks show different fluorescence characters. The powder of the root bark mounted in the nitrocellulose give fluorescent brown colour while the stem bark gives bright orange colour[6]. Chemical examination of the root of heartwood of *Oroxylum indicum*[7]. In vitro propagation of *Oroxylum indicum* Vent.was carried out using cotyledonary node explants. Among the different types of cytokinins used for culture establishment, 6-benzyladenine exhibited the best response with higher concentrations (8.87µM or above) for inducing multiple shoots. Inclusion of indole-3-acetic acid (2.85µM) into 6-benzyladenine-supplemented medium triggered a high frequency of response as well as a proliferation of shoots [8].

Geographical Distribution:-

Oroxylum indicum Vent.is a medium sized tree that occurs throughout India in the moist deciduous forest of the Himalayas [9]. The wood is yellowish white to deep yellow in colour, soft, light and homogeneous. Wood emits no characteristic odour and has no taste. The root bark is 3-8mm thick, initially sweet in taste without any offensive smell, rough, grayish to buff colour, with cracks and fissures and circular or somewhat vertically elongated lenticels on the external surface. The stem bark is greenish yellow, having slight mucilaginous and sweetish taste and seen with patches of brown colored tissue and transversely elongated or circular lenticels [10]. This plant is a large evergreen plant, reaching 20m tall with sparse branching and large compound leaves of 1 to 2m in length. The plant looks like branches themselves. They also have side stalk and main stalk, these stalks accumulate at the base of the tree like a collection of bone, and thus its other name is “Broken bone plant”. The large flowers are in terminal branches, the buds fill with liquid, and they open in night emitting a powerful stink to attract bats, which help in pollination, and fruits are long flat pods. The plant is a native of Asia, from the foot of Himalaya & Southern China to India [11].

Active ingredient of Dashmoolarishta:-

This drug constitutes one of the ingredients of a well known Ayurvedic preparation known as Dasamoola-A decoction of 10 roots (Table 1). The root bark is used as an astringent and tonic and also in diarrhoea and dysentery. The stem bark is used in acute rheumatism. In the form of an infusion it is used as a diphoretic. The fruits are used as carminative and stomachic, while the seeds are used as purgative. The roots are used in dropsy and the leaves are reputed as an emollient. The stem is used in scorpion sting. Fruits are also used in Bronchitis for children [12].

Table 1:- Name of plant used in Dasamoola preparation.

S. No.	NAME OF PLANTS
1.	*Stereospermumchelonoides*
2.	*Gmelinaarborea*
3.	*Clerodendrunphlomidis*
4.	*Premnaintegrifolia*
5.	*Aeglemarmelos*
6.	*Solanumindicum*
7.	*Solanumsurattense*
8.	*Desmodiumgangeticum*
9.	*Tribulusterrestris*

Fig. 1: Tree of *Oroxylum indicum*

Fig. 2: Side stalk of *Oroxylum indicum*

Fig. 3: Stem bark of *Oroxylum indicum*

Phytochemical description

The main chemical constituents of *Oroxylum indicum* are Baicalein and Scutellarein. It also contains various flavone glycosides like Baicalein-6-glucuronide, Baicalein-7-glucuonide, and Scutellarein-7-glucuronide [13]. The defatted leaves of *Oroxylum indicum* contain anthraquinone glycosides like aloe-emodin [14]. The heart wood of *Oroxylum indicum* yields β-sitosterol and another compound found to be identical with prunetin-4, 5-dihydroxy-7-methoxy isoflavone [15]. The stem bark of *Oroxylum indicum* contains oroxyin-A, Baicalien and Scutellarein in the ether extract and Scutellarein-7-rutinoside in the ethyl acetate extract. Chrysin and baicalien-7-glucuronide occur in the mother liquor of ethar and ethyl acetate extract where as the mother liquor of aqueous extract yields p-coumaric acid [16]. The seeds *Oroxylum indicum* contain terpenes, alkaloids and saponins whereas sterols and tannin are absent [17].

The ethanolicextact of the defatted seeds yielded a glycoside [18]. Which was later characterized as Baicalien-6-glucoside[19]. A new flavone, oroxindin characterized as 5-hydroxy-8-methoxy-7-O-β-D-glucopyranuronosyl flavone (Wogonin-7-O- β-D-glucuronide) was isolated from the ethanolic extract of the seeds [20].

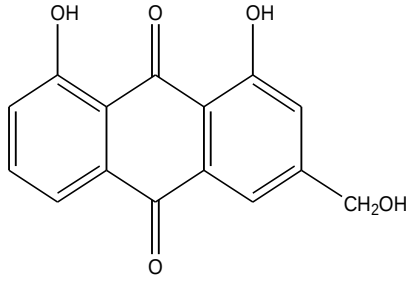

Fig. 4: Aloe-emodin

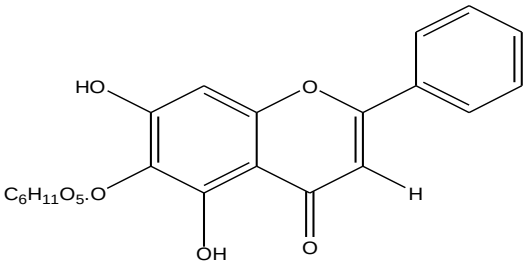

Fig. 5: Baicalien

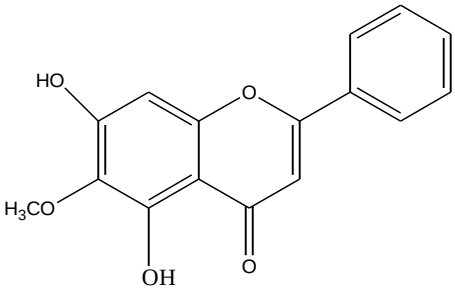

Fig. 6: Oroxylin–A

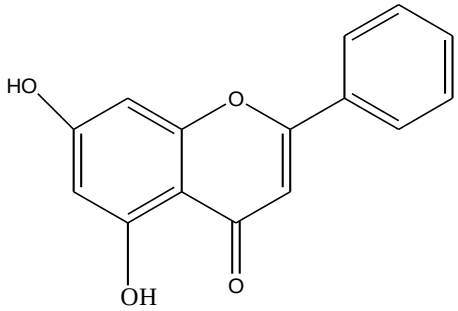

Fig. 7: Chrysin

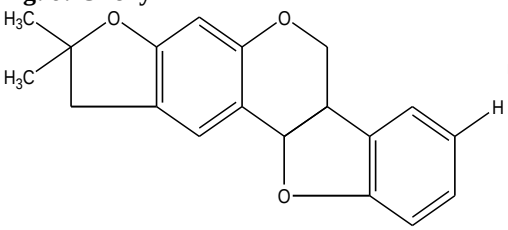

Fig. 8: Methyl oroxylopterocarpan

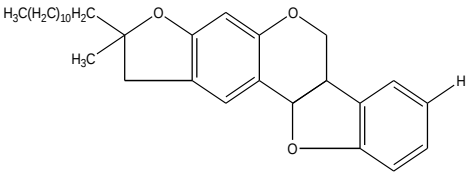

Fig. 9: Undecanyloroxylopterocarpan

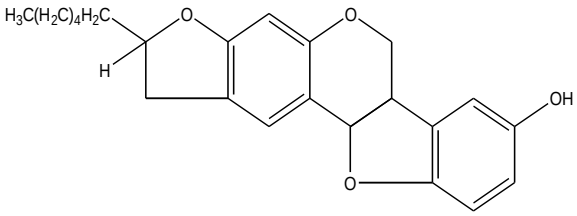

Fig. 10: Hexyl oroxylopterocarpan

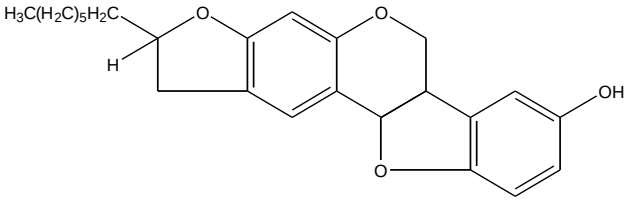

Fig. 11: Heptyloroxylopterocarpan

Nine new compounds which were related to naphthalene basic ring, together with four other compounds were isolated from the root bark of *Oroxylum indicum* Vent.[21]

Pharmacological Description:-

Antibacterial:-

Anti microbial activity of crude petroleum ether, ethyl acetate and methanolic extracts of O.indicum and 2,5-dihydroxy-6, 7-dimethoxy flavone (Compound 1) and 3, 7, 3′, 5′-tetramethoxy-4′-hydroxy flavone (Compound 2) was screened against fourteen (five Gram-psitive and nine Gram-negative) pathogenic bacteria and seven pathogenic fungi using the disk diffusion method. The zones of inhibition produced by the crude petroleum ether, ethyl acetate and methanol extracts and compound 1 and 2 against pathogenic bacteria were found between 8-16, 8-19, 0-8, 9-18 and 9-21 mm, respectively and against pathogenic fungi, 8-20, 8-18, 9-15, 9-20 and 7-18 mm, respectively. The crude petroleum ether, ethyl acetate extracts and compound 1 and 2 showed mild to moderate activity against all

bacteria and fungi, whereas the methanol extract showed little activity against bacteria but moderate activity against fungi [22, 23].

Antidiarrhoeal:-

Methanol extract and chloroform extract of the plant show the Antidiarrhoeal activity. According to a study made on four groups of Swiss albino mice which were kept under different conditions reduced the number of stool more (52.17%) than that observed from the standard drug Loperamide (40.58%). On the contrary the chloroform extract moderately inhibited the number of stool formation (31.88%) [24].

Anticancer:-

Alcoholic extract of the plant *Oroxylum indicum* show antiproliferative effect on in vitro proliferation of human breast cancer cell lines and expression of estrogen receptor alpha-A[25]. 95% ethanolic extract exhibit cytotoxic activity against Hep2 cell lines at a concentration of 0.05%. Flavonoid Baicalein present in the plant has anti-tumor effect on human cancer cell lines [26].

Antimutagenic:-

Methanolic extract of *Oroxylum indicum* strongly inhibited the mutagenicity of Trp-P-1 in an Ames test. In vivo genotoxic activity and cell proliferative activity were examined in the stomach mucosa of male F344 rats by in vivo short-term methods after oral administration of a nitrosated *Oroxylum indicum* Vent fraction, which was found to be mutagenic without S9 mix to Salmonella typhimurium TA98 and TA100 [27].

In vitro effects of baicalein on the viability and induction of apoptosis in the HL-60 cell line was investigated. The cell viability after treating with baicalein for 24 h was quantified by counting viable cells using trypan blue staining. The results showed that baicalein caused a 50% inhibition of HL-60 cells at concentrations of 25–30 microM. The inhibition of proliferation of HL-60 cells due to 36–48 h exposure to 10 or 20 μM baicalein was associated with the accumulation of cells at S or G2M phases. However, proliferation inhibition at a higher dose may be associated with induction by apoptosis and terminal deoxynucleotidyltransferase-mediated dUTP nick end labeling (TUNEL). The results indicate that baicalein has anti-tumor effects on human cancer cells, and *Oroxylum indicum* extract could be used in supplementary cancer therapy [28]. Methanolic extract of *Oroxylum indicum* strongly inhibited the mutagenicity of Trp-P-1 in an Ames test. The major antimutagenic constituent was identified as baicalein with an IC50 value of 2.78+/−0.15 microM. The potent antimutagenicity of the extract was correlated with the high content (3.95+/−0.43%, dry weight) of baicalein. Baicalein acted as a desmutagen since it inhibited the N-hydroxylation of Trp-P-2.

Gastro-Protective Activity:-

50% alcoholic extract of root bark of *Oroxylum indicum* and its different fractions viz. petroleum ether, chloroform, ethyl acetate and n-butanol fractions in ethanol-induced gastric mucosal damage gastroprotective activity and n-butanol fraction was also studied in Water Immersion Plus Restraint Stress (WIRS)-model.

Alcoholic extract (300 mg/kg) and its different fractions (at a dose of 100–300 mg/kg) showed significant reduction in gastric ulceration against ethanol-induced gastric damage. Out of all these fractions, n-butanol fraction showed significant maximum inhibition of gastric lesions. In WIRS-model, pretreatment with n-butanol fraction showed 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 gastroprotective effect of n-butanol fraction against both ethanol and WIRS-induced gastric ulcers in rats. Flavonoids present in *Oroxylum indicum* Vent. was found to be responsible for its gastro-protective activity [29].

Anti-inflammatory:-

Aqueous and alcoholic extracts were tested using three different in vitro systems for effects relevant to anti-inflammatory activity. The aqueous extracts of O. indicum significantly reduced myeloperoxide release [30]. According to a experimental study both root bark and stem bark decoction produced a considerable suppression in edema formation against carrageenan.

Oroxylum indicum leaves exhibited significant anti-inflammatory activity at a dose level of 150mg/kg body weight and 300mg/ kg body weight. *Oroxylum indicum* aqueous extract at a dose of 300 mg/kg body weight showed maximum anti-inflammatory activity. However the activity produced by both the dose was less effective than the

reference standard diclofenac sodium. Extract at both doses showed significant anti-inflammatory activity at 5 hr. against carrageenan injection suggesting that the extract predominantly inhibit the release of prostaglandin like substances. In conclusion, leaves of *Oroxylum indicum* showed anti-inflammatory activity which may be attributed to the presence of different chemical constituents present within [31].

Antihyperglycaemic activity:-
The decocted ethanolicextact of plant is being utilized as an antidiabetic agent by the tribal people Sikkim and Darjeeling Himalayan region [32].

Antioxidant:-
The alcoholic extract of *Oroxylum indicum* showed inhibition of Heinz body induction in an in vitro model and strong total antioxidant activity. Presence of many of the therapeutic potential of the phenolic compounds is reason for the antioxidant property of the plant. Maximum amount of the phenolic compounds are found to be present in leaves extract followed by root, bark and stem extract. The antioxidant activity of phenolic compounds is mainly due to their redox properties, which play an important role in absorbing and neutralizing free radicals, quenching singlet and triplet oxygen, or decomposing peroxides [33].

Diuretic activity:-
Ethnolic extract (50%) of the fruit of *Oroxylum indicum* showed spasmogenic action on isolated guinea pig ileum, where as the root and stem as well as stem bark extracts, had no such effect. The decoction of *Oroxylum indicum* bark showed good diuretic activity in rats, comparing favorably with potassium acetate and being more potent than urea [34].

Immunomodulatory activity:-
The mechanism of action of the n-butanol fraction (100 mg/kg body weight, per os, once daily for 22 consecutive days) of the root bark of *Oroxylum indicum*, vent. (Bignoniaceae) was evaluated in rats using measures of immune responses to sheep red blood cells (SRBC haemagglutinating antibody [HA] titer) and delayed-type hypersensitivity (DTH) reactions. In a triple antigen-mediated immunological edema model, the extent of edema raised in drug-treated rats was greater compared to that in control rats, thus confirming enhanced DTH reactions in response to the drug treatment. Based on the all these findings, the reported immunomodulatory activity of an active fraction of *Oroxylum indicum* might be attributed to its ability to enhance specific immune responses (both humoral and cell-mediated) as well as its antioxidant potential[35].

Antifungal:-
The dichloromethane extracts of *Oroxylum indicum* display antifungal activity against dermatophytes and wood rot fungi. The activity is probably due mainly to lapachol and b-lapachone which were shown to be present in these plant extracts. Microscopical study has shown that these extracts inhibit the development of mycelium and conidia in the filamentous fungi [36].

Conclusion:-
Oroxylum indicum is a unique plant profusely used in Homeopathic, Ayurveda and Unani medicine system to cure both diseases and disorders. Previously reports on their biologically active molecules specify that their physiological and biochemical importance modify during developmental stages. These aspects are very positive for commercial exploration of this plant. To understand the mode of action of different active chemical constituents may provide a special opportunity to develop its various formulations for health benefits. Ariel parts of the plant like bark, root and stalks possess rich flavonoids which might be used against different disorders in future. Whether it also endowed with inimitable property, this natural scientific curiosity was also enthusiastically attended by undertaking detailed exploration of active part and chemical constitution of *Oroxylum indicum*.

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