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Oroxylum indicum– a medicinal plant of North East India: An overview of its nutritional, remedial, and prophylactic properties

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ABSTRACT

Oroxylum indicum (family: Bignoniaceae) or Broken bones tree, which is distributed throughout India and South East Asia. *Oroxylum indicum* is known by such regional names as Bhatghila, Tona, Bhut-vriksha, Shyonaka, and Hanyu pinyin. Over the past two decades, many reports have appeared in mainstream scientific journals describing its nutritional and medicinal properties. While much of this recent enthusiasm indeed appears to be justified, it is critical to separate rigorous scientific evidence from anecdote. The present review provides the complete information about literatures of *Oroxylum indicum* as botanical descriptions, vernacular names, biological activity of plant parts, ethanomedicinal uses and current status of research with scope of investigation of *Oroxylum indicum* for future research. The structures of twenty eight isolated compounds from different parts of *Oroxylum indicum* with IUPAC names, molecular formula, formula weight, melting points were also reported in this study.

INTRODUCTION

Plants contain a broad range of bioactive compounds such as lipids, carbohydrates, phenolics, terpenoids, carotenoids, anthocyanins, flavors and fragrances (Wang *et al*., 2006). Almost half of the best-selling pharmaceuticals are natural or closely related to natural products, which tell the tremendous potential for the identification of novel medicinally important bioactive compounds from these sources. It has been estimated that only a small percentage of compounds from biological sources have been isolated and investigated (Strege, 1999). There is increasing interest both in the industry and in scientific research for spices and aromatic herbs because of their strong biological properties. *Oroxylum indicum* (*Bignoniaceae*) a broken bone tree is a native tree often grown as an ornamental for its strange appearance. Mostly sighted along the river banks or slopes of the hills.

Except in the western drier area, the plant is distributed throughout India and South East Asia. *Oroxylum indicum* (Kurz.) is a traditional herbal medicine in China and Japan (Kamkaen *et al*., 2006). The use of this plant for the treatment of various ailments is part of the local tribal communities' knowledge of various tribes in Manipur (India) such as Anal, Kuki, Mao, Maram, Tanghkul and Zeliangrong (http://www.nif.org.in.). It is safe for human consumption when taken in normal dosage (http://www.ecoplanet.in/). *Oroxylum indicum* is one of the herbs from the group-Dasamula herbal product (http://www.herbal cureindia.com/). It is the purpose of this brief reviews to: (a) critically evaluate the published scientific evidence on *Oroxylum indicum*, (b) highlight claims from the traditional and tribal medicinal lore and from non-peer reviewed sources that would benefit from further, rigorous scientific evaluation, and (c) suggest directions for future clinical research that could be carried out by local investigators in developing regions.

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Efflorescence

Fruit Pod

Leaves

Stem bark

IMPORTANTCE OF BIGNONIACEAE FAMILY

The family Bignoniaceae, or Trumpet Creeper family, is a family of flowering plants comprising of about 650-750 species in 116-120 genera. Members of the family are mostly trees and shrubs and more rarely lianas (Podranea and Macfadyena) and herbaceous plants. As shrubs, they are twine climbers or tendril climbers, and rarely root climbers. The family and its genus Bignonia was named after Jean-Paul Bignon by his protégé Joseph Pitton de Tournefort in 1694 (http://en.wikipedia.org/wiki/ Bignoniaceae.).The family has cosmopolitan present in both the Old World and the New World, with Catalpa the only genus common to both. Members are distributed mostly in the tropics and subtropics, with the center of diversity in South America. A number of temperate species are found, mainly in North America and East Asia. Thirteen species in 8 genera (including 2 naturalized) are present in southern Africa, 12 genera and 35 species are present in China, 21 of which are endemic to China. In Australia, 10 genera and 17 species are found, only in the mainland states. In India, the family is represented by 15 genera and 40 species, which mostly occur in Western and Southern India and a few species in the Himalayas (http://en.wikipedia.org/ wiki/Bignoniaceae).

Besides their use as ornamental plants, some members also provide timber, such as roble de sabana (*Tabebuia rosea*), Catalpa, Oroxylum, Haplophragma, Spathodea, Meliosma, Stereospermum. Fruit from the calabash tree (*Crescentia cujete*) is used in the tropics as a water container. The fruit of the sausage tree (*Kigelia africana*) is used in Africa as a laxative and for dysentery. The jacaranda is common as an avenue tree. Compounds detected from this family include anthraquinones (found in 4 genera), verbascosides (found in 8 genera), cornoside (found in Eccremocarpus), quercetin, ursolic acid and more rarely, saponins (http://en.wikipedia.org/wiki/Bignoniaceae.).

TAXONOMICAL CLASSIFICATION

Oroxylum indicum (L.)Vent. belongs to the family Bignoniaceae. Its taxonomical classification reported in literature (http://www.ncbi.nlm.nih.gov/Taxonomy/) is as given below:

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

BOTANICAL DESCRIPTION

A small tree, 8-15 m tall, branched at top; bark light-brown, soft with green juice and often with numerous corky lenticels. Leaves are 3-7 cm long, 2-3 pinnate with opposite pinnae, rachis very stout, cylindrical, leaflets 2-4 pairs, 6-12 cm long and 4-10 cm broad, ovate or elliptic, acuminate, glabrous, base rounded or sometimes cordate; petioles of the lateral leaflets 6-15 mm long. Flowers numerous, foetid, in large erect racemes, 0.3-0.6 meter long or even more pedicels 6-30 mm long. Calyx 4 cm long, leathery, oblong-campanulate and glabrous. Corolla usually lurid-purple, reaching 10 cm long, fleshy lobes about 4 cm long with crisped margins. Stamens 5, slightly exerted beyond the corolla tube, one of them little shorter than the 4, filaments cottony at the base. Capsules 0.3-0.6 meter long and 5-9 cm broad, straight, tapering to both ends, flat, hardly 8 mm thick, acute, valves semi-woody. Seeds numerous, 6 cm long, winged all round except at the base (http://enwikipedia.org/wiki/oroxylum_ indicum; Kirtikar & Basu, 2001; Ayurvedic Pharmacopoeia of India). In India, the plants flower any time during August to February depending on climate.

GEOGRAPHICAL DISTRIBUTION

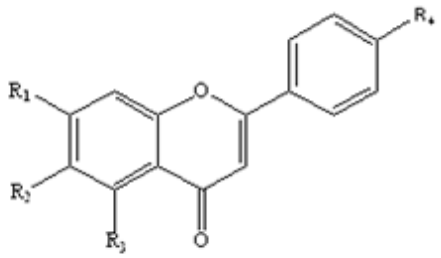
It is native to the Indian subcontinent, in the Himalayan foothills with a part extending to Bhutan and southern China, in Indo-China and the Malaysia ecozone. It is visible in the forest biome of Manas National Park in Assam, India. It is also reported from Sri Lanka (Ceylon) (Theobald, 1981). It is found in Fujian, Guangdong, Guangxi, Guizhou, Sichuan, Taiwan, Yunnan, Cambodia, India, Indonesia (Java, Sumatra), Laos, Malaysia, Myanmar, Nepal, Philippines, Thailand and Vietnam (Lawania *et al*., 2010; Maciuk *et al*., 2000).

Synonyms

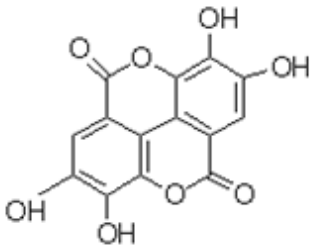
The synonyms of *Oroxylum indicum* species discussed by different committees, which are: *Bignonia indica* L. (Species Plantarum, 1753), *Spathodea indica* L. (Pers.) (Synopsis Plantarum, 1807), *Calosanthes indica* L. (Blume.) (Blume, 1826), *Hippoxylon indica* L. (Raf.) (Sylva Telluriana, 1838), *Oroxylum*

Table 1. Previously isolated compounds from different parts of *Oroxylum indicum.*

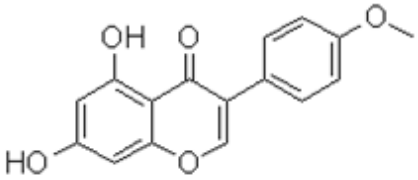
Entry	Compound Name	IUPAC Name	Molecular Formula	Formula Weight	Melting Point (°C)	Fig. no.	Reference
1.	Baicalein	5,6,7-Trihydroxy-2-phenyl-4H-1-bezopyran-4-one	$C_{15}H_{10}O_5$	270.24	263.7	I	Sankara *et al*., 1972 A ; Sankara *et al*., 1972 B.
2.	Biochanin A	5, 7-Dihydroxy-4'-methoxyisoflavone	$C_{16}H_{12}O_5$	284.26	211.5	IV	Sankara *et al*., 1972 A ; Sankara *et al*., 1972 B.
3.	8, 8' Bis-baicalein	-	$C_{30}H_{18}O_{10}$	539	238	VII	Dinda *et al*., 2007.
4.	Chrysin	5,7-Dihydroxy-2-phenyl-4H-1-bezopyran-4-one	$C_{15}H_{10}O_4$	254.24	286	II	Dinda *et al*., 2007, Sankara *et al*., 1972 A; Sankara *et al*., 1972 B.
5.	Ellagic acid	2,3,7,8-Tetrahydroxy [1]-benzopyrano [5,4,3-cde][1] benzopyran-5,10 dione	$C_{14}H_6O_8$	302.19	≥ 350	III	Vasanth *et al*., 1991; Dinda *et al.*, 2007.
6.	6–Hydroxy luteolin	2-(3,4-dihydroxyphenyl)-5,6,7-trihydroxy-4H-1-benzopyran-4-one	$C_{15}H_{10}O_6$	286	284	X	Dinda *et al.*, 2007.
7.	Oroxylin A	5, 7-dihydroxy-6-methoxy flavone	$C_{16}H_{12}O_5$	284.25	197	VI	Rao *et al*., 2007; Vasanth *et al*., 1991.
8.	Oroxoloside methyl ester	3,4,5–trihydroxy–6-(6-methoxy-4-oxo-2-phenyl-4-H-chromen-7-yloxy) tetrahydropyran-2-carboxylic acid methyl ester	$C_{23}H_{27}O_{11}$	475	201	XI	Rao *et al*., 2007; Vasanth *et al*., 1991; Rao *et al*., 2011.
9.	β-Sitosterol	17-(5-Ethyl-6-methylheptan-2-yl)-10,13-dimethyl-2,3,4,7,8,9,11,12,14,15,16,17-dodecahydro-1*H*-cyclopenta[*a*]phenanthren-3-ol	$C_{29}H_{50}O$	414	142	VIII	Dinda *et al*., 2007.
10.	Scuttellarien	5,6,7,4'-Tetrahydroxy-2-phenyl-4H-1-bezopyran-4-one	$C_{15}H_{10}O_6$	297	300	IX	Dinda *et al*., 2007.
11.	Ursolic acid	[(3β)-3-Hydroxyurs-12-en-28-oic acid]	$C_{30}H_{48}O_3$	456.70	292	V	Suratwadee *et al*., 2002.
12.	-	Chrysin 6-C-β-D-glucopyranosyl-8-O-β-D-glucuronopyranoside	$C_{28}H_{30}O_{14}$	615.13	-	XII	Yan *et al*., 2011.
13.	-	Baicalein 7-O-β-D-glucuronopyranosyl-(1→3)[β-Dglucopyranosyl-(1→6)]-β-D-glucopyranoside	$C_{32}H_{37}O_{21}$	769.17	-	XIII	Yan *et al*., 2011.
14.		Scutellarein 7-O-β-D-glucopyranosyl-(1→6)-β-D-glucopyranoside	$C_{27}H_{28}O_{17}$	611.16	-	XIV	Yan *et al*., 2011.
15.	-	2-Methyl-6-phenyl-4H-pyran-4-one	$C_{12}H_{10}O_2$	186.9	81.87	XXV	Yan *et al*., 2011.
16.	Chrysin-7-Ogentiobioside	5-hydroxy-2-phenyl-7-((3S,4S,5S)-3,4,5-trihydroxy-6-(((3S,5S)-3,4,5,6-tetrahydroxy-tetrahydro-2H-pyran-2-yloxy)methyl)-tetrahydro-2H-pyran-2-yloxy)-4H-chromen-4-one	$C_{26}H_{28}O_{14}$	564	-	XV	Yan *et al*., 2011.
17.	Baicalein-7-O-diglucoside	5,6-dihydroxy-2-phenyl-7-((3S,4S,5S)-3,4,5-trihydroxy-6-(((3S,5S)-3,4,5,6-tetrahydroxy-tetrahydro-2H-pyran-2-yloxy)methyl)-tetrahydro-2H-pyran-2-yloxy)-4H-chromen-4-one	$C_{26}H_{28}O_{15}$	580	-	XVI	Yan *et al*., 2011.
18.	Baicalein-7-O-glucoside	5-hydroxy-2-phenyl-7-((3S,4S,5S)-3,4,5-trihydroxy-6-(hydroxymethyl)-tetrahydro-2H-pyran-2-yloxy)-4H-chromen-4-one	$C_{21}H_{20}O_9$	416	-	XVII	Yan *et al*., 2011.
19.	Scutellarein-7-O-glucopyranoside	-	$C_{21}H_{20}O_{11}$	448.38	-	XVIII	Yan *et al*., 2011;
20.	Aequinetin	Chrysin-7-O-glucuronide	$C_{22}H_{20}O_{10}$	416.38	-	XIX	Yan *et al*., 2011;
21.	Chrysin-6-C-β-D-glucopyranosyl-8-C-α-L arabinopyranoside	5,7-dihydroxy-2-phenyl-6-((2S,3S,4R,5S)-3,4,5-trihydroxy-6-(hydroxymethyl)-tetrahydro-2H-pyran-2-yl)-8-((2R,5S)-3,4,5-trihydroxy-tetrahydro-2H-pyran-2-yl)-4H-chromen-4-one	$C_{26}H_{28}O_{13}$	548	-	XX	Yan *et al*., 2011.
22.	Pinocembrin	5,7-dihydroxy-2-phenyl-2	$C_{15}H_{12}O_4$	256.25	203	XXI	Yan *et al*., 2011;
23.	Pinobanksin	3,5,7-trihydroxyflavanone,	$C_{15}H_{12}O_5$	272.25	-	XXII	Yan *et al*., 2011.
24.	Lupeol	(1R,3aR,5aR,5bR,9S,10R,11aS)-3a,5a,5b,8,8,9,10,11a-octamethyl-1-(prop-1-en-2-yl)-icosahydro-1H-cyclopenta[a]chrysene	$C_{30}H_{50}O$	426.71	218	XXIII	Yan *et al*., 2011;.
25.	2α-Hydroxyl lupeol	-	$C_{30}H_{50}O_2$	440	-	XXIV	Yan *et al*., 2011.
26.	Echinulin	(3S,6S)-3-[[2-(1,1-Dimethyl-2-propenyl)-5,7-bis(3-methyl-2-butenyl)-1H-indol-3-yl]methyl]-6-methyl-2,5-piperazinedione	$C_{29}H_{39}N_3O_2$	461.7	-	XXVII	Yan *et al*., 2011.
27.	Adenosine	2-(6-amino-9H-purin-9-yl)-5-(hydroxymethyl)furan-3,4-diol	$C_{10}H_{13}N_5O_4$	267.24	234	XXVIII	Yan *et al*., 2011.
28.	Dimethyl Sulfone	Methylsulfonylmethane	$C_2H_6O_2S$	94.13	109	XXVI	Yan *et al*., 2011.



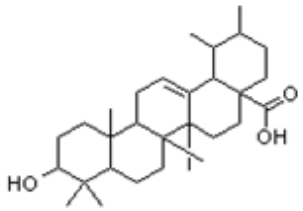
(I) R_1 = OH, R_2 = OH, R_3 = OH, Baicalein
(II) R_1 = OH, R_2 = H, R_3 = OH, Chrysin
(IX) R_1 = OH, R_2 = OH, R_3 = OH, R_4 = OH, Scutellarein



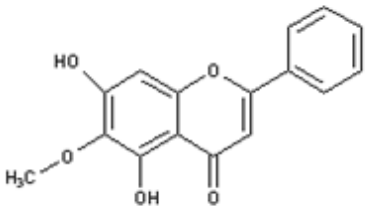
(III) Ellagic acid



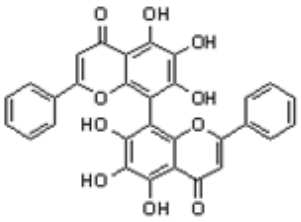
(IV) Biochanin A



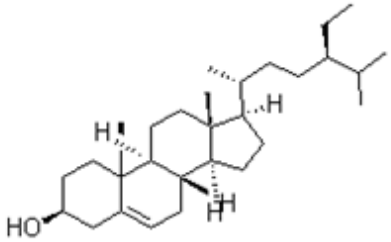
(V) Ursolic acid



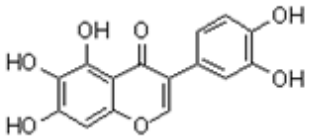
(VI) Oroxylin A



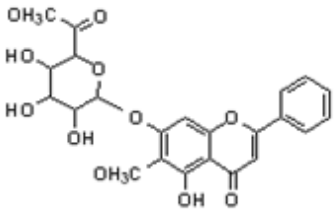
(VII) 8,8'-Bisbaicalein



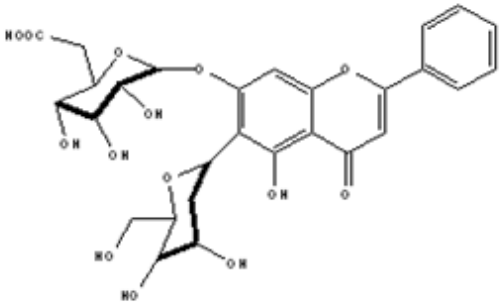
(VIII) β-Sitosterol



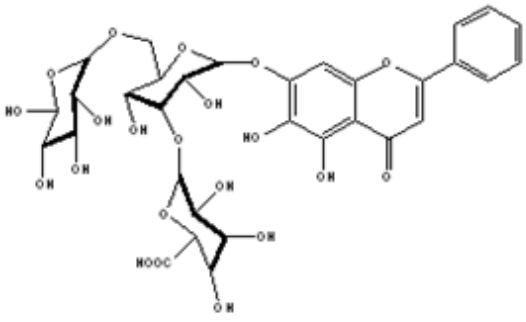
(X) 6 – Hydroxyluteolin



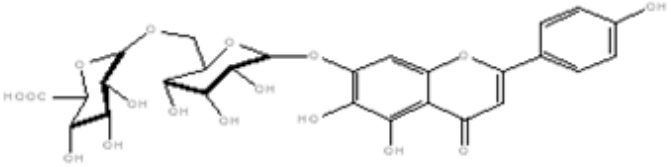
(XI) Oroxoloside methyl ester



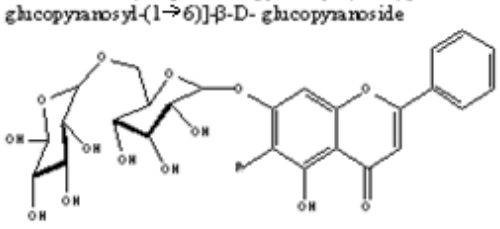
(XII) Chrysin 6-C-β-D-glucopyranosyl-8-O-β-D-glucuronopyranoside



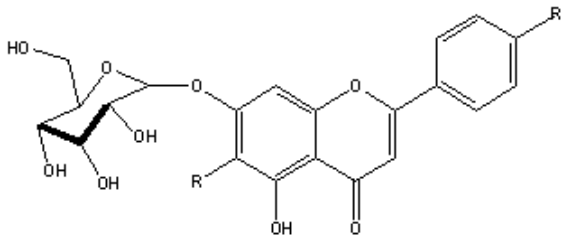
(XIII) Baicalein-7-O-β-Dglucuronopyranosyl-(1→3)[β-D-glucopyranosyl-(1→6)]-β-D- glucopyranoside



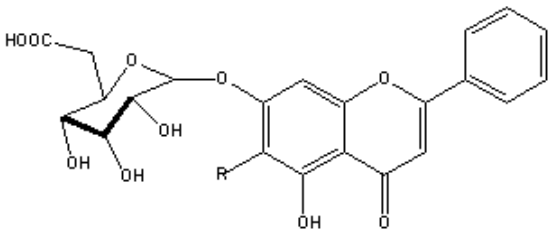
(XIV) Scutellarein 7-O-β-D-glucopyranosyl-(1→6)-β-D-glucopyranoside



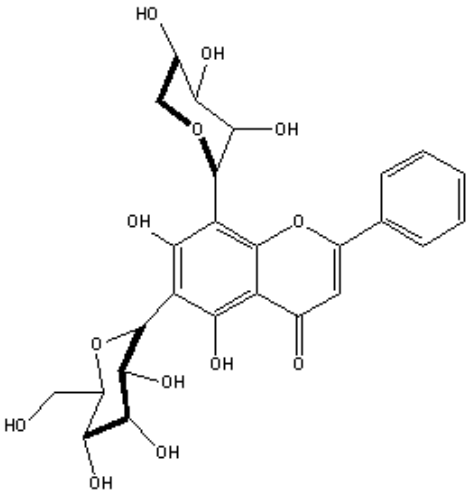
(XV) R= H, Chrysin-7-Ogentiobioside,
(XVI) R= OH = Baicalein-7-O-diglucoside,



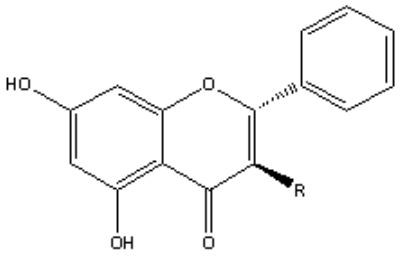
(XVII) R= H (Baicalein-7-O-glucoside)
(XVIII) R= OH (Scutellarein-7-O-glucopyranoside)



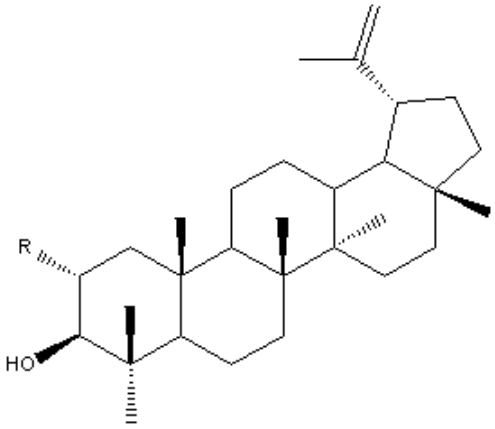
(XIX) R= H (Chrysin-7-O-glucuronide)



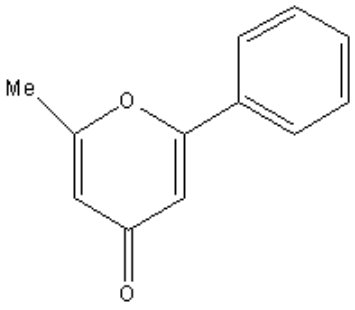
(XX) Chrysin-6-C-β-D-glucopyranosyl-8-C-α-L-arabinopyranoside



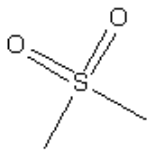
(XXI) R=H (Pinocembrin), (XXII) R=OH(Pinobanksin)



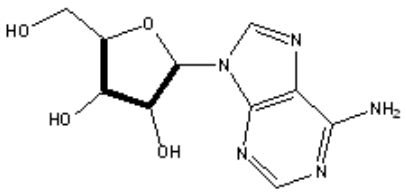
(XXIII) R= H (Lupeol), (XXIV) R= OH (2α-Hydroxyl lupeol)



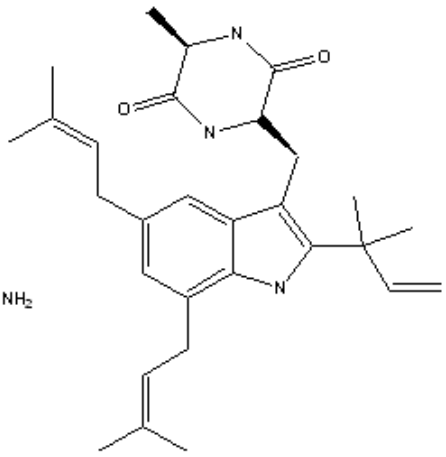
(XXV) 2-Methyl-6-phenyl-4H-pyran-4-one



(XXVI) Methylsulfonylmethane



(XXVIII) Adinosine



(XXVII) Echinulin

Fig 1: Chemical constituents of *Oroxylum indicum*

indicum L. (Kurz.) (Forest Flora of British Burma, 1877), Bignonia quadripinnata (Blanco, 1880).

Vernacular names

There are many vernacular names of *Oroxylum indicum* in different languages according to distribution of ecozone (http://en.wikipedia.org/wiki/Bignoniaceae; Ayurvedic Pharmacopoeia of India; Nadkarni, 1982). **Assamese**: Bhatghila, **English** : Broken bones plant, Indian calosanthes, Indian Trumpet, Indian trumpet flower, Midnight horror, Oroxylum, Tree of Damocles; **Chinese** : Hanyu pinyin: mù húdié, butterfly tree, **Nepalese**: Tatelo, **Bengali** : Tona, **Sanskrit**: Bhut-vriksha, Dirghavrinta, Kutannat, Manduk (the flower) patrorna, Putivriksha, Shallaka, Shuran or Son, Vatuk, **Kannada**: Tattuna, **Konkani** :Davamadak, **Malayalam** :Palaqapayyani, ashrppathiri, Vellappathiri, **Marathi :** Tayitu, Tetu, **Hindi:** Aralu, Shyonaka, **Singhala** (Sri Lanka) : Totila, Thotila, **Tamil** : Cori-konnai, Palai-y-utaicci, Puta-puspam (the flower), **Telugu** : Manduka-parnamu, Pampena, Suka-nasamu.

ETHANOMEDICINAL USES OF *OROXYLUM INDICUM*

Medicinal treatise of *Ayurveda* dates back to pre-historic Vedic era, which is the ancient testimony for use of plants as medicine. Accordingly, the medicinal properties of *Oroxylum indicum* are: The root bark of plant is acrid, bitter, pungent, astringent to the bowels, cooling, aphrodisiac, tonic, increases appetite, useful in "vata", biliousness, fevers, bronchitis, intestinal worms, vomiting, dysentery, leucoderma, asthma, inflammation, anal troubles. It is used to treat diarrhoea, dysentery, diaphoretic, and rheumatism (Kirtikar & Basu, 2001; Prakash, 2005). Paste prepared from sesame oil (*Sesamum indicum*) and the powdered bark of the root is given as digestive tonic. The seeds are purgative and taken orally to treat throat infections and hypertension (Singh *et al*., 2002). The fruits are acrid, sweet, stomachic, anthelmintic, effective in diseases of the throat and heart, piles, bronchitis, used as an expectorant, improves the appetite; useful in leucoderma (Chopra *et al*., 2002; Drury, 2006; Nadkarni, 1982; Khare, 2007). Leaves are prescribed for snake bite (Nadkarni, 1982; Khare, 2007). Leaves are used externally to treat an enlarged spleen and also to alleviate headaches and ulcers and also reported for its analgesic and antimicrobial activity (Drury, 2006).

In various tribes of India, bark and seeds of the plant are used in fever, pneumonia and respiratory troubles (Panghal *et al*., 2010; Patil *et al*., 2008). It is also used to cure various stomach disorders (Raut *et al*., 2009). In Nepal a root decoction is used in diarrhoea and dysentery. Seeds are used as a digestive. A seed 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 in diarrhoea and dysentery. Root bark and seeds are carminative, stomachic, tonic, diaphoretic and astringent. Root bark is also used to treat bile problems, cough, diarrhoea, and dysentery (Kunwar *et al*., 2009). It is also used in a formulation used for nootropic activity (Maciuk *et al*., 2000).

Oroxylum indicum is used as one of the important ingredients in most commonly used Ayurvedic preparations e.g. such as Dasamula, Amartarista, Dantyadyarista, Narayana Taila, Dhanawantara Ghrita, Brahma Rasayana, Chyavanaprasa Awaleha, etc. (Balkrishna, 2005; Kumar *et al*., 2009; Anonymous, 1998). In the composition of drug chavanprasha and mentat (mental drug) different parts of *Oroxylum indicum* are used (Laupattarakasem *et al*., 2003; Gupta *et al*., 2008). Plant materials are also used as wood, tannins and dyestuffs. A small deciduous tree, *Oroxylum indicum* possesses economic as well as medicinal importance.

CURRENT STATUS OF RESEARCH ON *OROXYLUM INDICUM*

There are many biological studies on different part of *Oroxylum indicum*, which are described in Table 2. The studies on antioxidant activities have been reported in all part of the plant but still not reported that which part of the plant have highest antioxidant activity in vitro and in vivo studies are required and most important aspect is that which part of the plant possess highest antioxidant activity in different antioxidant bioassay. The antimicrobial activity has studied on the root bark and stem bark. Anthelmintic, antiulcer, immunomodulatory and gastroprotective studies have been done in the root bark. Anti-inflammatory activity was performed on the leaves and stem bark, while antihepatotoxic and antimutagenicity studies have done on leaves and fruits respectively. Studies show that researchers are taking interest on isolation of bioactive compounds of *Oroxylum indicum* due to their important therapeutic uses. However, there is still lack of knowledge on details of chemical constituents which are responsible for different biological activities.

PREVIOUSLY ISOLATED PHYTOCHEMICALS

The *Oroxylum indicum* contains number of compounds such as phenols, tannins, alkaloids, flavonoids and saponins. All isolated compounds were reported in table no 1. Table was described the general names , IUPAC name and different physical properties of compounds. Stem bark and leaves contain flavonoids namely chrysin, oroxylin-A and baicalien (Sankara *et al*., 1972 A; Sankara *et al*., 1972 B), oroxyloside methyl ester and chrysin-7-O- methyl glucoside (Rao *et al*., 2007). Seeds contain ellagic acid.(Vasanth *et al*., 1991). Yan R *et al*., (2011) reported nineteen different compounds isolated from seeds. Root bark contains chrysin, baicalein, biochanin-A, and ellagic acid. Oroxylin A, chrysin, triterpene carboxylic acid and ursolic acid are found in fruit pods (Suratwadee *et al* 2002). Total twenty seven compounds were reported but there is still lack of knowledge on details of chemical constituents present in different part of *Oroxylum indicum.*

SCOPE OF THE PRESENT INVESTIGATION

Oroxylum indicum is a unique plant profusely used in *Ayurveda* and *Unani* system of medicines to cure both infectious and degenerative diseases. Earlier reports on isolation and

Table 2. Different biological studies on *Oroxylum indicum.*

Entry	Functional properties	Plant parts	Solvent Extract	References
1	Antioxidant	Stem bark	Ethyl acetate, Methanol, Ethanol, Chloroform	Gupta *et al*., 2008; Upaganlawar *et al*., 2007; Kumar *et al* 2011; Mishra *et al*., 2010; Kalaivani *et al*., 2009.
		Stem	Methanol	Mishra *et al*., 2010.
		Leaves	Methanol	Mishra *et al*., 2010.
		Root	Methanol	Mishra *et al*., 2010.
		Root bark	Water, Methanol	Mishra *et al*., 2010.
		Fruit	Methanol	Mishra *et al*., 2010.
		Seed	Aqueous ethanolic	Yan R *et al*., 2011.
2	Antimicrobial	Root bark	Ethyl acetate & Methanol	Uddin *et al*., 2003; Thatoi *et al*., 2008; Ali *et al*., 1998.
		Stem bark	Methanol, Ethyl acetate	Islam *et al*., 2010; Kumar *et al*., 2011.
3	Anthelminthic	Root bark	-	Dowimg *et al*., 2000.
4	Antiulcer	Root bark	Ethanol, Petroleum Ether, n-Butanol	Khandhar *et al*., 2006.
5	Anti-inflammatory	Leaves	Aqueous	Laupattarakasem *et al*., 2003;
		Stem bark	Aqueous & alcoholic extracts	Tenpe *et al*., 2009;
6	Anti-hepatotoxic	Leaves	Ethanol	Tenpe *et al*., 2009.
7	Anticancer	Fruit, Stem bark	Ethanol, Aqueous, Methanol	Roy *et al*., 2007; Tepsuwan *et al*., 1992; Lotufo *et al*., 2005; Narisa *et al*., 2006; Brahma *et al*., 2011.
8	Immunomodulatory	Root bark	*n*-Butanol	Zaveri *et al*., 2006.
9	Gastroprotective	Root bark	Alcoholic & *n*-Butanol	Zaveri *et al*., 2007.
10	Antimutagenicity	Fruit	Methanol	Nakahara *et al*., 2002.

characterization of bioactive molecules indicate that, their physiological and biochemical role changes during developmental stages. These aspects are significant for commercial exploitation of this plant. Understanding the physiological role of bioactive compounds during development of different part. It may provide an opportunity to standardize the stage of physiological maturity, which is critical to obtain quality raw material for design and development of products of health benefits. Root crops are rich source of different types of flavonoids. True to this, flavonoids are a major storage component in stem bark of *Oroxylum indicum.* Whether it also endowed with inimitable property, This natural scientific inquisitiveness was also ardently attended by undertaking detailed investigation on chemical constitution from different part of *Oroxylum indicum*.

CONFLICT OF INTEREST STATEMENT

We declare that we have no conflict of interest.

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