

MEDICINAL IMPORTANCE *SWERTIA SPECIOSA* (WALL D.DON:) A REVIEW.

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Swertia speciosa is one of the most important substitutes of *Swertia chirayita*, which belongs to family Gentianaceae. It is a perennial herb and distributed in marshy localities of timber zone in the Himalayan region to Bhutan between 2240 and 4000 m asl. This species had been reported to contain bioactive compounds like i.e. xanthone, antioxidants, amaroswerin, amarogentin and urosolic acid as in *S. chirayita*. These major bioactive compounds of *S. speciosa* play significant role as hepatoprotective, anti-hepatotoxic, anti-microbial, anti-inflammatory, anti-carcinogenic, anti-leprosy, hypoglycemic, antimalarial and anti-tumor. As *S. chirayita* is a critically endangered medicinal plant and is now on the verge of extinction and original populations at many places have been vanishing due to high demand of Pharmaceutical industries, traditional use and the developmental human activities. Keeping this in view, large scale propagation of *S. speciosa* should be taken up immediately by developing appropriate technologies as this species is an alternate source of many valuable bioactive compounds which were found in *S. chirayita*.

Index Terms : *S. speciosa*, *S. chirayita* substitute, Bioactive compounds, Biological activity, Cultivation and Conservation.

Introduction

In India approx 70 % medicinal plants are found in tropical areas mostly in various forest types spread across the Western and Eastern ghats, the Vindhya, Chotta Nagpur plateau, Aravalis and Himalayas, where as 30 % of the medicinal plants are found in temperate and Alpine area and higher altitudes they include species of high medicinal value.

WHO (World Health Organization) reported 80 % population of developing countries rely on traditional medicines, mostly plant drugs, for their primary health care need. In Modern Pharmacopoeia 25% drug derived from plants and many others which are synthetic analogues built on prototype compound isolated from plants. Hence, Demand for medicinal plant is increasing in both developing and development countries due to growing recognition of natural products, being non-narcotic, having no side-effects, easily available at affordable prices and sometime the only source of health care available to the poor. (Planning Commission, Govt. of India, 2000) Recent estimation reveals that more than two thirds of global population relies on drugs of plant origin (Auffield, 1991). The ability of synthetic drugs to control major complicated disease is limited. Natural drugs are preferred over synthetic drugs because of the lower incidence of adverse reactions to plant preparation and of their reduced cost. The plants have given western pharmacopoeia about 7000 different pharmaceutically important compounds and number of top selling drugs of modern time e.g., Quinine, artemisinin, taxol, camptothecin, etc.

About 90 % of medicinal plant used by industries are collected from the wild, while over 800 species are used in the production by industry, 20 % species of plants are under commercial cultivation. Over 70 % of the plant collections involve destructive harvesting because of the use of parts like root, bark, wood stem, whole plant in case of herbs.

Swertia, a genus family of Gentianaceae include a large group of annual and perennial herbs and representing approximately 135 species. *Swertia* species are common ingredients in number of herbal medicines. In India, 40 species of *Swertia* are recorded (Clarke, 1885; Kirtikar and Basu, 1984). The increasing demand of *Swertia chirayita* in India and world markets is a cause of major concern as most of the herbal industries collect it from the wild. Extensive collection and unscientific harvesting causes the natural population of the wild near to diminished continuously. Hence, the various other species of *Swertia* that are known to have some therapeutic potential against fever, dysentery, spasm, pain, malaria are often used as substitutes or adulterants for *S. chirayita*. *S. alata*, *S. angustifolia*, *S. bimaculeta*, *S. ciliata*, *S. densifolia*, *S. elegans*, *S. liwii*, *S. minor*, *S. nervosa*, *S. paniculata*, *S. multiflora*, *S. cordata*, are

commonly used as adulterants. Species of other genera such as *Andropis paniculata*, *Exacum tetragonum*, *Exacum pedunculatum*, and *Slevoglia orientalis*, are also extensively used as substitute or adulterants in *chirayita* trade.

These medicinal herbs used as substitute for *S.chirayita* on the basis of similar bioactive compound.

Botanical Description *Swertia speciosa*

S.speciosa , Wall. Cat.4384; cauline leaves elliptic acuminate bases connate, cymes forming a narrow panicle, flowers 5- merous, glandular depressions 2 on each corolla-lobe close to the base subconfluent prominently fimbriate, Seed compressed narrowly winged. Stem 1- $\frac{1}{2}$ -4 ft, hollow, $\frac{1}{5}$ in. thick. Radical leaves long – petioled, cauline 5 by 2 in., narrowed downwards, 7- nerved; tube at the base $\frac{1}{4}$ - $\frac{1}{2}$ in. Peduncles short , pedicles $\frac{1}{4}$ - 3 in. Sepals $\frac{1}{3}$ by $\frac{1}{6}$ in., ovate, acute, serrate, much overlapping at the base. Corolla- lobes $\frac{3}{4}$ by $\frac{1}{5}$ in., spatulate- oblong, shortly acute; fimbriae $\frac{1}{8}$ in . Stamens, capsule and seeds. (Flora of British of India J.D. HOOKER , VOL- iv) Flowering and Fruiting occurs during September and October while seeds are collected during mid November.

Distribution : Chirayita species is found everywhere in the world except in South America and Australia. The plant is a native of temperate Himalayas, found at altitude . *S. speciosa* is found in the moist subalpine zone (treeline) at altitude 3200 – 4000 masl :- Afghanistan (Kunar, Nuristan) Nepal, Pakistan (Kurrum, Chirtal, Swat) , Pakastani Kashmir (Deosai) ,Jammu and Kashmir (Kashmir), Himanchal Pardesh (Gulabaa, Kinnaur, Sirmaour), Uttarakhand (Garhwal and Kumaon region), Tibet.

Habitat: Found in slopy areas in the subalpine zones nearby timberline and grows luxuriantly besides ravines and between rocks.

Bioactive compound : Some important Phytochemical were reported by different research work from *S.speciosa* extract from aerial part as shown in following

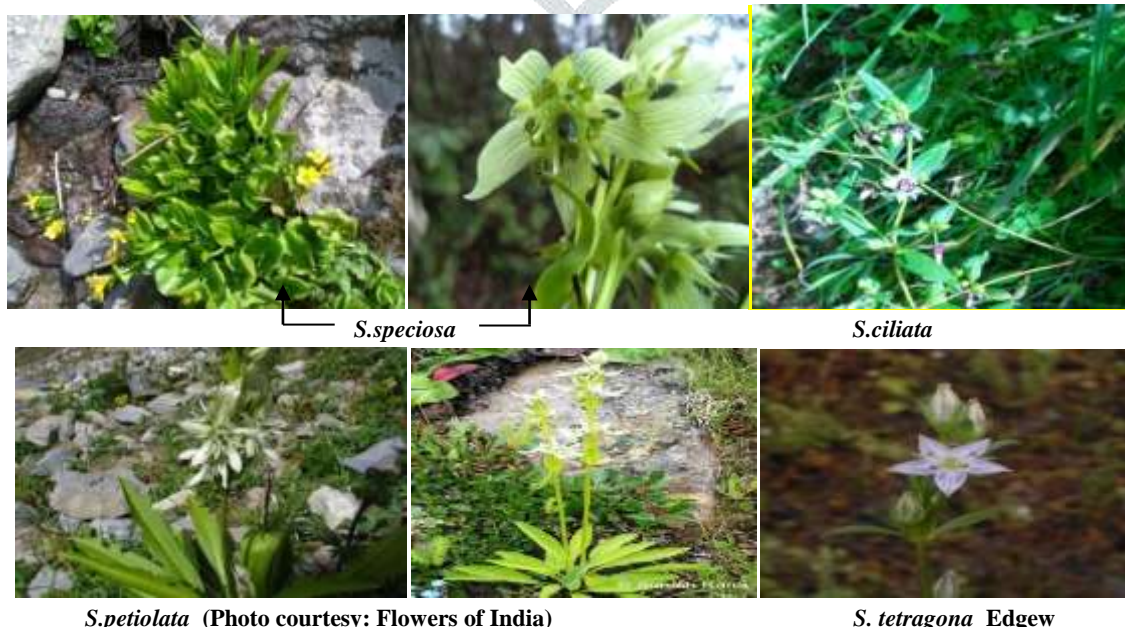
1-hydroxy-3,7-dimethoxyxanthone (Massias et al., 1977) 2,8-dihydroxy-1,6- dimethoxyxanthone (Massias et al.,1977)1,5,8-trihydroxy-3 methoxy xanthone (Bellidifolin) (Khetwal and Bisht,1988 ; Ashida et al., 1994) 1,2,8-trihydroxy-6-methoxy xanthone (Gentiakochianin or Swertanin) (Dreyer and Bourell, 1981) 2,4,5- trihydroxy-1- methoxy xanthone (Massias et., al 1977) 8-[glucopyranosyloxy]-1-hydroxy-3,5-dimethoxy xanthone (Khetwal and Bisht 1988)

Urosolic acid (Khetwal and Bisht, 1988) 6-hydroxy-3,5-dimethoxy-1-[Primverosyloxy] xanthone (Rawat et al., 2004). Mangiferin and Amaroswerin (Rajendra S.Chauhan and Parbhu Dutt 2015)

Biological activity : *S. speciosa* of Aerial part (Root) ground in water are put into eyes like surma (dye) to relieve snow burnt eye. These species used as whole part of plant for febrifuge, Stomachic, Anthelmintic, Sntipyretic (Garg 1987) used as ethano medicine and also used as Anti-tubercular (Bian et al., 1998), Hypoglycemic (Song, 1986), Anti- inflammatory (Banerjee et al., 2000), Anti-oxidative (Born et al., 1996) and anti-fungal activities (Rodriguez et al., 1995) etc. were reported.

Conservation Status: Common

Present work on conservation: Pursuing research study on the conservation, bioactive compounds and genetic diversity of this medicinal plant.





S.paniculata (Photo courtesy: Flowers of India)



S.alata



S.cordata (Photo courtesy: Flowers of India)



S.multicaulis



S.angustifolia (Photo courtesy: eflora India)



S.bimaculata (Photo courtesy: Flowers of India)



S.densifolia (Photo courtesy: eflora India)



S.hookeri (Photo courtesy: Flowers of India)



S.chirayita



S.lawii Burkill (Photo courtesy: eflora India)



S.minor (Photo courtesy: eflora India)



S.nervosa (Photo courtesy: eflora India)

*A.paniculata**S.orientalis**E.bicolor* (Photo courtesy: eflora India)

Botanical description *Swertia petiolata* Royle; D.Don in Trans. Linn. Soc.

Lower cauline leaves long –petioled oblong connate into a tube upper often sessile, cymes forming a narrow panicle, flowers 5- merous, glandular depressions 2 much fimbriate, seeds polyhedral scrobiculate not winged. Stem 1-3 ft; hollow, 1/8-1/6 in. thick . Lower cauline leaves 3-1/2 by 1 in., sessile hardly connate; upper cauline leaves petioled or sessile. Peduncles 1/2-1-1/2 in., mostly 3-5 – flowered ; pedicels 1/4-3/4 in. Sepals 1/3 by 1/8 in., lanceolate, acute (in Royle’s example) ,sometimes 1/2 by 1/6 in. Corolla – lobes 1/2-2/3 by 1/6-1/5 in., acute sub entire (in sub entire (in Royle’s example) with orbicular glands; in other examples emarginated or suberose at the tip, with glands elliptic or elongate; corolla lurid grey or nearly white with blue green nerves the glands yellow, the tip green. Style hardly any, stigma short. Capsule 1/2 by 1/4 in. Seeds corrugate-cristate (D. Don) i.e. testa lax in long series of glandular ridges, approaching in structure those *S.crodata*, but much larger.

Distribution : *S. petiolata* is a perennial medicinal herb which growing at high altitude on grassy and moist meadows of Afghanistan , Kashmir ,West Nepal and South Tibet , at altitude 28000 to 4000 m asl. Flowering: July – August.

Bioactive compound: 2,3-seco-2→Lactone1β,3β-epoxy-hop-17 (21) ene (Swertialactone c), 2,3-seco-2→lactone,1β,3β-epoxy-hop-16-ene (Swertia lactone D) (Bhan et al 1987) . 1,3-Dihydroxy-5,8-dimethoxyxanthone and 2 hydroxydimethylterephthalate (Kulanthaivel and pelleter (1988) were reported phyto constituents from aerial parts.3β-Hydroxylup-13 (18)-ene, 3β-hydroxylup-12ene-28-oic acid and urosolic acid (Bhan et al 1988) were reported from whole part of plant.1-Glycosyloxy-3-hydroxy-5,8-dimethoxyxanthone , 1,8-dihydroxy-3,5 dimethoxyxanthone and 1,3-dihydroxy-3-methoxyxanthone (Khetwal et al1990) were reported from aerial part of *S.petiolata*.

Biological activity : Dried Whole plants are powdered along with leaves of *Azadirachta indica*, *Centurea depressa* seeds of *Punica granatum* whole plants of *Gentianella moorcroftiana*, *Taraxacum officinale*, *Lomatogonium carinthiacum* , flowers of *Gentiana algida* , *Aster diplostephioides* and mineral salts then made into tablets. Three tablets are given twice or thrice a day hot water in case of high fever for 6-7 days.

Uses in Modern medicine : It is used as modern medicine in anti-inflammatory , analgesic activity.**Occurrence:** IUCN Red list of Threatened plant.

Conservation: To avoid extinctions, it is necessary to leave part of the population to regenerate. Cultivation & Propagation can play an important role for conservation this species.

Botanical Description of *Swertia ciliata* (D.Don) Burtt.

Swertia ciliata (Synom – *Swertia purpurascens*) is an annual herb 20-100 cm tall, with quadrangular stem ,some time branched . Leaves are 1-6×0.5-2.5cm, narrowly ovate pointed , ciliate or not . Flowers are brone in many flowered panicle. Flowers are 5 merous. Sepals are 3-5×0.5-2 mm, narrowly ovate to ovate, pointed. Flowers are pale blue or bluish white with purple band near the base above the gland , tube 0.5-1mm , 3-7×1-3mm , ovate, acute reflexed, or not . Gland one per loabe , horse- shoe- shaped . Filaments are flattend , puberulent, fused at base ,Staminal tube 1.5-2mm , anther oblong –ovate , obtuse. Ovary 5-9mm, gyanophore 0.5-2mm , Style distinct, Stigma sub-linear. Capsule 6-15 mm. *S. ciliate* is found in the Himalaya , from Kashmir to Sikkim, at altitude 2800-4000 masl. Flowering during the month of August . Seeds form during the month of October.

Origin & Distribution : Himalayan Endemic, *S.ciliata* is found in Jammu and Kashmir,Himachal pardesh, Punjab, Uttarakhand (Up hills), Meghhalaya, Assam, Sikkim, Nepal, Tibet, Afganistan.

Habitat : Rocky slopes, broad leave forest (Open space , forest clearing) , open slopes, meadows.**Occurrence :** Common, **Conservation :** Not Applied

Bioactive compound: The whole plant contains a number of tetra oxygenated and Penta oxygenated Xanthone. Amaroswerin, Amarogentin, Xanthone -c- Glucoside (Mangiferin) were reported from aerial part of *S. ciliata*.

Biological activity: Decoction of plant is given three times a day for 5-7 days to control cough, Cold and Fever used as ethano medicine.

Uses in Modern medicine – *S. ciliata* used as substitute as *S. chirayita*.

Botanical description of *Swertia tetragona*

Swertia tetragona Edgew. (Quadrangular) is an annual herb with stem 15-50 cm, finely winged or not. Leaves are 10-25×4-8 mm, narrowly ovate to obovate - oblong or linear, pointed or blunt. Inflorescence paniculate, lax. Flowers are pentamerous. Sepals 4-8 × 1-2 mm, narrowly ovate pointed free. Flowers are bluish white to greenish white, tube 1-1.5 mm, petals 4-8×1.5-2.5mm, Ovate, pointed. Glands are two per lobe, oblong, fringed. Filaments are 3-4 mm, thread-like, anther ovate, blunt. Ovary 5-6 mm, oblong stigmas nearly round, stalkless. Capsule is 6-10 mm. Seeds rounded, warty. Flowering August- October.

Origin & Distribution: Himalayan Endemic, Quadrangular swertia is found in the Himalayas, from Pakistan to Nepal at altitude of 2400-3300 masl.

Bioactive compound: Tetra oxygenated Xanthone,

Biological activity: Modern medicine used – *S. tetragona* is used in Hypoglycemic, anti hepatotoxic, antimicrobial, anti-inflammatory, anti-oxidant, anti-microbial, anti-tumour. Used as Substitute of *S. chirayita*.

Occurrence: Unknown, **Conservation:** Unknown

Botanical description of *Swertia alata*

Swertia alata (Synonym- *Ophelia alata*) is an annual herb, 15-20 cm tall, with sometime branched stem, which is quadrangular and winged. Leaves are 2-5×1.5-2 cm, ovate heart shaped 3-7 nerved. Flowers are borne in panicles. Flowers are 4 merous. But for its 4 petalled flowers, it looks quite similar to heart leaf swertia. Sepals are 4-6×1-1.5mm, narrowly ovate pointed, free. Flowers are lurid green or yellowish green with purple veins or dots, tube 0.5-1mm, lobes 5-7×1.5-2.5mm, Ovate elliptic -oblong, acute. Glands are watch pocket shaped with short, Compound fimbriae, One lobe. Filaments 4-6 mm, anther oblong to ovate-oblong, obtuse. Seeds are polyhedral, more or less rounded, warty. Flowering during August- November.

Distribution: Winged stem- *Swertia (S. alata)* is found in the Himalayas from Kashmir to Nepal, at altitude of 2000-3600m asl. **Occurrence:** Common, **Conservation status:** HMG/N Protection - Not applicable

Bioactive compound: 1,8-dihydroxy -3,7-dimethoxy xanthone, 1,7,8- trihydroxy-3-methoxy xanthone and 1-hydroxy-3,7,8 – trimethoxy xanthone were isolated from *S. alata* extract.

Biological activity: Ethanomedicine used of *S. alata* –Used as tonic, febrifuge, Stomachic, laxative, anthelmintic, ant-malarial, anti-diarrhoeic,

Botanical Description of *Swertia multicaulis* (D. Don)

Many-stem swertia distinguished from other swertia by its many short spreading stems 5-12 cm, which arises directly from the root. Flowers are blue, long stalked, in a much branched inflorescence, petals are 8-13 mm, blunt with a single nectary at the base, fringed with hairs. Sepals are narrow-oblong, 6-8 mm, Leaves are narrowly spoon shaped, about 5 cm, narrow to a winged leaf – stalk. Flowering June and September.

Origin & Distribution: Himalayan Endemic, *S. multicaulis* (many-stem *Swertia*) is found in eastern Himalayas from Central Nepal to South Tibet of at altitude of 4000- 4800 m asl.

Habitat: Shrub berries, open slopes, alpine meadows. **Occurrence:** Endemic to Nepal West Himalaya,

Conservation: HMG/N Protection – Not applicable

Bioactive compound: Bioactive compound of *S. multicaulis* Were no report.

Biological activity: Used as tonic, febrifuge, stomachic, laxative, anthelmintic, anti malarial, anti diarrhoeic used as traditional medicine

Botanical Description of *Swertia bimaculata*

Wild flower and native in eastern Himalayas or china. Leaves elliptic-lanceolate petioled 3-nerved, corolla-lobes mark half-way up with 2 green spots, filaments linear free, stigmas sessile hemispheric. **Stem-** 2-6 ft, stout, 4 angular, corymbose upwards. **Leaves** 3 by 1-¹/₄ in., or upper cauline sometimes 6-¹/₂ by 2-³/₄ in., glabrous, petioled or at least much narrowed at the base. **Flowers** numerous, 4-5 merous; pedicels 1\2- 1-¹/₂ in 1\4 in., elliptic, mostly obtuse. Corolla-lobes 1\3-1\2 in., broadly elliptic, white or yellowish-green,

with black spots in their upper half ; the two green spots in the middle viscid; scarcely depressed, no pits in the corolla- tube. Filaments attached on the corolla-tube; anthers oblong , not hastate. Capsule $\frac{3}{4}$ by $\frac{1}{4}$ in. Seeds $\frac{1}{40}$ in., cuboid –globose, smooth, obscurely reticulate.

Origin & Distribution : Sino- Japanese or Eastern Asiatic . Dobule spotted *Swertia* is found in Nepal eastern Himalaya , Sikkim, Bhutan , North east India, China

Habitat : Evergreen forest, shady floor, beside streams , swamps , meadows and forest, at altitude of 200-3000 m asl .**Occurrence :** Rare , **Conservation :** Applied

Bioactive compound: The three compounds i.e. Sesterterpenoid, aspterpenacid c (1), with unusual 5/3/7/6/5 Pentacyclic skelton , together with seven known once (4-10), were isolated from the ehanol extract of traditional chinese medicinal plant of *S.bimaculata* . Three new Xanthones (1-3), and five known ones , 1-hydroxy-378- trimethoxyxanthone, 1-hydroxy-38-dimethoxyxanthone and 17 –dihydroxy-38-dimethoxyxanthone and 15-dihydroxy-38-dimethoxyxanthone compound.

Biological activity : Hypoglycemic activity, Anti-oxidative activity, Anti-inflammatory, Ant-HIV activity. *S.bimaculata* is substitute of *S.chirayita*

Botanical description of *Swertia paniculata* .Wall D. Don (Synom-*Ophelia paniculata*)

Panicled *Swertia* is an annual herb , growing up to 18- 20 cm tall. Roots are yellow and fibrous. Branched stems are slender , erect, 1.5-4 mm in diameter . Basal leaves wither away at maturity . Stems and leaves are nearly stalkless, narrow lance- shaped 2- 5.5 cm long, 4-14 mm wide , margin fringed with hairs . Inflorescences are panicles of cymes, many flowered, spreading , to 70 cm. Flower stalks are erect, 0.6 -1.5 cm long . Flowers are 5 parted, meaning with most parts occurring in fives. Sepal tube is 1-1.5 mm, with ovate -lance –shaped sepals , 6-10×2-5 mm. Flowers are pale- yellow green, with 2 blackish purple spot above each nectary . Nectaries are one petal , horse shoe-shaped , naked . Stamens are 4-5 mm long, with purple anthers. Capsules are ovoid , 8-10 mm. Flowering : August- October.

Distribution : *S.paniculata* is found in the Himalaya from Kashmir to Bhutan and in Lushai Hills in Mizoram at 1,500 -2,400 m asl .

Bioactive compound: The root contain xanthones (including swercherin and bellidifolin); flavon- C-glycosides- swertisin and homoorientin. The plant gave polyoxygenated xanthone and xanthone-O-glycosides; also pentacyclic titerpenehederagenin. Aerial parts, in addition to xanthone , contain Urosolic acid.

Biological activity: Traditional used : Deocation of the plant is used as tonic. *S.paniculata* is also used as substitute for the *chirayita* in the treatment of malaria and other fever.

Occurrence : Common

Botanical description of *Swertia densifolia* (Synom : *Swertia decusata*) Griseb . Kashyapa

Distribution: From Konkan to Kerla at 15,000- 2000 m asl

Bioactive compounds: The leaves and flower contain xanthone – swertinin, titerpenes,oleanolic acid and beta –sitosterol . Decussatin is also in flower.

Biological activity : A Substitute for *S.chariyata*

Botanical Description of *Swertia cordata* (Wall. Ex G. Don) C.B.Clarke.

S.cordata is an annual herb 1-2 ft tall . Stems are erect, 4 angled with wings on angles, branched . Basal leave wither soon. Stem leaves are stalkless, ovate to ovate- heart shaped, 0.8 -2.3 cm long, 0.5- 1.2 cm broad, base heart – shaped and nearly stem- clasping, margin rough, tip pointed, vien 3-5 . Flowers are brone in narrow, dence, many flowers are thyrses 13-40 cm. Flowers are 5- merous. Flower- stalks are 3-10 mm long, channeled. Sepals are lance shaped to ovate- lance shaped , 5.5-7 mm long , margin rough and usually slightly curled, tip pointed . Flowers are white with purple vein , 1-1.5 cm in diameter . Petals are narrowly elliptic to elliptic- lance shaped, 0.8-1 cm long, tip pointed . At the base of each petal , is a circular greenish, viscous spot . Stamen filaments are about 5 mm . Style is short and distinct, stigma lobes capitate . Capsules are ovoid-ellipsoid , 6-8 mm .

Distribution : Heart – leaf *Swertia* is found in the Himalayas from Kashmir to Bhutan and North east india at altitude of 2500- 3200 m asl. **Occurrence :** Rare

Bioactive compounds: Two Xanthones , 1-hydroxy-2,3,7-tetramethoxyxanthone, 1-hydroxy-2,3,4,7-tetramethoxyxanthone and one triterpenoid, lupeol were reported isolation from the this plant. Urosolic acid and Mangiferin compounds contain in aerial part of the plant were reported by Khan & Haqqani 1981. Atta-ur-Rahman et al. 1994 were isolated 1- hydroxy-3,5,7,8- tetramethoxyxanthone and 1,7- hydroxy-3,5,8-trimethoxyxanthone from this plant *S.cordata*.

Biological activity : Anti-microbial activity, Anti-oxidant activity, Anti- diabetic activity,

Botanical Description on *Swertia angustifolia* Buch Ham ex D. Don (Synom: *S.affinis* C.B.Clarke)

Narrow –leaved *Swertia* is an annual herb , 20-80cm tall, Roots are yellow fibrous. Stems are erect, subquadrangular, narrowly winged on angles, branched . Leaves are stalkless, lanceshaped to elliptic lanceshaped, 2-6cm×3-12mm, both end flat, vein 1-3 inflorescences panicles of cymes, spreading branched, many flowered. Flowers are 4 merous. Pedicle erect, 3-7 mm. calyx tube 1-2mm, sepals are linear – lanceolate, 6-8 mm, apex acute, midvein 1-3. Flowers are white or pale yellow, with brown spots , 8-9 mm in a dimeter, tube 1-2mm. petals are 4-6.5 mm, tip blunt and apiculate . Nectaries 1 per corolla lobes, pocket –shaped, with an orbicular scale and minutely hair short fimbriae at apex of pocket. Filaments 3.5- 4 mm; anther ellipsoid, ca. 1 mm. Style short, distinct, stigma lobes capitate. Capsule ovoid, 5-7 mm. Seeds are brown , ellipsoid, about 0.6 mm. Flowering August- November.

Distribution : Subtropical Himalaya from Kashmir to Bhutan , the khasi and Lushai Hills , Manipur at 300 – 1800 m asl. Bihar and peninsular india up to 1,800 m asl.

Habitat : Shrublands, pasture, open slopes, stream side rocky areas .

Occurrence : Rare, Endemic to Nepal West Himalaya, Edangered. **Conservation status :** Not applicable

Bioactive compounds : Aerial parts contain urosolic acid , xanthenes and beta- sitosterol . Several tetra and penta oxygenated xanthenes , Angustiamerin, Angustioside have been isolated from plant.

Biological activity : Febrifuge and bitter tonic, Used as substitute for *S.chirayita*

Botanical Description of *Swertia hookeri*, Clarke

Cauline leaves elliptic scarcely connate at the base, cymes axillary dense distant, flowers 4- merous, Seeds much compressed narrowly winged. **Stem** 1-¹/₂ -4 ft ., hollow, ¹/₄-¹/₂ in. thick . Radical leaves 4 by 1 in., spatulate-elliptic., cauline 3 by 1 in., narrowed at both ends, sessile, 5-nerved . Peduncles hardly acute. Corolla- lobes 2/3 by 1/3 in., obtuse, purplish with blue nerves ; pit at the base of each deep, naked. Filaments linear, little dilated ; anthers oblong blue. Style 1/10 in., stigma is very short. Capsule 2/3 by 1/3 in., shining brown. Seeds 1/8 in. diam., discoid, exceedingly thin , smooth..

Distribution : Sikkim Himalaya; at altitude 12- 13,000ft

Bioactive compounds : The whole plant of *S.hookeri* contain two tri- and nine tetra oxygenated free , glucosyloxy, and stearyl ester xanthenes and one flavonol stearyl ester . The xanthenes are based on 1,3,5,-,1,3,5,8- and 1,3,7,8-oxygenated systems with middle oxygenation pattern predominating . These phytochemical compounds were reported by Shibnath Goshal ., et al. 1980.

Biological activity : The extract of *S.hookeri* is used by local population for the treatment of microbial infection in man, in hypertension and as a mood enhancer (Goshal et., al 1980)

Occurrence : Not Applicable

Botanical Description of- *Swertia lawii* Burkill or Synoms : *S.cryombosa* Var *lawii* C.B. Clark

Upper cauline leaves sessile ovate or oblong subacute 3-nerved, cymes forming a level-topped corymb, corolla- lobes subacute 3-nerved, cymes forming a level- topped corymb, corolla- lobes 1/3 by 1/6 in. broadly oblong shortly acute. *Ophelia corymbosa*, Griseb. Gentian.

Stem 8-20 in., quadrangular or 4 winged. Lower cauline leaves ³/₄ by 1/3 in., spatulate- obovate, obtuse, subpetioled; upper cauline ¹/₂ by 1/3 in., ovate , obtuse , mucronate. Corymb wide; pedicle 0-1/2 in., clustered. Sepals ¹/₄ in., narrowly lanceolate. Corolla- lobes white with blue – nerved or pale-blue , one gland at the base of each covered by scale with pubescent margin.- Described from weight's type

Habitat & Distribution : Western ghats from Maharashtra to south Kanara at 12000 m asl.

Bioactive compounds : Whole plant contain a number of xanthenes 1,3,7,8-Tetrahydroxyxanthone, 1,7,8-trihydroxy-3-methoxyxanthone, 1,8-dihydroxy-3,7-dimethoxyxanthone , 1-hydroxy-3,7,8-trimethoxyxanthone , and 1-hydroxy-3,4,7,8- tetramethoxy xanthone, 1,3,5,8,-tetrahydroxy- and 1-hydroxy-3,5,8-trimethoxyxanthone . Erythrocentaurin had also been reported from the plant.

Biological activity: Used as the substitute for *S.chirayita*. **Occurrence :** Endangered / Global:

Conservation : Seed germination and Invitropropagation method

Botanical Description on *Swertia racemosa* Wall.cat.4377

Leaves subsessile elliptic-lanceolate 3-nerved , filaments free linear slightly dilated below, style long cylindrical, stigmas short oblong. *Ophelia racemosa*, Griseb. **Stems** 18 in., 4- lanceolate. Leaves 1-³/₄ by ¹/₂ in. Pedicels 0-1/2 in., mostly short, fascicled , unequal. Calyx –tube 1/12 in., funnel shaped ; lobes 1/8 -1/6 in., lanceolate, very acute, almost keeled. Corolla –lobes 1/4-1/2 in., oblong acute; at the very base of each ,

almost in the corolla- tube, is a pit covered by a scale , teeth of its margin lanceolate- linear black not hairy. Filaments on the corolla – tube; anthers oblong , not hastate. Capsule 1/3 in. Seeds somewhat large, ellipsoid, smooth- on Wallich's sheets, some **S.chirayita is mixed with this , which seems** to have troubled D.Don as noticed by Grisebach. Flowers all 4- merous

Habitat : Open slopes, meadows, shrubland, rocky areas .

Origin & Distribution : Himalayan Endemic, Nepal (West, Central, East) , Sikkim , Bhutan, North East India, East Tibet at 3000-5000 m asl.

Bioactive compounds : Norswertianin, Swertianin , Methylswertianin, Desmethylbellidifolin , Bellidifolin , Methylbellidifolin, Oleanolic Acid

Biological activity : its used as tonic , two spoonfuls of decoction of plants are given twice a day to treat fever and cough ; Paste of the plant is applied locally to treat eczema and pimples , juice of aerial part is taken orally twice a day before meals to treat jaundice.

Botanical Description on *Swertia nervosa*

Leaves subsessile elliptic- lanceolate 3-nerved narrowed at the base , sepals oblong- linear exceeding the corolla, corolla- lobes greenish –yellow with one orbicular gland near the base of each lobe, stigmas subsessile hemisphere. **Stem** : 1-3 feet, 4- lineolate or 4- winged. Leaves 1-¹/₂ by 2/3 in., upper cauline subpetiolate. Panicles many – flowered; pedicels 1/3-1-¹/₂ in., very variable. Sepals 2/3 by 1/8 in., sometimes longer. Corolla- lobes ¼-1/3 in., ovate , acute, purple- nerved or dotted; gland large, sometimes viscous, little depressed, nearly naked; sometimes a distinct pit covered by a slit- like fold with a hairy margin. Filaments linear (in one form short); anthers oblong, scarcely hastate. Capsule 1/3 by 1/5 in., ovate. Seeds 1/40 in., polyhedral; testa somewhat loose, grlistening along the edge.

Origin & Distribution : South east china. North east India ,Bhutan, North West India, Temperate Nepal (West, Central ,East) and Sikkim, West China. altitude 6000-9000 ft. **Habitat:** Open slope ,

Occurrence : Common

Bioactive compounds : Bioactive gredients investigation of the whole plant *S.nervosa* yielded three 1,8- dihydroxy-3,7 dimethoxyxanthone (Methyl swertianin or Swertiaperenin), 1-hydroxy-3,7,8-trimethoxyxanthone (Decussatin), 1,7-dihydroxy-3,8-dimethoxy-xanthone (gentiacaulein)

Biological activity :Decotion of root is applied in skin disease, Plant is crushed and boiled in water and two spoonfuls of decotion are given twice a day before meals to treat malarial fever, extract of the plant is also given in the morning to cure ‘ Gano’ (Gas ball) and stomach problem

Botanical Description of *Swertia densifolia* (Griseb.) Kashyapa , Synom- *S.decussata* Nimmo ex Grah. , *Ophelia multiflora* Dalz

Leaves sessile ovate obtuse 5-3 nerved , corymbs very dense, corolla- lobes 1/3 by by 1/6 in. broadly oblong shortly acute. **Stem-** 1-3ft., terete or 4-winged. Leaves 1-¹/₄ by ³/₄ in ., numerous, approximate, decussate. Pedicels 0-1/2 in., mostly short. Sepals ¼-1/3 in., narrowly lanceolate . Corolla- lobes white with blue nerves, with one round depression at the base of each covering scale shortly hairy not very large.

Origin & Distribution : Endemic to Western ghats (India) and From Konkan to Kerla at 1,500- 2,000 m asl.

Bioactive compounds : The leaves and flowers contain xanthone – Swertinin, triterpenes, oleanolic acid and beta – isosterol . Decussatin is also present in the flowers and roots.

Biological activity : A substitute for *S.chirayita* and *Gentiana lutea*.

Botanical Description of *Swertia elegans*. Wall (1831)

Swertia angustifolia Buch- Ham. Ex D.Don. Accepted name Variety *Swertia angustifolia* var . *puchella* (D.Don) Burkill Synom = *Swertia puchella* var *elegans*.

Botanical Description of *Swertia minor* (Grisebach)

S.minor is an annual , glabrous herb, 13-38 cm tall. Stems 4- angular, winged (wings 0.1- 0.2 mm broad) . leave sessile ; blades cordate – orbicular 2-2.5 × 1.2-1.8 cm ; apex obtuse ; base sub – amplexicule , with 3- 5 secondary veins each side . Cymes dense , axillary or terminal panicles , 1-3 – flowered ; bract ovate – elliptic , 0.3-1×0.18-0.5 cm ; pedicle 0.5-1.8 cm long . Calyx lobes 4, ovate – oblong , 0.5-1×0.5-0.15 cm, 3- veined , divided almost to the base ; apex acute . Corolla dark purple with blue viens ; tubes 0.5- 1.5 mm long , lobes obovate , 0.8-1.5×0.4-0.6 cm ; apex obtuse –acute , gland 1 at the base of each corolla lobe, ovate , watch pocket shaped , fimbriae white , inserted on a green scaly base , 0.04-0.6 cm long . Stamens 4; filaments 1.2-3.5 mm long , white, dilated at the base , 1-4 hairs at base , anthers oblong , 0.5-1×0.3-0.7 mm brown . Ovary oblong , 6.5- 8×1-2 mm ; style 0.1-0.8 mm long ; stigmatic lobes orbicular , 0.02-

06×0.4-0.65 mm . Capsule oblong, 5-10 ×1-2.5 mm. Seeds polyhedral 0.3-0.6 ×0.1-0.4 mm; testa warty, brown. **Fruiting & Flowering**-September- December.

Origin & Distribution : Endemic to Western ghats (India) *S.minor* is found at 1200 m asl in South india . **Habitat** : Among grasses in rocky areas. **Conservation**

Bioactive compound : Mangiferin ,

Biological activity : *S.minor* , used as substitute for *S.chirayita* in the treatment of malarial and other kinds of fever.

Botanical Description of *Swertia chirayita*

Swertia chirayita has an erect about 2-3 ft long , the middle portion is round , while the upper is four angled with a prominent decurrent line at each angle. The stems are orange brown or purplish in colour. The root is simple , tapering and stout ,short, almost 7 cm long and usually half each thick. Flowering in *chirayita* is in form of numerous small , axillary , opposite, lax cymes arranged as short branches and whole inflorescence 2 ft long. Flowers are small stalked, green yellow, tinged with purple colour. The flower – tube is twice as long as the sepal- cup and divided near the base into four ovate- lance like segments. The upper surface of the petal has a pair of nectaries covered with oblong scales and ending fringe.

Origin & Distribution : Himalayan Endemic. *S.chirayita* is found in the Himalayas from Kashmir to Bhutan of altitude 1500- 3000 m asl and also found in the Khasi hills at altitude of 1200- 1500 m asl. *Chirayita* can be cultivated at between 1200- 2100 m asl.

Habitat : Open & moist place, forest floor, **Occurrence** : Endangered, **Conservation** : Propagation through Tissue culture & Viable Seed.

Bioactive compounds : 1,3,8- tetrahydroxyxanthone, 1,3,7,8- tetrahydroxyxanthone, 1,3,8- trihydroxy-5-methoxyxanthone, 1,5,8-trihydroxy-3-methoxyxanthone, 1,8-dihydroxy-3,5-dimethoxyxanthone (swercherin), 1,8-dihydroxy-3,7-dimethoxyxanthone (7-o-methylswertanin), 1-hydroxy-3,5,8-trimethoxyxanthone, 1-hydroxy-3,7,8-trimethoxyxanthone, 2,5-trihydroxyterephthalic acid (Aromatic carboxylic acid), 21- α -H-hop-22(29)-en-3- β -ol (Triterpenoid), Amarogentin, Amaroswerin (Seco-iridoid glycoside), Chiratanin (Dimeric xanthone) , Chiratenol (Hopane- triterpenoid), Chiratul (1,5 dihydroxy 3,8-dimethoxyxanthone), Decusstain (Xanthone), Enicoflavine(Xanthone), Episwertenol (Triterpenoid), Erythroidiol (Hexane extract), Gammacer-16-en- β -ol (Triterpenoid) , Gentianine (Triterpenoid alkaloid), Gentiocruicine (Triterpenoid alkaloid), Kairatenol (Hexane extract), Lupeol (Triterpene alcohol), Mangiferin (Xanthone), Mangostin (Xanthone), Oleanolic acid (Triterpenoid), Pichierenol (Swertane terpenoid) , Sweroside (Seco-iridoid glycoside), Sweroside-2'-o-3'',5''-trihydroxy biphenyl-2''carboxylic acid ester (Seco-iridoid glycoside), Swerta-7,9(11)-dien-3- β -ol (Swertane terpenoid), Swertanone (Triterpenoid), Swertenol(Triterpenoid), Swertianin (1,7,8-trihydroxy-3-methoxyxanthone), Syngaresinol (Lignan), Taraxerol (Triterpenoid), Urosolic acid (Triterpenoid), β -Amyrine (Triterpenoid alcohol), β -Sitosterol-3- β -D-glucoside(Sterol), ϕ -Taraxasterol or heterolupeol (Hexane extract) (P.Joshi and V.Dhawan , et al, 2005)

Some medicinal herbs used as substitute for *S.chirayita* on the basis of Biological activity

Botanical Description of *Andropis paniculata* Wall. Ex Nees

Distribution: Throughout india , from Himachal Pardesh to Assam and Mizoarm and all over southern india.

Bioactive compounds :Several bioactive constituents have been identified from the leaf and rhizome, including adrographolide, deoxyandrographolide , and other diterpenes.

Biological activity :Hepatoprotective, cholinergic, antispasmodic, stomachic, anthelmintic, alterative, blood purifier, febrifuge. *A.paniculata* acts well on the liver , promoting secretion of Bile. Used in Jaundice and torpid liver, flatulence and diarrhea of children, colic,Strangulation of intestines and splenomegaly; also use for cold and upper respiratory tract infection. As bitter tonic, febrifuge.

Occurrence : low Risk & Least concerned.

Botanical Description of *Exacum bicolor* Roxb. , Synom : *E.tetragonum* Roxb., *E.perrottetii* Griseb

It is stalked Persian violet, small annual herb , 7-30 cm tall , with four angled stem . Oppositely arranged leaves are stalkless , lance shaped, 3-5 cm long , 2-5 nerved , with tapering base. Flowers are brone in branched cymes. The stalk carrying the cymes & flowers are long and rigid. Flowers are purple or blue, with 4 lance shaped petals. Sepals are 4

Origin & Distribution: Endemism India, Upper Gangetic plains and tropical Himalaya , also in South india . *Exacum pedunculatum* L., found throughout india ascending up to 1000 m asl . Banglore, Belgaum, Chikamagalur, Hassan , Mysore, Tumkur, Uttara Kannada.

Occurrence : Not Evaluated.

Bioactive compound: *E.bicolor* apigenin, luteolin, vanillic, p- hydroxybenzoic, protocatechuric & p-coumaric acid

Biological activity: Used as a substitute for *Swertia chirayita* & *Gentiana lutea*. Pounded plant is applied externally in rheumatism and gout.

Botanical Description of *Slevogtia orientalis*

Synoms = *Encostema axillare* (Poir .ex Lam) , *Encostema hyssopifolium* (Wild) . verd , *Encostema verticillare* (Retz) Baill. *E.axillare* is a perennial herb which belong to family Gentianaceae growing up to 40 cm tall, with 4- angled stems . Leaves are narrow oblong lance shaped . Stalkless white flowers are brone in dense clusters in leaf axils . Common name is called Chhota chirayita . **Flowering** June- January.

Distribution : Such species is globally distributed in West indies , tropical Africa , Srilanka and Throughout India , from Punjab to Gangetic Plain to Kanya kumari up to 500 m asl.

Bioactive compounds: Whole plant contain alkaloids- gentianine, erythrocentaurin, enicoflavin, and genitocrucine ; flavonoids- apigenin , genkwanin iso- vitexin, Swertisin, saponarin and 5-O- glucoside derivatives of Sylwertisin and isoswertisin ; glycosides- swertiamarin and a triterpene betulin , ophelic acid.

Biological activity: Swertisiode exhibited hypotensive activity, Bitter tonic, Carminative, Blood purifier, Antirheumatic, Ant- inflammatory, Antipsychotic, Anthelmintic, Cardiostimulant, Antimalarial property . Such medicinal plant is used as substitute of *S.chirayita*.

Demand of *Chirayita* Species in Market : Herbs of *S.chirayita* have done domesticated in India as well as in globally and it is increasing at an estimate of 10 % every year. Nepal country is major export of *Chirayita* exporting more than 45 % of the world's of total volume (Joshi & Dhawan, 2005). Nine species are traded in Nepal: *Swertia chirayita*, *S. angustifolia*, *S. tetragona*, *S. racemosa*, *S.ciliata*, *S. dilatata*, *S.multicaulis*, *S. alata* ,*S.nervosa* (Shrestha *et al.*, 2010) . *S.chirayita* trade suffers from heavy adulteration of its similar species. 12 species from Nepal traded under the name of “*Chiraito* “ are *S.alata*, *S.angustifolia*, *S.bimaculata*, *S.cilata*, *S.dilata*, *S.paniculata*, *S.petiolata*, *S.tetragona*, *S.densiflora*, *S.lawii*, *S.elegans*, *S.minor*, *S.multiflora*, (Pyakurel & Baniya, 2011; Phoboo and Jha; 2010 and Dhawan , 2005) along with non –gentian adulterants like *Exacum* spp., *Andographis paniculata*, *Ainslia ealtifolia* ,and *Slevogtia orientlis*. (Joshi and Dhawan, 2005 WWF 2008). Typical adulteration in *S.chirayita* accounts for 20 % but adulteration 5 % is accepted. *S.speciosa* may be the best substitute of *Swertia chirayita*.

Discussion and Conclusion

Human and animal health have always depended upon medicinal plant due to the preventative and therapeutic value of herbal remedies, additional benefits of their low cost , wide accessibility and also cultural relevance. Increased consumption of medicinal plants, through expansion of local, regional and global markets have increased pressure on a resource that is unscientifically harvested from depleted wild populations in shrinking Wild habitat. According to IUCN many medicinal plants have been under categories Endangered, critically, extinct, so research work should be on Clinical trial on subspecies of medicinal herb and to developed protocol for conservation of medicinal plant. Some of the important species of genus *Swertia* found in the North West Himalaya have been described in brief above. All of the species possess some compounds that can be medicinally potent. *S. chirayita* is one of the most important species amongst all and its commercial exploitation is much higher in comparison to other species because of which its natural population is becoming rare. Since *Swertia speciosa* is a potent source of amaroswerin, magniferin and xanthone like compounds, it can be or in some cases it is being used as a substitute of *S. chirayita*. It is present in ample amount till now and there is a need to further study the herb to identify more bioactive compounds out of it and for its medicinal properties and uses as well. The plant needs to be conserved and brought under cultivation in advance so that it doesn't become rare or endangered in future like that of *S. chirayita*.

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