



Astavarga plants – threatened medicinal herbs of the North-West Himalaya

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Abstract: *Astavarga* eight medicinal plants viz., *Kakoli* (*Roscoeae purpurea* Smith), *Kshirkakoli* (*Lilium polyphyllum* D. Don), *Jeevak* (*Crepidium acuminatum* (D. Don) Szlach), *Rishbhak* (*Malaxis muscifera* (Lindl.) Kuntze), *Meda* (*Polygonatum verticillatum* (Linn.) Allioni), *Mahameda* (*P. cirhifolium* (Wall.) Royle), *Riddhi* (*Habenaria intermedia* D. Don) and *Vridhhi* (*H. edgeworthii* Hook. f. ex Collett). All of these plants have their natural habitats in Himalaya particularly the North-West Himalaya in Jammu & Kashmir, Uttarakhand and Himachal Pradesh between elevations of 1500 and 4000 m asl. Their natural habitats are specific in ecological environment and hence these occur only in small pockets. *Astavarga* is important ingredient of various *Ayurvedic* formulations such as *Chavyanprasha*. Although some work has been done on identification of medicinal plants mentioned under *Astavarga*, but still there is need to identify the true representatives of this *Astavarga* group. The present communication deals with the taxonomical and medicinal properties of these eight medicinal plants.

Keywords: *Astavarga*; *Ayurveda*; medicinal plants; herbs; formulations.

Introduction

The *Ayurveda* is the science of life and has been enhanced by numerous *Rishis* and *Saints* such as *Aswani Kumars*, *Atreya*, *Bhardwaja*, *Dhanwantri*, *Charak* and *Susrut* etc. During this early phase of *Ayurvedic* development, *Ashwani Kumars*, who had a vast reputation as *Ayurvedic* wonder healers, saw the old and frail, emaciated body of *Rishi Chayavan*, decided to rejuvenate his body through medication. *Rishi Chayavan* was born in the lineage of *Maharishi Bhrigu* (who was a great astrologist and made birth charts of Lacs of people which are valid even today). For this they invented *Astavarga* - a group of eight medicinal plants and did the miracle of rejuvenating the body of *Rishi Chayavan* and restored his youth. Since then after the name of *Rishi Chayavan* the preparation was called as *Chavyanprash* and has been a favourite and most demanding medicine for kings and rich people. With the disappearance of *Gurukul* system of ancient education, which had more practical and less theoretical approach, the

knowledge (practical in natural habitats) of medicinal plants started fading away coupled with no written details most of the medicinal plants over the several centuries, a great confusion about their actual identity had taken its deep roots (Sharma and Acharya Balkrishan, 2005). This was the case with *Astavarga* which included eight plants. All these plants have their natural habitats in Himalaya especially the North-West Himalaya. Their natural habitats are specific in ecological requirements and hence these occur only in small patches. These plants are considered as a very good *rasayana* with rejuvenating and health-promoting properties and are known to strengthen the immune system and have immense cell regeneration capacity. *Astavarga* is useful in promoting body fat, healing fractures, seminal weakness, fever, abnormal thirst, diabetic conditions and as a cure for *vata*, *pitta*, *rakta doshas*. *Astavarga* plants are also reported to restore health immediately and work as antioxidants in the body (Mathur 2003; Pandey 2005; Sharma and Acharya Balkrishna 2005). Due to high medicinal value, *Astavarga*

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plants are used in different forms, e.g. *Taila* (oil), *Ghritam* (medicated clarified butter), *Churana* (powder) and formulations in the traditional medicinal system (TMS) including *Chyavanprasha*, a health-promotive and disease-preventive tonic (Dhyani et al., 2010).

There was a mystery in the botanical description and the classification method of the *Astavarga* plants. Before one starts this work, it would be useful to know the traditional, ancient methods of their identification and their usage. The traditional *Nighantu* texts gave various synonyms for each plant and they together created an indicator for a *guna* (attribute) or its meaning. The names given to the plants were linked to other natural forms. This format was consistent with the times, when people lived in close association with nature. There was not much mystery in the matter of medicinal plants, because teaching was done in the forests; and was very practical. The dissemination of knowledge was verbal. Whatever may have been the history, a time came when a lot of literature was verbally transmitted from one generation to another. This was the era of codification after this period the gradual development of knowledge of *Ayurveda* and of medicinal plants got blocked. Many wrong perceptions developed in the identification of medicinal plants and its usage. The major traditions of *Ayurveda* became suspected and complicated, the correct identification of medicinal plants became very difficult.

The *Dhanvantri Nighantu* (ancient text) has the highest number of names for *Astavarga*. The *Dhanvantri Nighantu* also has the description of the pharmacological properties of the *Astavarga* plants. Other *Nighantus* like *Bhav Prakash*, *Shaligram* and *Rajnighantu* also have the details of their names and properties. From the time of *Bhavamishra*, (around 1500 AD), confusing concepts and mystery surrounded these medicinal plants. The *Bhav Prakash Nighantu* had described that even *Rajas* (kings) would find it difficult to access the *Astavarga* plants. Therefore substitute plants for *Astavarga* were recommended.

Over the centuries of *Ayurvedic* history, much confusion about identity of the *Astavarga* plants prevailed. In *Nighantus* by various au-

thorities and commentators concluded that the *Astavarga* was rare to kings and therefore suggested the use of substitutes instead of these plants. This suggestion put forth hampered further efforts to explore these plants in their habitats. After independence and restoration of interest in *Ayurveda* provided the necessary eagerness and also the modern taxonomic system of plant classification facilitated the task of correct identification of *Astavarga* plants. Effort by several authors on various aspects like distribution, their properties and propagation etc. of *Astavarga* plants have been discussed (Lattoo et al., 2001; Lattoo et al., 2005; Pandey et al., 2006; Wang et al., 2007; Chauhan et al., 2007 & 2008; Sharma et al., 2007; Rath et al., 2009; Khan et al., 2010; Sahu et al., 2010; Dhyani et al., 2010; Bisht et al., 2011; Rana and Samant, 2011; Sharma et al., 2011; Rath et al., 2011; Lahoni et al., 2012; Ravi Kant et al., 2012; Javed et al., 2012; Giri et al., 2012), but till date no attempt made in perspective of the correct identification and representative of the *Astavarga* group, there is much uncertainty about the botanical names of *Astavarga* plant species, so the present communication deals with correct identification of *Astavarga* plants described in various *Nighantus* and *Samhitas* with their taxonomical description from various floras. The present communication will help the researchers, scientists, farmers and cultivators to know about approved representative of *Astavarga* group.

Materials and methods

Information about the plants of '*Astavarga*' group was collected from an extensive literature survey (*Nighantus* and *Samhitas* by various authorities; Uniyal, 1975; Osmaston 1978; Collet, 1980; Dey, 1982; Polanin and Stainton, 1984; Naithani, 1985; Deva and Naithani, 1986; Uniyal, 1989; Chauhan, 1990; Warriar, 1994; Nayar et al., 1995; Godagama, 1997; Uniyal, 1997; Gaur, 1999; Hooker, 1997-1999; Kaushik and Dhiman, 2000; Sharma and Acharya Balkrishan 2005; Singh, 2006; Acharya Balkrishna, 2012) for identification of natural habitats and various species of *Astavarga* plants in the Himalayan region. Extensive field surveys were conducted in temperate, sub alpine

and alpine regions of Uttarakhand during the years of 2008-2011 at Mussorrie, Jaberket, Dhanolti, Kyarphulli, Deoban, Nagtibba, Jamuna valley, Kharshali, Har-ki-dun, Dayara, Bharnala, The Valley of flowers, Rudranath, Tungnath, Kedarnath, Rambara, Dronagiri, Panwali Kantha, Madhyamaheshwer, Chopta, Khirsu, Pauri, Gangotri, Bhojbas, Chirbas, Binsar, Pinder valley, Tejam Jankhola valley, Kali valley, Nanital, Ranikhet, Chabatia, Badrinath, Tons valley, Bhagirathi valley, Dodital, Chakrata, Vasukital, Hemkund, Yamunotri, Chamba, Devriyatal, Gangnani, Gaurikund, Mandal, Trijuginarayan, Kedarnath valley at an altitudes from 1200- 4000 m asl. The collected plant species were identified with the help of standard floras and notes were prepared on their morphological attributes.

Results and Discussion

All the eight plant species which are used in 'Astavarga' group of *Ayurvedic* medicine occurs mostly in Himalayan states viz., Himachal Pradesh, Jammu & Kashmir and Uttarakhand upto an elevation of 1200- 4000 m asl. These eight plant species belong to three different families, four species belong to the family Orchidaceae viz., (*Crepidium acuminatum* (D. Don) Szlach.), *Malaxis muscifera* (Lindl.) Kuntze, (*Habenaria intermedia* D. Don), (*H. edgeworthii* Hook.f. ex Collett) one species belong to the family Zingiberaceae viz., (*Roscoea purpurea* Smith) and three species belong to the family Liliaceae viz., (*Lilium polyphyllum* D. Don), (*Polygonatum verticillatum* (Linn.) Allioni) and (*P. cirrhifolium* (Wall.) Royle f. ex Collett). Details regarding their botanical names, synonyms, english names, distribution range, taxonomical features, flowering & fruiting time, active ingredients, medicinal uses, plant parts used, dosage, formulations and substitutes of these plant were discussed. Many scholars attempted exploration and research on medicinal plants, but they were confused in many instances. Accurate identification of medicinal plants became complicated and difficult. But we have collected all the existing available ancient texts and also with the help of modern plant science, for the first time attempted to identify the *Astavarga* plants.

Members of Astavarga plants

1. *Roscoea purpurea* Smith

Botanical Name: *Roscoea purpurea* Smith

Family: Zingiberaceae

English Name: Roscoe's Lily

Sanskrit/ Hindi Name: *Kakoli*

Habit and Habitat: A perennial rhizomatous herb upto 15-30 cm in height. Around the world found in Pakistan, Bhutan and Tibet between 1500-3100 m elevation. In India found in Central and Eastern Himalaya from Uttarakhand to Assam and Sikkim up to an altitude of 3300 m in alpine grassland, steep, grassy hill sides, damp gullies and stony slopes.

Taxonomic features: Purple coloured leafy stem, elongate, erect and robust; **leaves-** 5-6, lanceolate, 15 cm long, 1.2-2.5 cm wide, at flowering time, sheaths broad, purple or reddish, imbricated; **flowers-** few orchid like, on a sessile spike; **bracts-** oblong, hidden in the sheaths of the upper leaves; **calyx-** green, 3.8 cm long, slit deeply down one side as the flower expands; **corolla tube-** not longer than the calyx, dilated up wards, limb purple rarely pale lilac or white, upper segment about 2.5 cm long, obovate-cuneate, lower lanceolate, decurved, lip broad deeply bifid; **staminode-** oblanceolate, unguiculate, half as long as the upper segment, **fertile stamen-** as long as the staminode, anther-tails 0.4 cm long, lip 2.5-3.8 cm, deflexed; **fruits-** capsule cylindrical, 2.5-3.8 cm long; **seeds-** ovoid, minute, arillate; **rhizomes-** root fibres thick, fleshy, fascicled (figure 1a).

Flowering: June-July.

Fruiting: August-September.

Active ingredients: Its rhizome contains flavonoids, alkaloid, tannins, saponin, glycosides and phenolic compounds.

Properties & Action: Antirheumatic, febrifuge, galactagogue, haemostatic, expectorant, sexual stimulant, diuretic, tonic, sweet, bitter and cooling. The ethanolic extract of its rhizomes showed immunostimulant potential in mice (Sahu et al., 2010).

Uses: It is useful in haematemesis, excessive thirst and rheumatic pain.

Part used: Rhizome.

Dosages: As directed by the Physician.

Formulations: *Astavarga churna*, *Chyavanprash rasayan*, *Vachadi taila*, *Chitrakadi taila*, *Mahakalyan ghrita*, *Mahamayura ghrita*, *Jivaniya ghrita*, *Nagabala sarpi*, *Vajikaran ghrita*, *Brahini gutika* and *Jivaniya gana churna*.

Substitutes: *Aswagandha* (*Withania somnifera* (Linn.) Dunal) and *Kali musali* (*Curculigo orchioides* Gaertn.).

There is much confusion about the identification of *Kakoli*, many authors considered *Fritillaria roylei* Hook. as *Kakoli* (Singh, 2006 and Dhyani et al., 2010) and some *Fritillaria cirrhosa* D. Don but according to *The Plant List*, *Fritillaria cirrhosa* D. Don is its first name and *Fritillaria roylei* Hook. is the synonym of this. Chuneekar, 1969, 2006; Sharma, 1976; Uniyal, 1989, 1997; Sharma and Sharma, 1998, considered *Roscoea procera* Wall. and *Roscoea alpina* Royle as *Kakoli*, but according to Acharya Balkrishna (2012) the actual species of *Kakoli* is *Roscoea purpurea* Smith because of its purple coloured stout stem and also purple flowers as described in ancient text by *Shaligram* and *Bhav Prakash Nighantus*. There are three other species of *Roscoea* used as its substitute in Uttarakhand slightly differ from the above species are as follows-

1. *Roscoea capitata* Smith- A perennial rhizomatous herb, stem elongated; leaves many, linear; flowers many in a dense oblong, peduncled spike; corolla-tube not longer than the calyx; limb pale blue, upper segment oblong-cuneate, lip narrow- emarginate.

2. *Roscoea alpina* Royle- A perennial rhizomatous herb upto 15-25 cm in height; leaves several, leaf blade linear, rarely lanceolate 15-25 cm long and 1-2.8 cm wide, strongly keeled, base narrow, apex acuminate; inflorescence capitate, densely flowered; peduncle 5-10 cm long; flower blue in colour; calyx 2.5 cm in diameter, pubescent especially along veins, split on one side, apex 2-toothed; corolla-tube shorter than calyx; limb pale blue, upper segment oblong -cuneate, lip narrow emarginated.

3. *Roscoea purpurea* Smith var. *procera* (Wall.) Baker)- Stem is taller, green, more robust with broader leaf-sheaths; flowers at the apex, purple in colour and larger than *Roscoea capitata* Smith.

2. *Lilium polyphyllum* D. Don

Botanical Name: *Lilium polyphyllum* D. Don

Syn- *Lilium punctatum* Jacquem. ex Duch.

Family: Liliaceae

English Name: White Himalayan lily

Sanskrit/ Hindi Name: *Kshirakakoli*

Habit and Habitat: A perennial herb upto 60-120 cm in height. Around the world found in Pakistan, Nepal, West China, Tibet and Afghanistan upto an elevation of 1800-3700 m asl. In India found in Western Temperate Himalayas up to an elevation of 2000-4000 m in Jammu & Kashmir, Uttarakhand and Himachal Pradesh.

Taxonomic features: An erect, slender, hollow, leafy stem; **leaves**-sessile, alternate or nearly opposite or whorled, 7-12.5 cm long and 5-12 mm broad, linear or narrow lanceolate or oblanceolate, acuminate, with parallel venation, lower leaves sometimes whorled, margins papillose; **flowers**-pendulous, 10-12 cm in diameter, showy, fragrant, drooping, solitary, whorled or in 4-10 flowered, terminal raceme raised on the naked top of the stem; pedicel-7-9 cm long; **bracts**-leaf like, whorled, crenulate; **perianth**-tepals-6, 6-8 cm long, broadly infundibular, dull yellowish or greenish outside, white within speckled with long purple streaks and dots, segments 6, oblanceolate, 1.8 cm broad, revolute from the middle, usually narrowly nectariferous at the base; **stamens**-6, diverging exerted, filaments filiform, anthers large, yellow to orange, dorsifixed, versatile, 1.2 cm long; **ovary**-superior, trilobular, style long, very declinate; stigma capitate, obscurely 3-lobed; **fruits**- 2-3 cm long, oblong, three angled, erect, coriaceous, loculicidal, 3-lobed capsule; **seeds**-numerous, circular, brown in colour, vertically compressed; testa pale, membranous appressed; **bulbs**- narrow, loose mass of few long narrow subequal fleshy imbricating scales, without any outer coats, white in colour (figure 1b).

Flowering: Mid June-mid July.

Fruiting: July-September.

Active ingredients: Its bulb contains linalool and -terpineol. The methanolic extract of bulb of *Lilium polyphyllum* yielded three steroidal glyceride -sistosterol-3-glyceryl-2'-linoleiyl-3'-linoleiate, Glyceryl-1-n-octadec-9-enoyl-2-n-decanoyl-3-n-decanoate and Glyceryl-1-octadec-9'-enoyl-2-octadec-9", 12"-dienoyl-3-tetracosanote (Javed et al., 2012).

Properties & Action: The bulbs are sweet, bitter, refrigerant, galactagogue, expectorant, aphrodisiac, diuretic, antipyretic and tonic. It mainly shows soothing, astringent and anti-inflammatory properties.

Uses: Bulbs are useful in agalactia, cough, bronchitis, vitiated conditions of pitta, seminal weakness, strangury, burning sensation, hyperdipsia, intermittent fevers, haematemesis, rheumatalgia and general debility.

Parts Used: Bulbs.

Dosages: Powder 3-6 gm or as directed by the Physician.

Formulations: *Astavarga churna*, *Chyavanprash rasayan*, *Vachadi taila*, *Mahakalyan ghrita*, *Mahamayura ghrita*, *Jivaniya ghrita*, *Vajikaran ghrita*, *Brahini gutika* and *Jivaniya gana churna*.

Substitutes: *Aswagandha* (*Withania somnifera* (Linn.) Dunal), *Safed musali* (*Chlorophytum arundinaceum* Baker), *Fritillaria roylei* Hook., *Fritillaria oxypetala* D. Don. One species of *Lilium* is also reported as substitute viz., *Lilium wallichianum* Schult. & Schult. f. which is a perennial bulbous herb, upto 120-180 cm long; leaves linear, 15-30 cm long and 6-18 mm wide; flowers sub-solitary, horizontal, sweet-scented very fragrant, trumpet-shaped, white or cream coloured tinged with yellow or green.

3. *Crepidium acuminatum* (D. Don) Szlach.

Botanical Name: *Crepidium acuminatum* (D. Don) Szlach.

Syn- *Malaxis acuminata* D. Don, *Microstylis wallichii* Lindl.

Family: Orchidaceae

English Name: The gradually tapering Malaxis, Jeevaka

Sanskrit/ Hindi Name: *Jeevak*

Habit and Habitat: A terrestrial, pseudo bulbous, 5-25 cm in height, perennial, tender herb. Around the world found in Cambodia, China and South-East Asia up to 1400 m height. In India found in temperate and subtropical Himalayas at an altitude of 1200-2100 m from Himachal Pradesh, Uttarakhand to Arunachal Pradesh, Assam, Nagaland, Manipur, Mizoram, Tripura and in Khasi hills at an altitude of 1500-1800 m and also found in Andaman Islands, Travancore, Anamallay hills and Madhya Pradesh.

Taxonomic features: Its stem is underground, spreading, fibrous roots downwards, ribbed; **leaves**-Usually 2-4, sessile or petioled, 7.5-12.5 cm long, ovate-lanceolate, often discolored, light green, acute with prominent veins, leaves in whorls on the nodes directly raised upwards, angular, attenuate, stem covered by basal leaves forming a tubular structure; **flowers**-*Scape*-7.5-20 cm long, flower small shortly stalked in terminal raceme, about 10 mm in diameter, yellowish-green with purple centre; *bracts*- spreading shorter than the ovary; *sepals*-oblong, dorsal 1-3 nerved, lateral 3-5 nerved, 2 lateral rather shorter than the dorsal, margins recurved; *petals*-linear, slender, longer than sepals, margin recurved, lip-5, shield like, slightly convex, tip rounded, notched or bilobulate, adnate to the base, the column sides of the lip produced upwards into large auricles, auricle of the lip very variable, acute or obtuse, straight and slightly overlapping; *staminal column*-very short with short spreading arms; *anthers*-subterminal, *pollinia*-4; **fruits**-6 chambered capsule; **seeds**-minute, powdery, ovoid; **pseudobulbs**-pseudobulbs 3-9 cm long and 1-3 cm in diameter, conical, fleshy, smooth, shining, in pairs, new one look like garlic cloves, greenish-white, covered with membranous sheath, slightly mucilagenous, remain alive over longer period (figure 1c).

Flowering: July-August.

Fruiting: September-October.

Active ingredients: Its pseudobulbs contains alkaloid, glycoside, flavonoids and -sitosterol. Also contains piperitone, O-Methylbatatasin, 1, 8-cineole, citroenellal, eugenol, glucose, rhamnose, coline, limonene, p-cymene and ceryl alcohol.

Properties & Action: The pseudobulbs are sweet, refrigerant, aphrodisiac, ferbrifuge and tonic.

Uses: It is useful in haematemesis, fever, seminal weakness, burning sensation, dipsia, emaciation, tuberculosis and general debility. The ethanolic extract of its pseudobulb showed analgesic and anti-inflammatory activity in experimental animals (Sharma et al., 2007).

Part used: Pseudobulb

Dosages: As directed by the Physician.

Formulations: *Astavarga churna*, *Chyavanprash rasayan*, *Chitrakadi taila*, *Vachadi taila*, *Mahakalyan ghrita*, *Mahamayura ghrita*, *Mahapadma taila*, *Jivaniya ghrita*, *Vajikaran ghrita*, *Brahini gutika* and *Himvana agada*.

Substitutes: *Vidari kand* (*Pueraria tuberosa* (Willd.) DC), *Safed behmen* (*Centaurea behen* Linn.) and *Guruchi* (*Tinospora cordifolia* (Willd.) Miers).

Various species of *Malaxis* are found in North-West Himalaya (Uttarakhand) viz., *Malaxis cylindrostachya* (Lindl.) Kuntze and *Malaxis mackinnoni* (Duthie) Ames) are used in place of *Jeevak*.

4. *Malaxis muscifera* (Lindl.) Kuntze

Botanical Name: *Malaxis muscifera* (Lindl.) Kuntze

Syn- *Microstylis muscifera* (Lindl.) Ridl.

Family: Orchidaceae

English Name: Adder mouth orchid, The fly bearing *Malaxis*, Snake mouth orchid, *Rishbhaka*.

Sanskrit/ Hindi Name: *Rishbhak*

Habit and Habitat: A perennial, terrestrial herb, variable in size, 15-45 cm in height. Normally found in Afghanistan, Bhutan, Nepal, China and Pakistan up to an elevation of 2100-

4100 m asl. In India found in temperate Himalayas up to an altitude of 2400-3600 m eastwards to Sikkim, Himachal Pradesh, Jammu & Kashmir and Uttarakhand.

Taxonomic features: Its stem long, erect, tuberous at the base with ovoid pseudobulbs, sheathed; **leaves** 1 or 2, unequal, sessile or petioled, 5-10 cm long and 2-4 cm broad, ovate to ovate-lanceolate, oblong or rounded, obtuse, narrowed at the base to sheathing petiole; **flowers** -minute, 3-4 mm long, pale yellow-green in terminal raceme, 10-25 cm long; pedicel 3-4 mm long erect; *bracts* equalling or shorter than the pedicels, lanceolate; *sepals*-broadly lanceolate; *petals*-linear, shorter than sepals; lip quite entire or bearded at the tip only, ovate, abruptly pointed, acute, margins thickened, sides of the lips not produced upwards into auricles; column sessile, very short with very short spreading arms; anthers-subterminal, pollinia 4; **pseudobulb**-round, shining white, bullock horn shaped, conical, straight or slightly curved, 2-7 cm long, 0.5-1 cm in diameter with mucilaginous substance (figure 1d).

Flowering: July-August.

Fruiting: September-October.

Active ingredients: Pseudobulb contains a bitter principle, alkaloid, flavonoid and glycoside.

Properties & Action: Pseudobulb-Sweet, refrigerant, aphrodisiac, haemostatic, antidiarrhoeal, styptic, antidysentric, febrifuge, cooling and tonic.

Uses: It is useful in sterility, vitiated conditions of *pitta* and *vata*, seminal weakness, internal and external haemorrhages, dysentery, fever, emaciation, burning sensation and general debility.

Part used: Pseudobulbs.

Dosages: As directed by the Physician.

Formulations: *Astavarga churna*, *Chyavanprash rasayan*, *Chitrakadi taila*, *Mahakalyan ghrita*, *Mahamayura ghrita*, *Mahapadma taila*, *Jivaniya ghrita*, *Vajikaran ghrita* and *Himvana agada*.

Substitutes: *Vidari kand* (*Pueraria tuberosa* (Willd.) DC.) and *Lal behmen* (*Centaureum roxburghii* (D. Don) Druce).

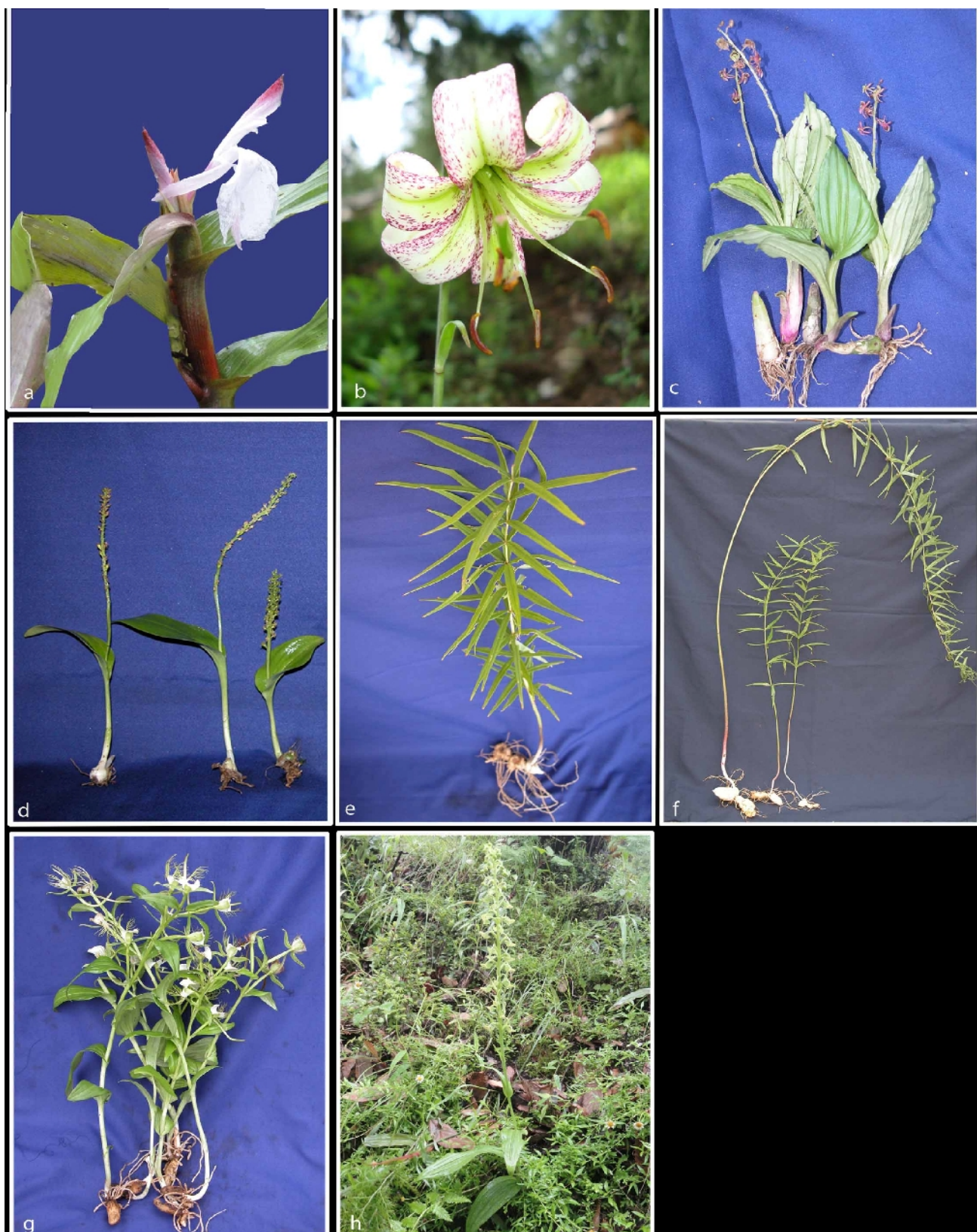


Figure 1: Showing Astavarga plant species;- a-*Kakoli* (*Roscoea purpurea* Smith); b- *Kshirkakoli* (*Lilium polyphyllum* D. Don); c- *Jeevak* (*Crepidium acuminatum* (D. Don) Szlach); d- *Rishbhak* (*Malaxis muscifera* (Lindl.) Kuntze); e- *Meda* (*Polygonatum verticillatum* (Linn.) Allioni); f- *Mahameda* (*P. cirrifolium* (Wall.) Royle); g- *Riddhi* (*Habenaria intermedia* D. Don); h- and *Vriddhi* (*H. edgeworthii* Hook. f. ex Collett).

5. *Polygonatum verticillatum* (Linn.) Allioni

Botanical Name: *Polygonatum verticillatum* (Linn.) Allioni

Syn- *Convallaria verticillata* Linn.

Family: Liliaceae

English Name: Whorled Solomon's Seal, Whorled leaf Solomon Seal

Sanskrit/ Hindi Name: *Meda*

Habit and Habitat: A perennial herb, 0.3-1.2 m in height. Around the world found in Europe, Turkey, North and Central Asia, Pakistan, Afghanistan and Tibet up to an elevation of 4500 m asl. In India found in Temperate Himalayas from Kashmir (at an altitude of 2000-3600 m) to Sikkim (at an altitude 2600-4000 m asl), Himachal Pradesh and Uttarakhand (1600-3500 m asl).

Taxonomic features: Erect, tall, angled, simple, leafy above, grooved, glabrous, sometimes mottled, very slender or stout, sometimes as thick as the middle finger (about 1 cm in diameter); **leaves**-in whorls of 4-8, sessile, linear or linear-lanceolate, 7.5-15 cm long and 0.4-2.5 cm broad, tip usually acute, sometimes obtuse or slightly enrolled to the midrib, membranous, green above, glaucous beneath, often ciliate on the margins and nerves; **flowers**-in whorls of 2-3 flowered axillary raceme, on curved 6-18 mm long peduncle, flowers pendulous, 6-8 mm long, greenish-white or lilac; pedicel 6-18 mm long; jointed at the top; **perianth**-very variable in size, 4-12 mm long, constricted at the middle, tubular, tube slender, mouth 6-cleft, outer lobes subvalvate; **stamens**-6, inserted above the middle of the tube; anthers-subsessile, included, dorsifixed; **ovary**-3-locular or trigonous, style-straight, as long as the ovary, stigma-3; **fruits**-6-7 mm in diameter, globose berries, green when immature and red, orange or purple when mature; **seeds**-6-10, globose, testa thin; **rhizomes**-Thick, creeping, like ginger, shortly branched, 0.7-1.5 cm in diameter, comparatively less thick except in very old (7-8 yrs old) plants. Rhizome white or dull white in colour, flesh inside is white (figure 1e).

Flowering: July-August.

Fruiting: September-October.

Active ingredients: Rhizome contains lysine, serine, aspartic acid, threonine, diosgenin, -sitosterol, sucrose and glucose. Leaves contains glucomanone, glucofractone and hemicellulose.

Properties & Action: It is diuretic and also indicated in pain, pyrexia, burning sensation, phthisis and weakness. Rhizome-Aphrodisiac, tonic and galactagogue, emollient, appetizer.

The aerial parts extract showed leishmanicidal activity against *Leishmania major* which causes *Kala azar* (Khan et al., 2010).

Uses: Regular usage of rhizome powder decreases senility, debility and enhances other rejuvenating properties.

Part used: Rhizomes.

Dose: Powder 2-3 gm or advised by the Physician.

Formulations: *Vachadi taila*, *Astavarga churna*, *Chyavanprash rasayan*, *Chitrakadi taila*, *Mahakalyan ghrita*, *Mahamayura ghrita*, *Mahapadma taila*, *Jivaniya ghrita*, *Brahini gutika*, *Vajikaran ghrita* and *Indrokta rasayan*.

Substitutes: *Satavari* (*Asparagus racemosus* Willd.), *Salam mishri* (*Eulophia campestris* Wall.)

Polygonatum verticillatum (Linn.) All. var. *rubrum* is also similar to *Meda* and used instead of this at some places of Uttarakhand. Its stem is about 60 cm in height, new stem pinkish-purple, later on turns green; leaves slender, verticillate; flowers small, 2-6 in the axis of upper leaves, pink-purple or dark purple in color, pendulous; fruit- blue-black berries; its rhizome is very bitter in taste.

6. *Polygonatum cirrhifolium* (Wall.) Royle

Botanical Name: *Polygonatum cirrhifolium* (Wall.) Royle

Syn- *Convallaria cirrhifolia* Wall.

Family: Liliaceae

English Name: King's Solomon's Seal, Mahameda, Tendril leaf Solomon's seal, Coiling leaf Solomon's Seal. Coiling leaf *Polygonatum*.

Sanskrit/ Hindi Name: *Maha meda*

Habit and Habitat: A tall, perennial herb, 30-120 cm in height. Found in Northern Asia, in China, Nepal, Bhutan and Pakistan at an altitude of 2000-4000 m. In India found in temperate Himalayas from Himachal Pradesh eastwards to Sikkim at an altitude of 1500-3300 m, in Manipur at an elevation of 1200 m and in other regions of Uttarakhand upto an elevation of 2000-3000 m asl.

Taxonomic features: Its stem is very weak, flexuous, unbranched, terete or grooved, puberulous or glabrous often climbing by means of tendril like tips of the leaves and grow generally in association with bushes; **leaves**-always in whorls of 3-6, sessile, linear, 7.5-12.5 cm long and 3-5 mm broad, narrowed into the slender revolute tips, cirrhose, membranous, glaucous and costate beneath, the margins usually inrolled to the midrib; **flowers**- whorled on 2-4 flowered peduncle, 5 mm in diameter, pendulous, white often greenish or slightly purple; peduncle 5-15 mm long; **bracts**-3-4 mm, white; pedicel 4-6 mm long; **perianth**-white, 8-11 mm long, slightly constricted in middle, lobes 2 mm long, subcylindric; **stamens**-6, inserted above the middle of the tube, filaments-ciliolate, 5 mm long, anthers-dorsifixed, included; **ovary**-trigonal, 2.5 mm, style straight as long as the ovary, stigma-3; **fruits**-6-8 mm in diameter, excessively variable in size, green and on ripening orange-red, globose or ellipsoid berries; **seeds**-variable in number, 4 mm in diameter, subglobose, testa thin; **rhizomes**-rhizome moniliform or terete, generally look like ginger but less thick, 1-2 cm in diameter, white or dull white in colour (figure 1f).

Flowering: July-August.

Fruiting: September-October.

Active ingredients: Its rhizome contains glucose, sucrose and two new steroidal saponins sibiricoside A and B. The main ingredients of n-butanol extract of rhizomes are steroid terpenoide, polysaccharides, phenol and stannin. Recent spectroscopic studies identified following compounds, -L-rhamnopyranosyl, -D-glucopyranoside, dauvosterol, -sitosterol, 6-nonadecenoic acid, 6-stearic acid and one inorganic compound.

Properties & Action: Cooling, mild laxative, galactagogue, aphrodisiac, depurative, wound healer, febrifuge, expectorant and tonic. Compounds extracted from its rhizome showed fungicidal activities (Wang et al., 2007).

Uses: It is useful in cough, leprosy, skin diseases, anorexia, worms, emaciation, gout, debility, fever, sexual debility and other seminal disorders.

Part used: Rhizomes.

Dosages: As directed by the Physician.

Formulations: *Vachadi taila*, *Astavarga churna*, *Chyavanprash rasayan*, *Chitrakadi taila*, *Mahakalyan ghritha*, *Mahamayura ghritha* and *Indrokta rasayan*.

Substitutes: *Satavari* (*Asparagus racemosus* Willd.), *Nagbala* (*Sida veronicifolia* Lam.), *Shakakul mishri* (*Polygonatum multiflorum* (Linn.) All.) and *Prasarani* (*Paederia foetida* Linn.).

7. *Habenaria intermedia* D. Don

Botanical Name: *Habenaria intermedia* D. Don
Syn- *Ochyrorchis intermedia* (D. Don) Szlach.

Family: Orchidaceae

English Name: Intermediate Habenaria, White wild orchid, The in-between Habenaria, Rein deer orchid

Sanskrit/ Hindi Name: *Riddhi*

Habit and Habitat: A stout, terrestrial perennial herb, 25-50 cm in height.

It is Found in Pakistan, Bhutan and Nepal upto an altitude of 2000-3300 m asl. In India found in Temperate Himalayas at an altitude of 1500-2400 m from Kashmir to Sikkim, Uttarakhand and Himachal Pradesh.

Taxonomic features: Its stem is erect, cylindric, terete, robust, leafy on the nodes; **leaves**-3-5, ovate or oblong or ovate-lanceolate, scattered, 5-10 cm long, sheathing, acuminate, base rounded or cordate, 5-7 nerved; **flowers**-few, distant, very large 5 cm across, white or greenish white, 2-6 flowered raceme borne on a stout axis; **bracts**-leafy, broad, lanceolate, acuminate, equalling the ovary or more; **sepals**-

persistent, 20-25 mm long, green, spreading tips, reflexed, upper one white inside, dorsal sepals recurved, lateral sepals falcately lanceolate, acuminate, reflexed, 5-nerved, narrower than the petals; *petals*-strongly 5-nerved, entire, obovate, falcate, glabrous, lips white, 3-lobed, longer than sepals, green, side lobes of the lip fimbriate, lacerate to the middle or inner margin, broad, petaloid, mid lobe linear, narrow; spur 5-6 cm long, flexuous, very stout, twice as long as the ovary, more or less curved; side lobes deeply fringed; *stamens*-5-6 cm long, curved, anther cells with long, erect, filiform tubes, glands of pollinia small; stigmatic processes-long, slender, incurved; rostellum adnate to the face of the column between the anther cells; **fruits**- pedicelled capsule, 3.8-5 cm long, fusiform, beaked, terete; **tubers**- oval or oblong, 1.5 -3.5 cm long and 1.0-2.5 cm in diameter, covered with fine white hairs, round at the opposite end but tapering towards stem joint, skin is dirty, white, flesh white (figure 1g).

Flowering: July-August.

Fruiting: September-October.

Active ingredients: Tuber contains bitter substances, starch and minerals. Also contains taxol an anticancer drug.

Properties & Action: Tuber-Sweet, cooling, emollient, brain tonic, aphrodisiac, depurative, appetizer, anthelmintic, *rasayana* and tonic.

Uses: It is useful in burning sensation, thirst, fever, cough, asthma, muscular pain, sprains, arthritis, sciatica, insanity, leprosy, skin diseases, anorexia, worms, emaciation, gout and general debility.

Part used: Tubers.

Dosages: Powder 2-3 gm or as advised by the Physician.

Formulations: *Vachadi oil*, *Vajikaran ghrta*, *Astavarga churna* and *Chyavanprash rasayan*.

Substitutes: *Varahi kand* (*Tacca integrifolia* Ker Gawl.), *Bala* (*Sida cordifolia* Linn.) and *Chiriya musali* (*Asparagus filicinus* Buch.-Ham. ex D. Don).

8. *Habenaria edgeworthii* Hook.f. ex Collett

Botanical Name: *Habenaria edgeworthii* Hook.f. ex Collett

Syn- *Platanthera edgeworthii* (Hook.f. ex Collett) R. K. Gupta

Family: Orchidaceae

English Name: Edgeworth's *Habenaria*, Edgeworth's *platanthera*

Sanskrit/ Hindi Name: *Vridhhi*

Habit and Habitat: A tuberous terrestrial orchid, growing up to 30-60 cm in height. In India found from Himachal Pradesh, Uttarakhand to North West Himalaya, it is also found in Nepal and Pakistan up to an altitudes of 2500-3000 m asl on grassy pastures.

Taxonomic features: Its stem somewhat flexuous leafy stem, covered with hairs; **leaves**-2-4 in number, sheathed, the second leaf largest, 6-10 cm long, 4.5 cm wide, ovate to ovate-lanceolate; **flowers**-yellowish green, deflexed in buds, in cylindrical inflorescence, spike 20-25 cm long, 3 cm broad, dense; **bracts**-lanceolate, equalling the ovary in length; **sepals**-green, margin ciliate, broadly ovate; **petals**-bright yellow, sometimes greenish-yellow, thick, obliquely triangular, labellum-entire, 7-9 mm long, strap-shaped, bright-yellow, spur longer than ovary, 1.5-2.5 cm long, directed upwards; **column** 2-3 mm, anther canals short, stigmatic processes-short, oblong; **ovary**-twisted, glabrous; **fruits**-capsule, usually opening laterally; **seeds**-numerous, dust like small seeds; **tubers**-small, fusiform, ellipsoid to subglobose, 1-2.4 cm long, 0.4-0.9 cm in diameter, covered with fine white hairs, fleshy, white inside and mucilaginous (figure 1h).

Flowering: July-August.

Fruiting: September-October.

Active ingredients: Tuber contains bitter substances, minerals, starch and phenolic compounds.

Uses: Cooling, emollient, brain tonic, blood purifier, appetizer, *rasayan* and tonic. Tuber is useful in burning sensation, excessive thirst, fever, cough, asthma, insanity, leprosy, skin diseases, anorexia, worms, emaciation, gout and general debility.

Part used: Tuber.

Dosages: Powder 2-3 gm or as advised by the Physician.

Formulations: *Mahamayura ghrita*, *Astavarga churna* and *Chyavanprash Rasayan*.

Substitutes: *Varahi kand* (*Tacca integrifolia* Ker Gawl.), *Salam panja* (*Dactylorhiza hatagirea* (D. Don) Soo) and *Maha bala* (*Sida acuta* Burm.f.).

Habenaria griffithii Hook.f. is a perennial tuberous herb, 15-30 cm long; leaves 2-3 (2 larger

near base of stem), 5-7 cm long and 2-3 cm wide, oblong-elliptic or oblong, upper leaves rapidly diminishing in size; flowers very small, greenish, somewhat tubular; perianth segments 3-4 mm long, spreading at their tips; petal linear lanceolate, widened towards base. It is used in place of *Riddhi* and *Vridhhi* at various parts of Uttarakhand.

Some main characteristic features of all the species of *Astavarga* group is presented in table 1.

Table 1: Main characteristic features of *Astavarga* plants.

| Botanical name | Sanskrit name | Family | Main characteristic features for identification |
|---|---------------------|---------------|---|
| <i>Roscoeia purpurea</i> Smith | <i>Kakoli</i> | Zingiberaceae | Anthers bifurcated at the tip. Stem is slightly purple in colour, flower purple. |
| <i>Lilium polyphyllum</i> D. Don Syn- <i>Lilium punctatum</i> Jacquem. ex Duch. | <i>Kshirakakoli</i> | Liliaceae | Flowers are white in colour, purple coloured within, long-linear and dotted. |
| <i>Crepidium acuminatum</i> (D. Don) Szlach. Syn- <i>Malaxis acuminata</i> D. Don, <i>Microstylis wallichii</i> | <i>Jeevak</i> | Orchidaceae | Tip of lip edge is straight - linear. Raceme is pincillate. |
| <i>Malaxis muscifera</i> (Lindl.) Kuntze Syn- <i>Microstylis muscifera</i> (Lindle.) Ridl. | <i>Rishbhak</i> | Orchidaceae | Leaves 2, centrally bifurcated or 3 lipped. Pseudobulb resembles with the bull's horn. |
| <i>Polygonatum verticillatum</i> (Linn.) Allioni Syn- <i>Convallaria verticillata</i> Linn. | <i>Meda</i> | Liliaceae | Leaves are arranged in whorls, four to eight in number, acute, pointed tips. |
| <i>Polygonatum cirrhifolium</i> (Wall.) Royle Syn- <i>Convallaria cirrhifolia</i> Wall. | <i>Maha meda</i> | Liliaceae | Leaves are arranged in whorls, 3-6 in number, tip of leaf is tendril like. ascending, occurs with support of nearby shrubs. |
| <i>Habenaria intermedia</i> D. Don Syn- <i>Ochyrorchis intermedia</i> (D. Don) Szlach. | <i>Riddhi</i> | Orchidaceae | Flowers are white in colour, lobes of petals fimbriated and long in size. |
| <i>Habenaria edgeworthii</i> Hook.f. ex Collett Syn- <i>Platanthera edgeworthii</i> (Hook.f. ex Collett) R. K. Gupta | <i>Vridhhi</i> | Orchidaceae | Spur is truncated above, petals and ligules are yellow in colour. |

It seems that In spite of an elaborate description of the *Astavarga* plants in the old texts (*Nighantus*), those experts who have done research in the modern times, have only expressed their opinions, perhaps due to lack of resources, government support and due to lack of motivation to work in *Ayurvedic* field, by government supported organizations or in the absence of thorough research and various other reasons have relied on information obtained from the market and traders on the basis of their research and botanical identification. No one got the right opportunity and optimistic environment for searching these plants through an extensive expedition to the Himalayas. Utilizing the available resources, they carried out research and instead of removing uncertainty, they made botanical identification of *Astavarga* plants even more doubtful and uncertain. For four

Astavarga plants *Vridhi*, *Rishbhak*, *Mahameda* and *Kshirkakoli*, it was difficult to gather them even at small scale rather at large scale, either for business purpose or for some other work. Doubt and uncertainty was much more regarding these four plants. The major reason being unavailability and identity of the *Astavarga* plants. The difficulty in finding the natural habitat, lack of knowledge of the specific ecological conditions, difficulty in access and scarce availability has also contributed to the mystery about their botanical identify. As these plants grow in small ecological niches. Even to collect small quantity of these four *Astavarga* medicinal plants, it is necessary to undertake a long expedition in the North-West Himalayas. Besides this, quick destruction of natural forests, many developmental programmes, environmental changes, changes in the natural habitat due to

geographical and climatic conditions, led to decrease in the ecological density and availability of these plants, as they required specific natural conditions and habitat for their growth. This is especially true for *Lilium polyphyllum* D. Don. Colonel Henry Collet in his book “*Flora Simlensis* (1980)” had written hundred years ago, that this plant was easily available in the forests around Shimla but now it is rarely found there. Other *Astavarga* plants like *Habenaria intermedia* D. Don and *Habenaria edgeworthii* Hook. f. ex Collet also have the same status, it is difficult to find these plants in large numbers. Another important reason for this decline was the harvesting of fodder for the domestic animals from forest area. Forest fire also destroyed lower vegetation in these areas. Due to the indiscriminate cutting of grasses and bushes along with the underground reproductive parts of the plants and the matured seeds were also destroyed. Due to the cutting, the seeds do not germinate in the soil. This results in the reduction in the population of these plants. After years of expeditions across the Himalayas, and constant study of the ancient *Ayurvedic* texts, this is the first attempt to create a reliable and easy identification of rare and hard to find medicinal plants like *Astavarga*.

Ravi Kant et al., 2012 concluded that, the demand of these orchids viz., *Jeevak*, *Rishbhak*, *Riddhi* and *Vridhhi* for various *Ayurvedic* formulations has been increased many folds especially in Himachal Pradesh and Uttarakhand where a large number of pharmaceutical units have been established recently by various companies such as Divya Pharmacy, Dabur, Himalaya, Baidhyanath etc. These plants are becoming so rare that different *Ayurvedic* formulations are now using other substitutes at their place. The species like *Habenaria intermedia* (Chauhan et al., 2007) and *Malaxis muscifera* (Chauhan et al., 2008) have been exploited at such a level, that they have been considered as endangered species. Similarly the other two species, *Malaxis acuminata* and *Habenaria edgeworthii* are also facing the survival threats. Thus, there is an urgent need to take every possible measure to conserve the gradually declining natural population of these valuable plants both by *in-situ* and *ex-situ* means.

Recently Bisht et al., 2011 concluded that habitat specificity, narrow range of distribution, land-use disturbances, introduction of non-natives, habitat alteration, climatic changes, heavy livestock grazing, explosion of human density, fragmentation and degradation of plant density, population bottleneck and genetic drift are the potential causes of rarity in medicinal plant species. The women of these areas carry all the activities of domestication of cattle. They collect the food and fodder from the nearby forests and due to lack of identification cut these species along with the fodder grasses. This is therefore one of the reasons of threatened status of these plant species.

Although these species are listed as endangered but there is no proper management plan for conservation due to the lack of related information and collection of these species continues from the wild through illegal means. Domestication and cultivation of such medicinal orchids may be encouraged to fulfill market demand, which will increase the income of local people on one hand and reduce pressure on the natural habitat on the other. Such economically important orchids should be conserved with both *in situ* and *ex situ* methods of conservation. In addition, further studies may be initiated to increase seed germination, tissue culture, seedling establishment and detail ecological adaptation of species to strengthen the conservation programme (Chauhan et al., 2007 & 2008).

Conservation prioritization and future strategy

Ex-situ cultivation of wild endangered medicinal plants has been considered as one of the most prioritized solutions to dilute the harvesting pressure on these taxa and at the same time an appropriate alternative to produce raw material and to meet the bulk demand of pharmaceutical sector. Based on the threatened status and the high utility, these species have been prioritized for *ex-situ* cultivation (Ahuja, 1995; Nautiyal et al., 1997; Badola and Pal, 2002). Additionally, it occupied the top rank among medicinal plants of the West Himalaya prioritized for conservation (Sastry and Chatterjee, 2000).

Realizing a huge gap in existing knowledge, considering high ethnobotanical as well as industrial values and the endangered status of these species, the following points need to be considered for its conservation and sustainable utilization: (1) These species have been listed as “Endangered” (Ved et al., 2003) for the globe, however, based on its low density, frequency and abundance in natural pockets in Himachal Pradesh, Jammu & Kashmir and Uttarakhand, it deserves to be categorized as “Critically Endangered” for the globe; (2) the natural habitats of these species throughout the Himalayas need to be identified and officially protected for conservation; (3) harvesting and trade of these species need to be banned strictly; (4) mostly, underground parts like rhizome, bulbs, tubers and pseudobulbs of these species are used in traditional and modern medicine; phyto-chemical investigation of other similar species need to be carried out so that optimum use of these invaluable threatened species could be done; (5) the techniques developed for propagation and cultivation of these species need to be tested repeatedly; (6) lack of planting materials is one of the constraints in large scale cultivation of these species, micro-propagation techniques should be developed and germplasm from elite populations used for generating large scale healthy planting materials of the species; and (7) the native communities need to be sensitized to the sustainable use and conservation value of these species.

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References:

- Acharya Balkrishna, 2012. *Secrets of Astavarga Plants (for vitality and anti-aging)*, Divya Prakashan, Patanjali Yogpeeth, Uttarakhand, Haridwar.
- Ahuja, P.S. 1995. Approach to project design on medicinal and aromatic plants. In: *Cultivation of Medicinal Plants and Orchids in*

Sikkim Himalaya (eds., Sundriyal, R.C. and Sharma, E.). HIMAVIKAS Occasional Publication No. 7, Bishen Singh Mahendra Pal Singh, Dehra Dun, pp. 81-89.

- Badola, H.K., Pal, M. 2002. Endangered medicinal plants in Himachal Pradesh. *Current Science* **83** (7): 797-798.
- Bhandari, C.R. 1985. *Vanaushadhi Chandraodaya*, Chandraraj Bhandari, Bhanpura Indore, Vol. (I - X).
- Bisht, Poonam, Prasad, Pratti, Nautiyal, Bhagwati, Prasad. 2011. *Polygonatum verticillatum* (Linn.) All. and *Polygonatum cirrhifolium* (Wall.) Royle: two threatened vital healers from astavarga nurtured by Garhwal Himalaya, India, *J. Plant Develop.* **18**: 159-167.
- Chand, Lal (Commentator), Shri Vagabhatta Virachitam, 1963. *Astanghrdya*, Motilal Banasri Das, Delhi.
- Chauhan R.S., Nautiyal, M.C., Prasad, P. 2007. *Habenaria intermedia* D. Don – an Endangered medicinal orchid. *MIOS Journal*, **8**(10): 15–20.
- Chauhan, N. S. 1990. Medicinal Orchids of Himachal Pradesh, *J. Orchid Soc. India*, **4** : 99-105.
- Chauhan, R.S., Nautiyal, M.C., Prasad, P., Purohit, H. 2008. Ecological features of an endangered medicinal orchid, *Malaxis muscifera* (Lindley) Kuntze, in the western Himalaya. *MIOS Journal*, **9**(6): 8–12.
- Chubey, D.R. 1986. *Abhinava Nighantu* Chaukhamba Sanskrit Series, Varansai.
- Chunekar, K.C. 1969. *Vanaspatika Anusandhan Darshika*, Vidya Bhavan, Varanasi.
- Chunekar, K.C., Pandey, G.S. 2006. *Bhavaprakasa Nighantu*, Chaukhamba Bharti Academy, Varanasi.
- Collet, H. 1980. *Flora Simlensis, A hand book of the flowering plants of Shimla and neighbourhood*, Bishen Singh Mahendra Pal Singh, Dehradun.
- Dev, Atri. 1960. *Ayurveda ka Brihat Itihas*, U.P. Govt. Rajrshi Purshotam Das Tandon, Hindi Bhavan Lucknow.

- Deva, S., Naithani, H. B. 1986. *The Orchid flora of North West Himalaya*, Print and Media Associates, New Delhi, India.
- Dey, A. C. 1982. *Indian medicinal plants used in Ayurvedic preparations*, Bishan Singh Mahender Pal Singh, Dehradun.
- Dhyani, A., Nautiyal, B.P., Nautiyal, M.C. 2010. Importance of Astavarga plants in traditional systems of medicine in Garhwal, Indian Himalaya, *International Journal of Biodiversity Science, Ecosystem Services & Management* Vol. 6, Nos. 1–2, March–June, 13–19.
- Duthie, J. F. 1906. The Orchids of North-Western Himalaya, *Ann. Roy. Bot. Gard. Calcutta*. 9 : 81-211.
- Dwivedi, Vishwanah (Commentator) 1977. *Bhav Prakash Nighantu*, Motilal Banarsi Das, Delhi.
- Gaur R.D. 1999. *Flora of the District Garhwal North West Himalaya with ethnobotanical notes*, Transmedia Publication, Srinagar Garhwal, India.
- Giri, Lalit., Jugran, Arun., Rawat, Sandeep., Dhyani, Praveen., Andola, Harish., Bhatt, I.D., Rawal, Ranbeer, S., Dhar, Upendra. 2012. In vitro propagation, genetic and phytochemical assessment of *Habenaria edgeworthii*: an important Astavarga plant, *Acta Physiol. Plant*, **34**: 869-875.
- Godagama, S., Hodgkinson, L. 1997. *The handbook of Ayurveda- India's medical wisdom explained*, Kyle Cathie Limited, London.
- Gupta, Atrideva. 2002. *Asthangha Samgraha*, Krishana Das Academy Varanasi, (Vol. II).
- Hooker, J.D. 1997-1999. *Flora of British India*. Bishan Singh Mahendra Pal Singh 23-A, New Connaught place, Dehradun, 248001, India. (Vol. V-VI) (reprints).
- <http://www.theplantlist.org/tpl/record/kew>.
- Javed, Naquvi Kamran., Ansari, Shahid Husain., Mohammad, Ali., Iram Nazish. 2012. Phytoconstituents from the bulb of *Lilium polyphyllum* D. Don, *International research Journal of Pharmacy*, **3 (2)**: 146-148.
- Kamat, S.D. 2002. *Studies on Medicinal Plants and Drugs in Dhanvantari- Nighantu*, Chaukhamba Sanskrit Pratishtan, Delhi (First Published).
- Kaushik, P., Dhiman, A.K. 2000. *Medicinal Plants and Raw Drugs of India*, Bishan Singh Mahendrapal Singh, Dehradun.
- Khan, H., Saeed, M., Gilani, A.U., Khan, M.A., Dar, A., Khan, I. 2010. The antinociceptive activity of *Polygonatum verticillatum* rhizomes in pain models, *J. Ethnopharmacol.*, Feb 3; Vol-**127(2)**:521-7.
- Lattoo S. K., Khan, S., Dhar, A. K. 2005. A new chromosome number in *Polygonatum cirrhifolium* Royle: an endangered liliaceous medicinal herb. *Current Science*, **89(7)**: 1080-1081.
- Lattoo, S. K., Dhar, A. K., Jasrotia, A. 2001. Epicotyl seed dormancy and phenology of germination in *Polygonatum cirrhifolium* Royle. *Current Science*, **81(11)**: 1414-1417.
- Mathur, D.R. 2003. *Yogtarangini*, Varanasi (India): Chaukhamba Vidhya bhawan.
- Mishra, Brhmashankar., Vaisya, R. 1984. *BhavaPraksh* of Shri Bhav Mishra, Chaukhamba Sanskrit Sansthan, Varanasi.
- Naithani, B.D. 1985. *Flora of Chamoli*. Vol. II. Howrah, Botanical Survey of India, Department of Environment.
- Nautiyal, A.R., Nautiyal, M.C., Purohit, A.N. 1997. *Harvesting Herbs-2000: Medicinal and Aromatic Plants- An Action Plan for Uttarakhand*. Proceeding of a Seminar on Harvesting Herbs-2000. Bishan Singh Mahendra Pal Singh, Dehra Dun, p. 196.
- Nayar, A., C.K.N., Mohanan, N. 1995. *Medicinal Plants of India*, Nag Publishers, Delhi-7.
- Osmaston, A.E. 1978. *A Forest Flora for Kumaon*, Bishan Singh Mahendra Pal Singh, Dehradun, India.
- Pandey, D. 2005. *Sarangadhara samhita*, Varanasi (India), Chaukhamba Amarabharati Prakashan.

- Pandey, Madan Mohan., Govinddarajan, R., Khatoon, Sayyada, Rawat., Ajay Kumar Singh., Mehrotra, Shanta. 2006. Pharmacognostical studies of *Polygonatum cirrhifolium* and *Polygonatum verticillatum*, *Journal of Herbs, Spices & Medicinal Plants*, **12** (1-2): 37-48.
- Pandit, Ramprasad. 1998. *Madanpal Nighantu*, Khemraj Shri Krishanadass, Mumbai.
- Parashar, Shri Radhakrishana. 1974. *Sharngadhar Samhita*, Shri Vaidyanath Ayurved Bhavan Pvt. Ltd. Nagpur.
- Polanin, O., Stainton, Adam. 1984. *Flowers of Himalaya*, Oxford University Press, Delhi.
- Raj, Khem., Das, Krishan. 1981. *Shaligarm Nighantu*, Krishandas, Mumbai.
- Ram Datta., Mathur, Krishan Lal. 1995. *Brhata Nighantu Ratnakar*, Khemraj Shri Krishna Das. (Part I & II).
- Rana, Man Singh., Samant, Sher Singh. 2011. Population biology of *Lilium polyphyllum* D. Don ex Royle-A critically endangered medicinal plant in a protected area of Northwestern Himalaya, *J. Nat. Conserv.* 19(3): 137-142.
- Rath, Chinmay., Suman Kumari., Dhar, Bishnupriya., Mohanty, R.C., Dixit, Renu., Padhi, M.M., Babu, Ramesh. 2011. Phyto-Pharmacognostical studies of two endangered species of *Malaxis* (Jeevak and Rishabhak), *Pharmacognosy Journal*, **3**(26): 77-85.
- Rath, Chinmay., Suman Kumari., Dhar, Bishnupriya., Mohanty, R.C., Singh, Arun., Padhi, M.M., Lavekar, G.S. 2009. Pharmacognostical and Phytochemical Evaluation of rare and endangered *Habenaria* spp. (Riddhi and Vriddhi), *Pharmacognosy Journal*, **1**(2): 94-102.
- Ravi Kant., Verma, Jagdeep., Thakur, Kranti. 2012. Distribution pattern, survival threats and conservation of 'Astavarga' orchids in Himachal Pradesh, North west Himalaya, *Plant Archives* Vol. **12** No. 1, pp. 165-168.
- Sahu, M.S., Mali, P.Y., Waikar, S.B., Rangari, V.D. 2010. Evaluation of immunomodulatory potential of ethanolic extract of *Roscoea procera* rhizomes in mice, *J Pharm Bioalied Sci.*, Oct-Dec; Vol-**2**(4):346-349.
- Sastry, A.R.K., Chatterjee, S. 2000. Prioritization of Medicinal Plants of India. In: *Setting Biodiversity Conservation Priorities for India* (eds., Singh, S. Sastry, A.R.K., Mehta, R. and Uppal, V.). World wide Fund for Nature-India, pp. 467-473.
- Sharma B.D., Acharya, Balkrishna. 2005. Vitality strengthening Astavarga plants (Jeevaniya & Vayasthapan Paudhe), Uttaranchal (India), Divya Publishers, Divya yog mandir.
- Sharma, Alok., Reddy, G.D., Kaushik, Atul., Shanker, K., Tiwari, R.K., Mukherjee, Alok., Rao, Ch.V. 2007. Analgesic and anti-inflammatory activity of *Carissa carandas* Linn. fruits and *Microstylis wallichii* Lindl. tubers. *Natural Product Sciences*, **13**(1): 6-10.
- Sharma, Anant Ram. 2001. *Susruta Samhita*, Chaukhamba Surbharti Prakashan, Varansi, First Edition, (Vol. I- III).
- Sharma, P.V. 1993. *Dravya Guna Vijnana*, Chaukhamba Bharti Academy, Varanasi, (Vol. I).
- Sharma, P.V. 2003. *Dravyaguna Vijnana*, Chaukhamba Bharti Academy, Varanasi, (Vol. II).
- Sharma, P.V. 1976. *Introduction to Dravyaguna*, Chaukhamba Orientalia, Varanasi.
- Sharma, Priyavrata., Sharma, Guru Prasad. 2006. *Kaiyadeva-Nighantu*, Chaukhambha Orientalia, Varanasi, (Second Edition).
- Sharma, Priyavrata. 1987. *Cikitsakalika*, Chaukhamba Surbharti, Prakashan Varanasi, (First Edition).
- Sharma, Pushpa., Mahajan, Nipun., Garg, Pankaj., Singh, Gurkirpal., Dadhwal, Sumit., Sharma, Sakshi. 2011. *Malaxis acuminata*- A review, *International Journal of Research in Ayurveda & Pharmacy*, **2**(2): 422-425.

- Sharma, R.S. 1969. *Vanaushadhi Nidarshika*, Kashi Hindu University, Varanasi.
- Sharma. P.V., Sharma, Guru Prasad. 1998. *Dhanwantri Nighantu* Chaukhamba Orientalia, Varanasi.
- Shastri, Ambikadatta., Rajeshwardatta. 2005. *Bhaisajyaratnavali*, Chaukhambha Sanskrit Sansthan, Varanasi, (Eighteen Revised Edition).
- Singh, Amrit Pal. 2006. Astavarga- Rare Medicinal Plants, *Ethnobotanical Leaflets* 10: 104-108.
- Singh, Thakur Balwant., Chunekar, K.C. 1972. *Glossary of Vegetable Drugs in Brihatrayi*, Chaukhamba Sanskrit Series office, Varanasi.
- Trikamji, Yadav ji. 1971. *Dravya Guna Vigyanam*, Shri Sharma Ayurveda Mandir, Nagpur.
- Tripathi, Brahmanand. 2003. *Asthangha Hridayam*, Chaukhamba Sanskrit Pratishthan, Delhi.
- Tripathi, Brahmanand. 2004. *Charaka-Samhita*, Chaukhamba Surbharti Prakashan, Varanasi (Vol. I - II).
- Tripathi, Indra Deva. 2006. *Arkaprakasha*, Chowkhamba Krishnadass Academy Varanasi, (Second Edition).
- Tripathi, Indra Deva. 2006. *Raj Nighantu*, Chowkhamba Krishnadass Academy, Varanasi.
- Tripathi, J.P. (Commentator). 1983. *Chakradatta* of Shri Chakrapani Datta. Chaukhamba Sanskrit Series office, Varanasi.
- Tripathi, Ravi Dutt. 2006. *Astanga-Samgraha sutrasthana*, Chaukhamba Sanskrit Pratishthan.
- Uniyal, Mayaram. 1975. *Astavarga Sandigdha Vanaushadhi*, Dhanwantri Patrika, Shri Jwala Ayurved Bhavan Aligarh.
- Uniyal, Mayaram. 1989. *Medicinal Flora of Garhwal, Himalayas*. Shree Baidyanath Ayurved Bhavan, Nagpur.
- Uniyal, Mayaram. 1997. *Medicinal Plants and Minerals of Uttarakhand Himalaya*, Baidyanath, Ayurved Shodh Sansthan, Patna.
- Vaisya, Shri Shaligram. 2007. *Shaligram Nighantu Bhushanam*, Khemraj Shri Krishnadass ,Mumbai, (Vol. VII-VIII).
- Ved, D.K., Kinhal, G.A., Ravikumar, K., Prabhakaran, V., Ghate, U., Sankar, R.V., Indresha, J.H. 2003. CAMP Report: Conservation Assessment and Management Prioritisation for the Medicinal Plants of Jammu & Kashmir, Himachal Pradesh & Uttaranchal, Workshop, Shimla, Himachal Pradesh. FRLHT, Bangalore, India, p. 206.
- Wang, Dong – mei., Zhu, Wei, Li Juan-Li. 2007. Study on chemical constituents of *Polygonatum cirrhifolium* rhizome and their fungicidal activities, *Journal of Sichuan University* (Natural Science Edition); Vol-44: 918-921.
- Warrier, P.K., Nambiar, V.P.K., Ramamurthy, C.R. 1994. *Indian Medicinal Plants*, Orient Longman, Chennai.