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Mini Review

SWERTIA CHIRAYITA: THE HIMALAYAN HERB

S. Khanal[1]*, N. Shakya[1], N. Nepal[1] and D. Pant[1, 2]

[1]Central Department of Biotechnology, Tribhuwan University, Kathmandu, Nepal
[2]Central Department of Botany. Tribhuwan University, Kathmandu, Nepal

*Corresponding author's email: connectsupreet@gmail.com

Abstract

Swertia chirayita is a native Himalayan herb typically found in the altitude of 1500 to 3100m. *Swertia* species are commonly used as primary medicines in fever, digestive and enteric diseases; especially *S. chirayita* is of principal importance. The pharmacological and ethno-medicinal perspective of the plant is well understood traditionally and pharmaceutically. Its secondary metabolites including glycosides and xanthones show promising bioactivity making it a powerful herb. Mixing of *Swertia chirayita* with its other species is done routinely in chiretta trade. Extensive wild collection and lack of sustainable conservation has led to the vulnerable status of the wild cultivar.

Key Words: *Swertia chirayita*; medicinal; trade; conservation

Introduction

The plants species of genus *Swertia* (family Gentianaceae) are diverse and large genus populated with 170 species (Brahmachari *et al*., 2004; Hajimehdipoor *et al*., 2008); distributed at the mountainous region of tropical Asia, Europe, America and Africa. Himalayan regions houses most of the species of *Swertia* (Negi *et al*., 2011; Dutt *et al*., 1996). The traditional use of the plant in various ailments is famous in Tibetan and Chinese medicine systems (Phobooand Jha, 2010). They are known for the bitter taste and used in traditional remedies against loss of appetite, fever, and digestive disorders (Negi *et. al*., 2011; Jensen and Schripsema, 2002). *Swertia chirayita* is known to contain various active principles including xanthones, secoirioid glycosides, flavonoids, alkaloids, phenolics (Brahmachari *et al*. 2004; Negi *et al*. 2011). These secondary metabolites are responsible for various bioactivities that make the plant therapeutically potent and powerful.

Morphology

The family *Gentianaceae* is a family of flowering plants containing a wide range of colors and floral patterns. Members of the family have leaves that are opposite each other on the stem. *Swertia* L (*Gentianaceae – Gentianeae – Swertiinae*) is annual, biennial or perennial herb ranging from 2-4 cm. to over 1.5 m in height with tetra or pentamerous flowers, 1 or 2 nectaries at the base of characteristically rotate corolla lobes. The genus mostly occurs in alpine or temperate habitats in Asia, Africa and North America. The circumscription of the genus has often been debated, resulting disagreement amongst taxonomists due to the morphological similarities (nectariferous and rotate corolla lobes) among the species of *Swertia* and the related genera (Bhattarai, 1996; Joshi and Joshi, 2005; Manandhar, 2002).

Swertia L. (Gentianaceae) is morphologically diverse but taxonomically distinct genus, taxonomically classified as Family: Gentianaceae, Tribe: Gentianeae, Subtribe: Swertiinae, Genus: Swertia (Brahmachari *et al*., 2004; Sharma *et al*., 2011).

Ecology and Distribution

Plants belonging to *Gentianaceae* family are annual and perennial herbs or shrubs and are native to the northern temperate areas of the world (Singh, 2008). *Swertia chirayita* is a native plant species of temperate Himalayan region from 1200 to 2100m altitude. The distribution of *Swertia chirayita* is not uniform, and depends on altitude and slope. The growth is more favorable on north facing slopes. (Joshi and Dhawan, 2005; Phoboo and Jha, 2010; Sharma *et al*., 2011). *Swertia chirayita* is known to grow in acidic soil conditions (Bhattarai 1996, Sharma *et al*., 2011; Barakoti, 2004). *Anaphalis triplinervis, Anemone obtusiloba, Oxalis corniculata, Artemesia vulgaris, Bidens spp., Eupatorium adenophorum, Viola spp., Rhododendron arboretum* and *Acer spp.* are the common associates of *S. chirayita* (Phoboo and Jha, 2010; Bhatt *et al*., 2006; Sharma *et al*., 2011).

Due to its diverse topographical distribution, Nepal houses 31 species including five varieties of *Swertia* (Joshi and Joshi, 2008; Shrestha *et al*., 2010) among, *Swertia acualis* is the endemic one (Joshi, 2008). There are 31 species

distributed in Nepal (Joshi and Joshi, 2008), 40 species in India (Dutt *et al*., 1995) and 79 species in China (Hajimehdipoor *et al*., 2008). *Swertia* is a large genus of herbs distributed within an altitude of 1200-3600m (Negi *et al*., 2011). This plant is native and indigenous to Himalayan landscape. Nepal occupies a prominent percentage of *Swertia* distribution and has a majority share in its trade (Joshi and Joshi, 2008).

Medicinal and Pharmacological Aspects

Plants belonging to *Gentianacece* are well known for their pharmacological properties. They have bitter compounds called glycosides and hence are best remedies for digestive disorders (Hottestmann Kalad M et al., 1981). Some of the most promising and high potential drugs like Amarogentin, Swertiamarin and Swechirin have been studied for drug development (Brahmachari et al., 2004). *Swertia chirayita* is a crucial medicinal plant that has been mentioned in pharmaceutical codex, traditional medic systems and many pharmacopoeias (Joshi and Dhawan, 2005; Tabassum *et al*,. 2012; Negi *et al*., 2011). Ayurveda focuses its uses as antipyretic, anthelminthic, antiperiodic, laxative, in asthma and leukemic conditions (Negi *et al.* 2011). Brahmachari *et al*., (2004) and Negi *et al*., (2011) have stated the pharmacological bioactivity of various compounds isolated from *Swertia* species, mostly attributing to its seco-irridoids and xanthones. These bioactive compounds are responsible for the therapeutic effects and pharmacological activities (Joshi and Dhawan, 2005).

Swertia chirayita is known to have metabolites including Xanthones and their derivatives, Alkaloids, Secoiridoid glycosides, Flavonoids, Terpenoids and other volatile compounds (Phoboo *et al*. 2010; Joshi and Dhawan, 2005;Brahmachari *et al*., 2004;Negi *et al*. 2011, Pant *et al*., 2000). Pant *et al.* 2000 has enlisted a total of 43 compounds whereas, Brahmachari *et al*., 2004 has enlisted a total of 48 compounds including 13 tetraoxygenated xanthones, 6 xanthone glycosides and derivatives, 18 terpenoids, 3 alkaloids, and 4 secoiridoid glycosides, whereas Joshi and Dhawan (2005) has tabulated a total of 40 compounds. Among those compounds, Xanthones and their derivatives and the secoiridoid glycosides are found to have important pharmacological aspects including anti-diabetic (Bajpai *et. al,.*, 1991;Saxena *et al.*, 1993), anti-malarial (Balaraju *et al*., 2009b;Brahmachari *et al*., 2004), hepatoprotective (Nagalekshmi *et al*., 2011), anti-leishmanial (Ray *et al.*, 1996;Medda *et al*., 1999), anti-carcinogenic effects (Rafatullah *et al*., 1993;Saha*et al*. 2004;Saha *et al*., 2006), antioxidant (Singh *et al*., 2011; Chen *et al*., 2011), anthelmintic (Iqbal *et al.*, 2006), antimicrobial (Kweera *et al*., 2011;Ahirwal *et al*., 2011), anti-pyretic(Bhargava et. al., 2009) and immunomodulation (Kumar *et al*., 2003). The major xanthones pharmacologically active and important are Swerchirin for its hypoglycemic attribute (Saxena *et al.*, 1993) and Mangiferin for its immunomodulatory, antioxidant and anti-inflammatory effects (Saha and Das, 2010; Phoboo *et al*., 2010). The plant is known to contain Amarogentin, a secoiridoid glycoside reported for its various pharmacological aspects including anti-leishmanial (Ray *et al*., 1996) and anti-carcinogenic (Saha *et al*., 2006). It is the most bitter compound known till date with the bitter index of 58,000,000 (Dutt *et al*., 1996).

Swertia chirayita is reputed for its medicinal and pharmaceutical value as it is a rich source of iridoid glucosides, xanthones and flavonoids. Of these, Swertiamarin is the most abundant active constituent and other active compounds reported are sweroside, amaroswerin, amarogentin, bellidifolin, Swertianolin, pseudonolin, isoorientin, isovitexin, swertiajaponin and swertisin (Wang et al., 2008). Among these, Amarogentin (Inoue et al., 1966) is the most bitter principle and it has anti-proliferative and pro-apoptotic actions (Saha et al., 2006).

Among various *Swertia* species, *Swertia chirayita* is the most important one and is highly valued (Brahmachari *et al*., 2004; Joshi 2008; Negi *et al*., 2011). Other traditionally important *Swertia* species substitute for the traditional healing. *S. davidi* is used as remedy for acute bacillary dysentery, *S. alata* as an appetite tonic and febrifuge, *S. minor* in the treatment of malarial and fever, *S. petvolata* and *S. thomsonii* finds its applications in the *Amchies* system of medicine (Brahmachari *et al*., 2004). Other important plants species includes *S. angustifolia, S. corymbosa, S. decussta, S. hookeri, S. macrosperma, S. petiolata, S. lawii, S. paniculata, S. punctata, S. calycina, S. purpurasencs, S. bimaculata, S. ciliata, S. densifolia, S. japonica and S. frachetiana* that are used in folklore medicine and as substitutes for *S. chirayita* in various countries for treatment of liver disorders, fever, dysentery, diarrhea, stomach problems and other ailments (Brahmachari *et al*., 2004;Negi *et al*., 2011; Joshi 2008).

The metabolites in *Swertia* herbs significantly varies according to geographic, climatic, environmental and other factors. As the application of *Swertia* herbs becomes more extensive, a quality standard is required to identify the raw materials in its trade and pharmaceutical applications. Quality control and evaluation of *Swertia* herbs have generally targeted Swertiamarin, due to the high content of this compound (Takei et al., 2001). The content of Amarogentin, Mangiferin and Swertiamarin has been determined using thin-layer chromatography and high-performance liquid chromatography (HPLC). However, a single compound alone could not be responsible for the overall pharmacological actions of *Swertia* herbs and synergistic effects among the various constituents probably play significant roles.

Trade and conservation status

The high ethno-medicinal value has made *Swertia* one of the largest exports on medicinal plants and NTFPs from Nepal. (Barakoti *et al*., 1999; Phoboo *et al*., 2010; Shrestha

et al., 2010, Joshi and Joshi, 2008). *Swertia chirayita* enjoys international and national market system and increasing at a rate of 10% annually (Joshi and Dhawan, 2005; Phoboo and Jha, 2010). Nepal is major exporter of chiretta exporting more than 45% of the world's total volume (Joshi and Dhawan, 2005; Barakoti 2004). Nine species are traded in Nepal: *Swertia chirayita*, *S. angustifolia*, *S. tetragona*, *S. racemosa*, *S. ciliata*, *S. dilatata*, *S. multicaulis*, *S. alata* and *S. nervosa* (Shrestha *et al*., 2010). *Swertia chirayita* trade suffers from heavy adulteration of its nearby species. 12 species from Nepal traded under the name "Chiraito" are *S. alata*, *S. angustifolia*, *S. bimaculata*, *S. cilata*, *S. dilatata*, *S. paniculata*, *S. petiolata*, *S. tetragona*, *S. densiflora*, *S. lawii*, *S. elegans*, *S. minor*, *S. multiflora* (Pyakurel and Baniya, 2011; Phoboo and Jha, 2010; Joshi and Dhawan, 2005) along with non-gentian adulterants like *Exacum spp*., *Andrographis paniculata*, *Ainsliaealatifolia* and *Slevolgia orientalis* (Joshi and Dhawan, 2005; WWF, 2008). Typical adulteration in *S. chirayita* accounts for 20% but adulteration of only 5% is accepted. The continuous adulteration leads to decrease in market and value of the product and has affected the export of the plant (WWF, 2008).

Most of the plants are still collected from wild by the local traders; this extensive and unmanaged collection has led to the depleting population of the plant and sequential danger of extinction (Joshi, 2008). The rampant collection and trade has made *Swertia chirayita* "vulnerable" (IUCN, 2004) and critically rare in the Indian Himalayas and Nepal (Joshi and Dhawan, 2005; Ghimire *et al*., 2008). India has enlisted the plant among the high altitude plants for *in situ* and *ex situ* conservation strategies. Besides, conservation of the plant *S. chirayita* has been prioritized by the government of India (Joshi and Dhawan, 2005). Similarly, the Nepal Government has enforced proper harvesting protocols, forbidding the collection and trade from May to September and cultivation of sustainable methods within the local communities. Establishment of various catchments for the proper cultivation of plants, sustainable harvesting (*in situ* collection), germplasm reserve, raising awareness, in situ strict management with community participation and government approach should be the successful conservation approach (Ghimire *et al*., 2008; Phoboo and Jha, 2010; Pyakurel and Baniya, 2011).

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