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# Review on the ethnomedicobotany and phytochemistry of *Sonchus brachyotus* A.P. de Candolle (Asteraceae)

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**Abstract**

Most of the recognized systems of health care of the world primarily rely on the drugs of herbal origin. Medicinal plants have also been regarded as valuable and affordable sources of different phytoconstituents which are used mostly in the drug discovery against various ailments. *Sonchus brachyotus* A.P. de Candolle of Asteraceae, commonly known as corn snow thistle, is a perennial herb of Eastern Himalaya and one of the mostly acclaimed plants in Indian as well traditional Chinese medicine. A number of phytochemical constituents have been found to be associated with the plant like linolenic acid, chlorogenic acid, β-sitosterol, apigenin, luteolin, quercetin etc. The plant has been found to possess diverse number of pharmacological activities like antioxidant, antirheumatic, antimicrobial, peroxinitrate-scavenging, antitumor activity and many more. It is traditionally used to treat rheumatism, diarrhoea, cough, bronchitis, gastric disorders, stomach pain, waist pain and even cancer. The present review summarizes the traditional claims, phytochemistry and pharmacology of *S. brachyotus* reported so far in the scientific literature.

***Key words*****:** *Sonchus brachyotus,* Asteraceae, Ethnomedicobotany, Phytochmeistry

## INTRODUCTION

Though the use of medicinal plants as potential source of relief from illness can be traced back over five millennia to the written documents in China and India, but it can be believed to be as an art of cure as old as human being (Mahesh & Satish 2008). Out of the huge number of estimated plant species, only a meager number of plants have been investigated phytochemically and subjected to biological and pharmacological screening. World Health Organization (WHO) estimated about 80 % of the populations of developing countries are directly dependent on the plant based medicines for the cure of their illness (Pareek 1996; Mukhopadhyay 1998; Rawat & Chandhok 2009). So, the increasing interest on ethnobotanical survey has become precious for both the modern health care program and for the conservation strategies of ethnomedicinal plants over the globe (Black 1996).

From the days of *Ayurveda* itself, India has the rich tradition of plant based medicine. Based on traditional information, not less than 3000 plants are used in the form of ethno- or folk-medicines and out of which approximately 1500 plants are systematically used in the traditional systems of medicine like *Ayurveda, Unani & Siddha* (Dash & Padhy 2006). Folk medicines are probably the original cradle to identify the plants as the source of medicines at the primary level (Prakash 1998). Several researches are going on as well as more are on demand to develop a database for the vast array of plant based medicines.

Asteraceae (*nom. alt*.; Compositae *nom. cons*.) is the largest family of the dicotyledonous flowering plants (Walters & David 1996). It consists of about 24000 – 30000 species in 1600 – 1700 genera, distributed worldwide and inhabits almost every type of environment except in Antarctica (Funk *et al*. 2005; Bremer 1994). In India, Asteraceae is represented by 900 species under 167 genera (Bisht & Purohit 2010 ). The Genus *Sonchus*,(Tourn.) Linnaeus of Asteraceae have shown a number of phytochemical potential. Numerous pharmacological activities on this genus has been reported. The leaves of *Sonchus wightianus* A.P. de Candolle are used in treatment of earache by Indian rural communities (NAPB 1997). The *S. alpinus* Linnaeus [*Lactuca alpina* (Linnaeus) A. Gray] extract is useful in the treatment of deafness, gout and geriatric problems (Hussain *et al*. 2010). The root extract of *S. arvensis* Linnaeus is used in cough, bronchitis and asthma whereas leaves are applied to swellings and latex is useful for ophthalmologic problems (Hussain *et al*. 2010). The leaf and root extract of *S. asper* (Linnaeus) Hill is applied to wounds and boils. Its stem is given as a tonic and sedative (Ambasta 1992). *In vitro* antioxidant potential has been found in different species of this genus. Different biological assays have revealed the various antioxidant effects of the various plant extract belonging to the genus *Sonchus* (Schaffer *et al*. 2005). Antioxidant and antibacterial activities have been reported in some of its growing in China like *S. oleraceus* Linnaeus, *S. arvensis* Linnaeus, *S. asper*(Linnaeus) Hill, *S. uliginosus* M. Bieberstein [*S. arvensis* subsp. *uliginosus* (M. Bieberstein) Nyman], *S. brachyotus* A.P. de Candolle and *S. lingianus* C. Shih ( Xia *et al*. 2011) .

*S. brachyotus* A.P. de Candolle is a perennial herb, 30 – 100 cm high. The taproot possesses shoot bearing lateral roots. Stems are erect, cylindrical, furrowed and usually unbranched below synflorescence but branched near inflorescence, glabrous. Glandular tipped hairs are present on main stem (Qureshi *et al*. 2002). Basal and lower stem leaves narrowly elliptic to oblanceolate, 5 – 20 × 1 – 3(- 5) cm, undivided or rarely pinnatifid to pinnatipartite, glabrous, semiamplexicaul to shortly auriculately clasping, margin denticulate and often sinuate-dentate, apex rounded, obtuse or subacute; lateral lobes narrowly triangular if any. Middle and upper stem leaves similar to lower leaves but smaller. Synflorescence corymbiform, with few to several capitula. Capitula with very many (usually 170 – 300) florets; peduncle 0.5 – 7 cm, slender, glabrous or more rarely white tomentose apically and glabrescent. Involucre broadly campanulate, ca. 1.5 cm, glabrous or more rarely basally faintly white tomentose. Phyllaries mostly glabrous, acute; outer phyllaries triangular-ovate to lanceolate, 1.5 – 3 mm wide. Corolla 1.6 – 2.6 cm. Achenes narrowly ellipsoid, 2 – 4 mm, subcompressed, with 1 – 3 main ribs on either face, weakly rugose. Pappus 1.1 – 1.2 cm, persistent, numerous, dimorphic, basally connate, scabrous. Flowering occurs between May to September (Wu & Raven 2011).

Though many of the investigations have been carried out on the different species of *Sonchus*, but the reports regarding *S. brachyotus* is scanty, though it also possess a number of potential values. So, in this review a scrutiny has been done to see the different phyto-pharmacological overview of *S. brachyotus* A.P. de Candolle.

## ETHNOMEDICINAL USES

**Traditional uses of various parts:** *Sonchus brachyotus* A.P. de Candolle is having a number of proven medicinal applications and are being used by the rural communities of India as well as in China. It is known by different vernacular names in different languages of India as well as around world (Table 1). The aerial parts of the plant remain the cheapest source of vitamins, proteins, minerals and even the essential amino acids in the diet of many people which may be of great importance in helping to alleviate hypo-alimentation associated

problems **(**Afolayan & Jimoh 2008; Yang *et al*. 2009). nThe water extract of the plant has been an important component of Chinese herbal mixture Antitumor B (Sun *et al*. 2010; Wang & You 2013 ).The leaves of the plant are used by the people of Korea, Apatani tribes of Arunachal Pradesh as well as the Reangs of Tripura for medication. (Table 2).

**Table 1**: The vernacular names of *S. brachyotus* A.P. de Candolle

| Vernacular names | Language | Country | References |
|---|---|---|---|
| *Bei Bai Jiang* | Chinese | China | Wang & You 2013 |
| *Hatijona, Hachijora, Hachijho na, hachijo na* | Japanese | Japan | www/gbif.org/species/3105742/vernaculars |
| *Sa de pul* | Korean | Korea | www/gbif.org/species/3105742/vernaculars |
| *Ban palang* | Bengali | India | www/gbif.org/species/3105742/vernaculars |
| *Karatu* | Kumaoni (Uttarakhand) | India | Bisht & Purohit 2010 |
| *Sahadevi, Sahadev bari* | Hindi | India | Bisht & Purohit 2010; www/gbif.org/species/3105742/vernaculars |
| *Blonghamchen* | Kokborok (Reang tribe of Tripura) | India | Shil & Choudhury, 2009 |
| *Chopley* | Garhwali | India | Rawat *et al*. 2010 |
| *Paku Hadu, Hammang, Kochi hama* | Apatani | India | Srivastava *et al.* 2010 |

**Table 2**. Medicinal uses of different parts of *Sonchus brachyotus* A.P. de Candolle

| Plant Part | Medicinal Use | References |
|---|---|---|
| Aerial parts as well as leaf extract | Icterohepatitis, inflammation, rheumatism, diarrhea, squamous cell carcinoma, snake venom poisoning | El & Karakaya 2004; Cambiea & Ferguson 2003; Cardoso *et al*. 2009 |
| Aerial plant parts | Diuretics and to treat hepatitis and hemorrhage | Moon 1984; Kim 1996 |
| Leaf extract | Diarrhea | Dash & Padhy 2006; Das *et al*. 2003 |
| Leaf extract | Rheumatism | Shil & Choudhury, 2009 |
| Root extract | Cough & bronchitis | Rawat *et al*. 2010 |
| Leaves and stem decoction | Gastric troubles, stomach pain & waist pain | Srivastava *et al.* 2010 |
| Leaf & stem extract | Dermatitis, ulcer and stomach problems | Bisht & Purohit 2010 |

**Traditional uses by different communities or tribes**: The species is utilized by the rural Chinese people as infusion or decoction and are administered orally or externally for treatment of acute icterohepatitis, cancer, inflammation, rheumatism, diarrhoea and snake venom poisoning (Cambiea & Ferguson 2003; El & Karakaya 2004; Vilela *et al*. 2009). It occupies an important position even in the Chinese herbal mixture, Antitumor B (ATB) which is used as a very effective chemopreventive agent of upper aerodigestive tract tumors in humans (Sun *et al*. 2010; Wang & You 2013). In Korea, the leaves of *S. brachyotus* are traditionally used to treat hepatitis and hemorrhage and are known to have diuretic action (Moon 1984; Kim 1996).

The Apatani tribes of Arunachal Pradesh uses the stems and leaves for making decoction which is administered for the treatment of gastric trouble, stomach ache and waist pain. Boiled leaves are used as vegetables and are considered to be effective in stomach ahe (Srivastava *et al*. 2010) . The root extracts are used against cough and bronchitis by the inhabitants of Tones Valley of Garhwal Himalaya (Rawat *et al*. 2010). The rural communities of Uttarakhand use the plant extract against dermatitis, ulcer and stomach problems (Bisht & Purohit 2010 ; Naithani 1984-1985). The freshly prepared leaf-extract is taken orally by the Reang tribes of Tripura to get cured from rheumatism (Shil & Choudhury, 2009). The tribal communities as well as inhabitants of village folks of plane areas of Orissa uses the plant extract for the treatment of diarrhoea (Dash & Padhy 2006; Das *et al*. 2003) (Tables 2 & 3).

**Table 3**. Medicinal uses of *S. brachyotus* A.P. de Candolle according to several communities/ tribes reported around the world

| Community / tribe | Country | Medicinal use | Reference |
|---|---|---|---|
| Chinese people | China | Icterohepatitis, inflammation, rheumatism, diarrhea, squamous cell carcinoma, snake venom poisoning | El & Karakaya 2004; Cambiea & Ferguson 2003; Cardoso *et al*. 2009 |
| Korean people | Korea | Diuretics and to treat hepatitis and hemorrhage | Moon 1984; Kim 1996 |
| Tribal communities as well as village folks of plane areas of Orissa | India | Diarrhoea | Dash & Padhy 2006; Das *et al*. 2003 |
| Reang | India (Tripura) | Rheumatism | Shil & Choudhury, 2009 |
| Inhabitants of Tone Valley of Garhwal Himalaya | India | Cough & bronchitis | Rawat *et al*. 2010 |
| Apatani tribes of Arunachal Pradesh | India | Gastric troubles, stomach pain & waist pain | Srivastava *et al.* 2010 |

**Phytochemistry of *Sonchus brachyotus*** A.P. de Candolle:

The plant has been reported to contain essential oils, which were extracted by water distillation and, so far, 36 components were identified those represented 89.49 % peaks of the essential oil. The main constituents are 2-Pentadecanone,6,10,14-trimethyl-(35.8%) and n-Hexadecanoic acid (35.3%) (Peng *et al*. 2010).

From the aerial parts of the dried plant several compounds have been isolated. The ethyl acetate fraction yields the compounds like linolenic acid, b-sitosterol, apigenin, quercetin. The aqueous ethanol extract revealed the presence of five phenolic compounds like chlorogenic acid, luteolin 7-O-rutinoside, luteolin 7-O-glucoside, luteolin 7-O-glucuronide & luteolin (Miao *et al*. 2010; Nugroho *et al*. 2012) (Figs. 1 – 9)**.**

HPLC method has been developed for the determination of pharmacologically important luteolin and its derivatives as well as chlorogenic acid. The assay combines the separation and quantification of analytes using a Varian HPLC system (Varian Inc., Walnut Creek, CA, USA) under UV light detection fixed at 254 nm (Nugroho *et al*. 2012)**.**

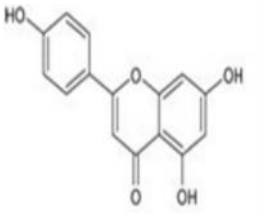

**Fig.1.** Apigenin

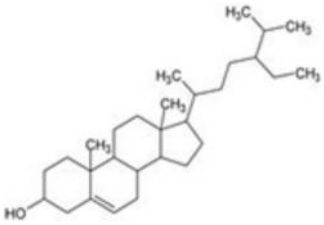

**Fig.2.** β sitosterol

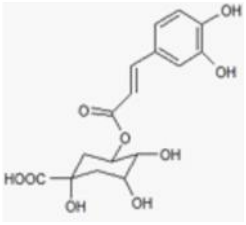

**Fig. 3.** Chlorogenic acid

**Fig. 4.** Linoleic acid

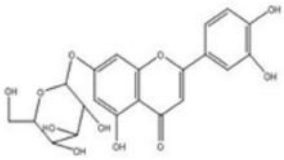

**Fig. 5.** Luteolin 7-O-glucoside

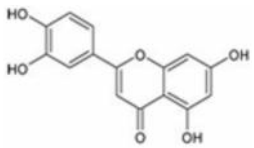

**Fig. 6.** Luteolin7-O-glucuronide

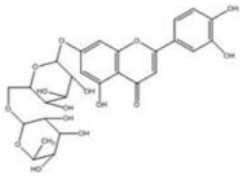

**Fig. 7.** Luteolin7-O-rutinoside

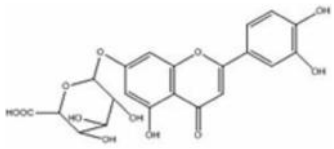

**Fig. 8.** Luteolin

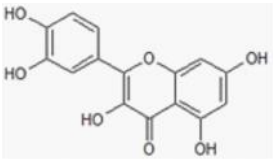

**Fig. 9.** Quercetin

**Pharmacological activities:**

Phenolics and flavonoids are the important antioxidant compounds those are obtained from most of the plants. These substances have also a role to play as antibacterial substances as well as peroxynitrite scavenging effect which can be used as geriatric medicine, diabetes mellitus etc.

1. **Antioxidant activities**:

   i. **Free radical scavenging activity:** The radical scavenging activity of the methanolic plant extract was evaluated based on its ability to quench the synthetic DPPH & $ABTS^{+}$ free radicals. It has been found that the plant has the $IC_{50}$ value of 18.65 µg/ml against DPPH & $IC_{50}$ value 66.70 µg/ml against $ABTS^{+}$. Phenolics and flavonoids present in the plant extract are believed to interrupt the free radical chain of oxidation & to donate hydrogen from phenolic hydroxyl groups, thereby forming the free stable radical (Mahakunakorn *et al*. 2004; Xia *et al*. 2011 ).

   ii. **Lipid Peroxidation:** Ascorbic & Trolox, the two standards, showed significant suppressive power on lipid peroxidation in mice brain homogenate with $IC_{50}$ value of 91.79 & 50.09 µM. The methanolic extract of *S. brachyotus* showed considerable degree of lipid peroxidation activity with $IC_{50}$ value of 103.05 µg/ml (Xia *et al*. 2011).

   iii. **Reducing power:** Some investigators have reported that the antioxidant power are concomitant with the development of reducing power (Sultana *et al*. 2009). The methanolic extract of *S .brachyotus* have the marked reducing power of $A_{700}$= 0.74 (Xia *et al*. 2011).

2. **Peroxinitrate-scavenging activity**: The aqueous ethanolic extract had strong peroxinitrate scavenging activity with an $IC_{50}$ value of 1.20 µg/ml. The $IC_{50}$ of luteolin & its 7-O-glucoside & its 7-O-glucuronide were 0.71 µM, 0.67 µM & 1.02 µM respectively, suggesting that those components in the extract may individually contribute to the high peroxinitrate-scavenging effect (Nugroho *et al*. 2012).

3. **Antibacterial activity**: The methanolic extract of the plant showed the antibacterial activity against *Staphylococcus aureus*, *Salmonella enterica*, *Escherichia coli* & *Vibrio parahaemolytices* (Xia *et al*. 2011).

4. **Antitumor activity:** The Chinese herbal mixture, anti-tumor B (ATB) is a mixture of six Chinese herbs including *S. brachyotus*. The chemopreventive effect of ATB on the development of 4-nitroquinoline-1-oxide (4NQO) induced oral squamous cell carcinomas in A/J mice were systematically evaluated and it was found that ATB reduced 4NQO induced oral cancer development by approximately 60 % (Wang *et al*. 2013).

## DISCUSSION

Survey of literature revealed that different parts of *Sonchus brachyotus* A.P. de Candolle is used as medicinal supplements in different tribal communities as well as of village folks around the globe (Moon 1984; Kim 1996; Dash & Padhy 2006; Das *et al*. 2003; Shil & Choudhury, 2009; Rawat *et al*. 2010; Srivastava *et al*. 2010; El & Karakaya 2004; Cambiea & Ferguson 2003; Cardoso *et al*. 2009). Numerous ethnomedicinal activities on this genus have been reported (Hussain *et al.* 2010). This might be due to the presence of many pharmacologically and medicinally important compounds such as linolenic acid, chlorogenic acid, b-sitosterol, apigenin, quercetin & luteolin (Nugroho *et al.* 2012). Phenolic and flavonoid components are the potent antioxidant and antibacterial substances, respectively, found in nature. *S. brachyotus* along with the other member of the genus have been found to possess phenolic and flavonoid components (Xia *et al.* 2011). The presence of phenols and flavonoids in the plant somehow might be responsible for its antioxidant and antibacterial properties respectively. Nugroho *et al*. (2012) confirms the presence of pharmacologically active compound luteolin in this species. The compound luteolin isolated from other plants has different pharmacological actions like inhibition of superoxide generation in neutrophils (Lu *et al.* 2002), anti-asthmatic activity reported (Jin *et al*. 2009), hepatoprotective activity (Quisheng *et al*. 2004), inhibition of iNOS & COX expression (Hu & Kitts 2004), gasoprotective activity (Freitas *et al*. 2008; Min *et al*. 2006), antidepressant activity (Vilela *et al*. 2010), antimutagenic activity (Nagy *et al*. 2009). Peroxynitrite is a cytotoxicant with strong oxidizing properties toward various cellular constituents, including sulphydryls, lipids, amino acids and nucleotides and can cause cell death, lipid peroxidation, carcinogenesis and aging (Choi *et al.* 2002). Nugroho *et al.* (2012) observed the peroxinitrate scavenging activity of luteolin isolated from *S. brachyotus* which could be used in the treatment of geriatric problems, obesity, diabetes mellitus and even artherosclerosis. But many of the possibilities mentioned like anti-asthmatic, hepatoprotective, antidepressant, antimutagenic, gasoprotective activity etc. for the plant have not been pharmacologically tested so far. Though plenty of the traditional data regarding the use of extract for curing the ailments are there, but most of them have not been reverse pharmacologically tested. Moreover the compounds like linolenic acid, chlorogenic acid, b-sitosterol, apigenin, quercetin and luteolin isolated from the plant have also been reported from some other plants too for which the bioactivity assay have already been carried out and most of those were used as established drugs. Still a gap is persisting in finding out new and novel compounds from this plant which may produce a lead compound in the new drug discovery.

## CONCLUSION

More investigations, pharmacological, phytochemical and clinical trials should be conducted to support the traditional therapeutic uses of Sonchus brachyotus A.P. de Candolle. It is also important to evaluate that the extract may not be effective only in the isolation, but may have modulating effect when given in combination with other drugs. So, it is cardinal to carry out more researches with this plant which can have potential to new drug discovery.

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