

A Comparative Nutraceutical Analysis of Edible *Solanum* L. Species Reported in India

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Received: 28 Sep 2022; Accepted: 01 Nov 2022; Published: 06 Nov 2022

Citation: Balkrishna A, Shankar R, Joshi RA, et al. A Comparative Nutraceutical Analysis of Edible *Solanum* L. Species Reported in India. Food Sci Nutr Res. 2022; 5(1): 1-6.

ABSTRACT

The Genus with its 1234 species has worldwide distribution and is native to almost all continents, except several parts of Canada, Arctic and Antarctica poles. The species are widely used for vegetable and medicines. Various species of *Solanum* are herbs, climbers, undershrubs, shrubs and trees. From India, 64 species have been reported inclusive of cultivars, out of which 16 species possess medicinal properties. Species like *Solanum lycopersicon*, *S. melongana*, *S. spirale*, *S. tuberosum* are widely used as vegetable and other supplementary food recipes whereas in the traditional culture of Northeast India, *S. nigrum*, *S. torvum*, *S. tuberosum*, *S. violaceum* are used as vegetable with the concept of digestion and worm infestation in different names and the natives adapted the cultivation of the concern species in their kitchen gardens for self and family use. To serve the purpose, shoots of *S. nigrum* and berries of other species are being used whereas in Ayurvedic system of medicine, *S. nigrum* is described for the preparation of liver related medicines like Kakamachi Ghrit.

Keywords

Solanum species, Nutritional value, Medicinal properties, Review.

Introduction

The genus *Solanum* L. with its 1,234 species are distributed almost all across the globe and is native to Afghanistan, Africa, Arab, Australia, Asian countries, America Europe, except several parts of Canada, Arctic circle and Antarctica. The species are widely used as vegetable and medicines. Various species are herbs, climbers, under shrubs, shrubs and trees. From India, 64 species have been reported inclusive of cultivars (<http://efloraindia.nic.in/efloraindia/home>). Out of which 16 species possess medicinal properties [1-7] and *Solanum lycopersicon*, *S. melongana*, *S. spirale*, *S. tuberosum* are widely used as vegetable and other supplementary food recipes whose nutritional values have been reported [8-19], whereas, in the traditional culture of Northeast India, *S. nigrum*, *S. torvum*, *S. tuberosum*, *S. violaceum* are used as vegetable with the concept of

digestion and worm infestation in different names and the natives adapted the cultivation of the concern species in their kitchen gardens for self and family use.

Methodology

The paper is based on literature survey from various publications made by one of the authors (RS) and the literature available in different relevant journals and the online sites. During the course of explorations in different states of Northeastern India, Uttar Pradesh and Madhya Pradesh, he has collected the information from various vegetable shops in the local markets of Northeast and other parts. Global distribution data were also collected during field exploration of nutritionally important plants and found plants of *Solanum nigrum*, *S. spirale*, *S. torvum*, *S. violaceum* are widely used and sold in local vegetable shops. Samples were collected and tested in own kitchen by the use of general preparation methods. The emphasis was made to collect more information on

the plants belonging to the Genus *Solanum*. Related literatures were also studied during the course of stay since 1992 to 2015 in Arunachal Pradesh and from 2015 to till date in Uttar Pradesh and Uttarakhand. Remaining species described in this communication are easily available in vegetable shops and are in regular use as vegetable.

Results

Solanum lycopersicum L. (Syn. *Lycopersicon esculentum* Mill.)

Distribution: Native to Peru however widely cultivated in almost all parts of world.

English name: Tomato; **Sanskrit:** Rakt phal; **Hindi:** Tamatar

Salient Features: Climber, plant tomentose with glandular hairs, leaves slightly succulent, dissected into lobes, flowers yellow, anthers dark yellow; berries large, 2-10cm in diameter; red with sweet sour juice and many seeds.

Nutritional Uses: Rich source of Vitamin-A and C, used in food as vegetable, sauces and several other preparations [17].

Solanum melongena L.

Distribution: Native to Indo China to China, however widely cultivated in India, Bangladesh, China, Laos.

English name: Eggplant; **Sanskrit:** Vrintak, Bhantaki; **Hindi:** Bhanta, Baigun, Baingan.

Salient Features: A spreading erect shrub, auricles introverted, leaves lobed, tomentose also with spreading auricles, flower purple with yellow anthers and stigma exceeds to anthers; berries long, elliptic or elongated with persistent calyx, violet green, yellow or white; seeds many.

Nutritional uses: Fruits are rich in flavonoids, amino acids like aspartic acid, histidine, tryptophan, steroids, alkaloids, glycoalkaloids oxalic acid, vitamin C etc. It also contains low calories and high moisture contents and are widely used in the preparation of vegetable and other food recipes [18].

Solanum nigrum L.

Distribution: Native to temperate Eurasia, Africa, Macronesia and is cultivated in almost all parts of world. In India it is widely distributed up to 1700 ma.s.l. in every part of the country. 24°43.810 N, 083°17.143 E) 24°32.368 N, 083°57.137 E (Arunachal Pradesh), 26°1N3.642N, 94°33.203E (Nagaland), N 27°49.440, E080°02.278 (Uttar Pradesh).

English name: Black night shade; **Sanskrit:** Kahamachi; **Hindi:** Makoi.

Salient Features: Erect herbs 0.5-0.75 m, occasionally up to 2m tall; leaves alternate, single or two at one place, elliptic to ovate lanceolate, flowers white with yellow anthers, berries violet-black with few seeds.

Nutritional uses: The unripe berries contain glycoalkaloids, steroidal glycosides, spirostanol and fruostanol glycosides, flavonoids. Berries are eaten raw and shoots are used as vegetable in Northeastern states [10].

Solanum spirale Roxb.

Distribution: Native to East Himalaya to South China and Indo-China, Sumatera to Jawa. In India it is found in Arunachal Pradesh, Assam, Khasia Hills and E. Bengal up to 1150 m. a.s.l.

English name: Spiral bittersweet; **Hindi:** MimgasKajur; **Sylhet:** Bagua.

Salient Features: It is an under shrub up to 3.5m. Tall, stem erect with 1 or 2 sharp ridges. Leaves subtended by a small leaf often much reduced, elliptic, entire, acute, membranous, glabrous; base alternate; flowers white, small and dense, spirally arranged; racemes, extra axillary; berries orange-red, globose, 7.0 mm in diameter.

Nutritional uses: The leaves contain high protein, carbohydrates vitamin A, C and E. The fruits contain sodium, potassium, calcium (Kalita et al., 2014). Tender leaves and berries are used as vegetable in gastric, berries and shoot shows antioxidant properties [20].

Solanum torvum Swartz

Distribution: Native to Mexico to North South America, Eastern Brazil and Caribbean. In India it is found throughout the Country in the tropical region except the Western Desert area. 25°16.898N 94°09.978E, (Assam), 25°48.941 N, 94°08.410 E (Nagaland).

English name: Pea eggplant, plate brush; **Bengali:** Titbaigun; **Assamese:** Hathibhekuri; **Tamil:** Sundai.

Salient Features: Shrub up to 1 m tall; stem with straight prickles; leaves broadly ovate, shallow cordate, inflorescence corymbose cyme with many flowers, berries globose, green up to 1cm.

Nutritional uses: The fruits contain minerals like iron, manganese, calcium, copper, zinc, vitamin C and A [21]. Fruits-eaten as a vegetable and said to be good for enlargement of the spleen; fruits burnt and fume inhaled for tooth ache [4,15].

Solanum tuberosum L. (Syn. *Solanum andigenum* Juz & Buk; *Solanum subandigena* Hawkes)

Distribution: Native to South America to Northwest Venezeula. In India, it is widely cultivated in every part of the country for food.

English name: Potato; **Sanskrit:** Swadukand, Mlekshhkand, Sukandak; **Hindi:** Alu; **Tamil:** Uralakilangu.

Salient Features: A tuberous twinning herb up to 0.7 m tall; tubers many of varying sizes and Creamish white to pinkish brown;

leaves lobed, tomentose with glandular hairs; flowers yellowish; berries green with white streaks and persistent calyx.

Nutritional uses: The tubers contain Vitamin C, reducing and non-reducing sugars, flavonoids, carotenoids, polyamines, phenolic contents [19]. Roasted tubers are eaten raw and fresh or boiled tubers are eaten as vegetable and in so many kitchen recipes as well as used in mouth ulcer (<https://www.intechopen.com> › chapters).

Solanum violaceum Ortega

Distribution: Native to Bangladesh, China (South Central), India, Jawa, Pakistan, etc. In India it is distributed in Arunachal Pradesh, Assam, Meghalaya, Manipur, Uttar Pradesh, Uttarakhand and Central and South Indian parts. 24°54.752 N, 94°07.349E (Manipur), 25° 41.003 N, 94° 06.173 E (Nagaland).

English name: Indian night shade; **Sanskrit:** Vrihati.

Salient features: Annual or perennial prickly shrub, prickles small slightly inverted, leaves lobed, flowers bluish purple, berries small orange on ripening.

Nutritional use: The berries contain crude protein, carbohydrates, total ash, alkaloids, polyphenols and saponins [11]. In India, berries are eaten as vegetable in Assam, Arunachal Pradesh, Mizoram and Nagaland. Berries are rich in crude fibers, calcium and vitamin-C and are eaten as vegetable [22]

Solanum virginianum L. (Syn. *Solanum ferox* Burm. f., *S. surratens* Burm. f., *S. xanthocarpum* Schrad.)

Distribution: Native to Afghanistan, Bangladesh, India, Iran, Japan, Pakistan, etc. In India it is distributed throughout the tropical part of India N27°57.216, E079°51.040.

English: Yellow-fruit nightshade; **Sanskrit:** Kantakari; **Hindi:** Bhatakataiya.

Table 1: Nutritional Values of Few Species of Solanum.

Content	Quantity g /100grams (Energy in Kcal/KJ)						
	<i>Solanum lycopersicum</i> L.	<i>Solanum melongena</i> L.	<i>Solanum nigrum</i> L.	<i>Solanum spirale</i> Roxb.	<i>Solanum torvum</i> Swartz	<i>Solanum tuberosum</i> L.	<i>Solanum violaceum</i> Ortega
Energy	17.7 kcal	1 25.0 kcal	355.04 kcal	----	----	36.57kcal	366.50 kcal
Carbohydrates	3.9 g	50 .88 g	37.2 g	----	7.04g	81.0g	52.55g
Sugars	2.6 g	3.53 g	----	----	----	3.7g	----
Dietary fiber	1.2 g	3.0g	23.1g	21.32g	3.99g	10.5g	4.80
Fat	0.2 g	00.18 g	8.2g	1.93g	0.28g	0.4 g	----
Protein	0.9 g	00.98 g	18.2g	13.02g	86.23g	9.5 g	32.55g
Vitamins	Quantity(µg/mg/100g)						
Vitamin A equiv.	42.0µg	---	4.66 mg	---	0.078mg	6.7 mg	371.72 mg
β Carotene	449.0µg	---	---	---	---	---	---
Lutein- zeaxanthin	123.0µg	---	---	---	---	---	---
Thiamine (B1)	0.037 mg	---	17.14mg	---	---	0.38mg	---
Riboflavin (B2)	0.019 mg	0 0.0.37 mg	1.0mg	---	---	0.14mg	---
Niacin (B3)	0.594 mg	00.649 mg	---	---	---	5.00mg	---
Pantothenic acid (B5)	0.089 mg	0.281.0 mg	---	---	---	1.43mg	---
Vitamin B6	0.08 mg	0.084.0 mg	---	---	---	1.43mg	---
Folate(B9)	15.0µg	2 2.0µg	200 mg	---	---	76.0µg	---
Vitamin C	14.0 mg	2.2.0mg	35.18 mg	---	2.686mg	93.8mg	39.99mg
Vitamin E	0.54 mg	0.3.0 mg	9.72mg	---	---	0.05 mg	---
Vitamin K	7.9 µg	3.5.0µg	---	---	---	9.0 µg	---
Minerals	Quantity (mg/100g)						
Calcium	10.0 mg	9.0 mg	17.33mg	73.69 mg	221.6mg	57.0 mg	253.912 mg
Iron	0.27 mg	00.23 mg	13.01mg	---	76.9 mg	3.71 mg	31.126 mg
Magnesium	11.0 mg	14.0 mg	247.59 mg	---	---	110.0 mg	10.1429 mg
Manganese	0.114 mg	00.232 mg	1.52mg	---	---	0.71 mg	---
Phosphorus	24.0 mg	24.0 mg	75.22mg	50.22mg	---	271.0 mg	19.90 mg
Potassium	237.0 mg	229.0 mg	42.89mg	309.90mg	---	2005.0 mg	726.394 mg
Sodium	5.0 mg	- ---	2.71mg	18.75mg	155.2 mg	29.0 mg	---
Zinc	0.17 mg	00.16 mg	0.07mg	---	21.5 mg	1.38 mg	---
Copper	---	---	---	---	---	0.52 mg	---
Selenium	---	---	---	---	---	1.4mg	---
Water	94500 .0mg	92000 .0mg	84.7mg	---	---	---	85.58 mg
Lycopene	2.57 mg	---	---	---	---	---	---

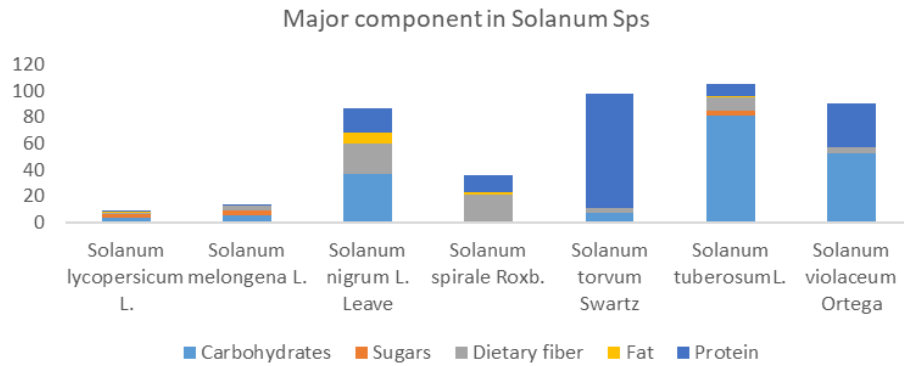


Figure 1: Graph Showing Quantitative Nutritional Values of Edible Parts of *Solanum* Species.

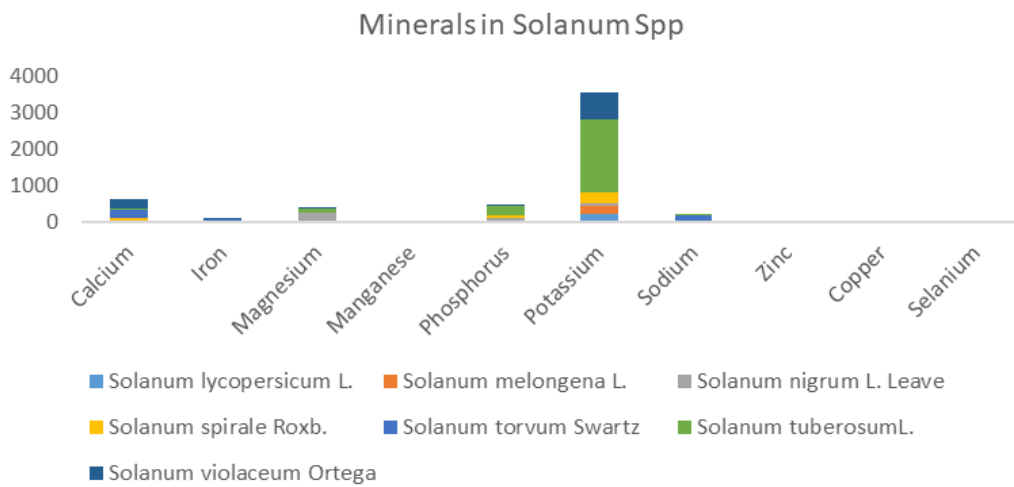


Figure 2: Graph Showing the Quantity of Minerals in the Edible Parts of *Solanum* Species.



Figure 3: Photographs of the plants and parts under study.

Salient Features: Prostrate prickly herb, prickles yellowish, flowers purple, anthers yellow, berries yellow when ripe.

Nutritional use: Berries contain several steroidal alkaloids, glycoalkaloids, coumarins, caffeic acids, etc. [23] and are eaten as vegetable by tribes near Gwalpada district of Assam [1].

The nutritional values of species *Solanum lycopersicum*, *S. melanganum*, *S. nigrum*, *S. torvum*, *S. tuberosum* and *S. violaceum* are tabulated in the table 1 and the graphical representation has been given in Figure 1 and 2.

Discussion

The Genus *Solanum* L. is a genus with wide distribution along with cultivars having nutritional and medicinal value. Most of the species are commonly used as medicines in the treatment of various diseases like, cough, asthma, sore throat, worm infestation, arthritis and other joint pains, toothache removal of tooth worms, ear infection, wound healings and contraceptive. Several species like *Solanum lycopersicum*, *S. melongena*, *S. nigrum*, *S. torvum*, *S. tuberosum* and *S. violaceum* are used as vegetable in different parts of the Country. In India, leaves of *Solanum nigrum* is eaten as vegetable despite its use in various ayurvedic formulations viz. Kakmachi Ghrit used for various digestive and liver tonic. Tubers of *S. tuberosum* are widely used as vegetable whereas berries of *S. lycopersicum*, *S. melongena* are worldwide used as vegetable whereas the berries of *S. spirale*, *S. torvum*, and *S. violaceum* are sold in the markets of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram and Nagaland as vegetable and the local tribal people also domesticated in their kitchen gardens with the concept of use to remove intestinal worms too [4,24]. However, the taste of the berries shows bitterness but are in common use. The nutritional values of the different *Solanum* species mentioned as vegetable have been worked out in past [16,21,25]. The fruits of *S. virginianum* is said to be used as vegetable by several tribal communities in Gwalpara district of Assam and Khasi and Jayantiya hills of Meghalaya [1] however, all the nutritional parameters were yet to be studied for wild edibles. The fresh berries and cooked vegetable is free from bitterness and gives better taste. During the course of various explorations in different parts of the Country the Global positioning was recorded and given for all the plants described. As the fruits of *S. lycopersicum*, *S. melonganum* and tubers of *S. tuberosum* are widely used as vegetable and the others are restricted only to the tribal communities in the places of their occurrences, if we go through the comparison of nutritional aspects for the acceptance of *S. nigrum*- shoot, *S. spirale*- berries, *S. torvum*- berries, and *S. violaceum*- berries, it is very much clear that the fiber contents in *S. violaceum* and *S. nigrum* are very rich, in respect of carbohydrate contents berries of *S. violaceum* and *S. nigrum* are rich in carbohydrate contents. Berries of *S. spirale* are rich in fat contents whereas berries of *S. torvum* are rich in protein contents. In respect of Vitamins, the shoots of *S. nigrum* are the rich source of Vitamin A as next to *S. tuberosum* and better in Vitamin B. *S. violaceum* and *S. nigrum* shows the richness of Vitamin C. If we consider the mineral contents *S. violaceum* is the rich source of calcium and *S. torvum* is rich in iron and zinc.

Conclusion

The present communication on nutritional contents i.e., fibers, carbohydrates, fats, protein, mineral vitamins, along with the flavor and taste, it is found that the intake of shoot of *S. nigrum* and berries of *S. spirale*, *S. torvum*, *S. violaceum* needs to be included in popular dietary recipes whereas the nutritional analysis of berries of *S. virginianum* needs to be studied.

Acknowledgments

Authors are thankful to Swami Ramdev Ji, Patanjali Yogpeeth for encouragement and providing necessary facilities and financial assistance for the studies. Thanks, are also due to the Director General Central Council for Research in Ayurvedic Sciences, New Delhi for various field studies and the Ministry of Ayurved, Yoga & Naturopathy, Unani, Sidha and Homoeopathy for financial assistance.

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