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A REVIEW ON NUTRITIONAL AND THERAPEUTIC IMPORTANCE OF SOLANUM TORVUM AND SOLANUM NIGRUM FRUITS

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ABSTRACT

Solanum torvum (Turkey berry, locally known as Sundakai) and Solanum nigrum (Black nightshade, known as Manathakkali) are important medicinally and nutritionally significant plants belonging to the Solanaceae family. Both species are widely consumed in traditional diets and form a key component of ethnomedicine in Asia, Africa, and South America. Their small fleshy fruits (berries) are rich sources of essential nutrients, bioactive phytochemicals, and antioxidants. Nutritionally, these berries provide carbohydrates, proteins, dietary fiber, vitamins (vitamin A, vitamin C, and folates), and minerals such as iron, calcium, and potassium, contributing to improved immunity and prevention of micronutrient deficiencies. Phytochemical analyses have revealed the presence of alkaloids, flavonoids, glycosides, saponins, tannins, and phenolic compounds that play crucial roles in disease prevention and health promotion. Therapeutically, S. torvum has been reported to possess antihypertensive, antidiabetic, antimicrobial, anti-inflammatory, and hematinic properties, making it useful in managing anemia, infections, and cardiovascular conditions. Similarly, S. nigrum exhibits hepatoprotective, antioxidant, anticancer, gastroprotective, and diuretic activities, supporting its use in the management of liver disorders, ulcers, and inflammatory conditions. Both plants have also shown promising roles in combating oxidative stress and lifestyle-related disorders. Despite their wide use in traditional systems, scientific evidence from in-depth clinical studies remains limited, highlighting the need for further pharmacological investigations, standardization, and safety evaluations. This review aims to consolidate current knowledge on the nutritional profile and therapeutic importance of S. torvum and S. nigrum berries, providing a comparative insight into their potential applications as functional foods and nutraceuticals.

KEYWORDS: *Solanum torvum*; *Solanum nigrum*; Turkey berry; Black nightshade; Nutritional value; Phytochemicals; Antioxidant; Therapeutic importance; Pharmocology Activity; Traditional uses; Toxicity.

INTRODUCTION

Medicinal plants are traditionally used to treat numerous human infections, and their bioactive compounds have long been important in therapeutic development, particularly in cancer and infectious diseases. Medicinal plant-derived natural products have garnered much interest in recent years as potential bioactive agents for insect vector control. Vector control is threatened by the emergence of resistance to conventional synthetic insecticides in vectors, among which mosquitoes pose high threats to human and animal health and life, often leading to the transmission of serious diseases, such as dengue, Ebola, filariasis, and malaria, resulting in millions of deaths each year.

The *Solanum* family of plants is a large genus within the Solanaceae family that contains up to 2,000 species ranging from food crops to medicinal herbs. The genus *Solanum* has received much interest in chemical and biological studies over the last 30 years. Several steroidal saponins, steroidal alkaloids, disaccharides, flavonoids, and phenols have been implicated in the biological activities (Kaunda and Zhang, 2019). The genus *Solanum* appears to have a lot of potential, although most of the species are unknown or have had little research on their chemical contents. Several reviews of the *Solanum* genus and their phytochemistry have been published. These compounds have been linked to various health-promoting activities in the fight against several noncommunicable diseases, which are the leading causes of death worldwide. Many species belonging to this genus present a huge range of pharmacological activities such as anticancer, hepatoprotective, antimalarial, anthelmintic, and other activities (Elizalde-Romero *et al.,* 2021). Plants in this family are recognized for having a wide spectrum of alkaloid compounds, some of which are therapeutically the most potent. Steroidal glycoalkaloids are the most common and important group of nitrogen-containing secondary metabolites identified in Solanaceae plants. More than 350 *Solanum* species have yielded more than 100 different forms of glycoalkaloids (Jayakumar K., and Murugan (2015) and Roshan K., *et al.,* (2020).

Humans depend on plants for their livelihood. Berries and vegetables serve as both sources of nutrition and medicine (Karmakar *et al.,* 2015). There is vast knowledge about the benefits of

berrie and vegetables in the human diet. One of the important families of vegetables which contribute to the health and well-being of humans is Solanaceae (Lalmuanthanga *et al.,* 2015). It has so many species which include *S. bahamense* of *Carl Linnaeus* (as var *persicifolium*), *S. ferrugineum, S. melongena, S. grandiflorum, S. torvum* and *S. nigrum,* to mention but a few (Agyei-Poku, 2017). *S. torvum* (Solanum *torvum*) and *S. nigrum* (*Solanum nigrum*) are native to Ghana.

Different countries refer to *Solanum torvum* and *Solanum nigrum* by different local names. *Solanum torvum* is referred to as "pendejera" or "turkey berry" in Haiti and "susumber" in Jamaica. It's known as "pea eggplant" or "platebrush" in Malaysia, and "Anachunda," "Chunda," or "Parachunda" in Malayalam, the language of India. *Solanum nigrum*, on the other hand, goes by the names "Makoi" or "kakamchi" in India, "Пасленчерный" in Russia, and a number of other names in China, including “Long kui” in general, “He tian” in the north, “Ku kui” in the south, “Huang tian” in the northeast, and “Hong kui” in the northwest. It is known as "garden huckleberry" or "black nightshade" in English-speaking nations (Balkrishna *et al.,* 2022).

The fruits of these plants are berries because their fruits are in clusters with a lot of seeds. They are usually eaten as vegetables. Apart from being used in the preparation of stews and soups they also have medicinal properties. These plants have been studied widely for several medicinal properties. Such properties include antioxidant, antiviral, antimicrobial, antihypertensive, antiplatelet aggregation and cardiovascular (Elizalde-romero *et al.,* 2021). These activities can be attributed to the presence of flavonoids, alkaloids, phenolic acids and saponins. Minerals play a vital role in the growth and development of humans. Studies have shown that the berries and leaves of *S. torvum* and *S. nigrum* contain various minerals and nutrients that prevent Iron Deficiency Anemia (Essuman *et al.,* 2015). Most African diets contain a majority of grains and starchy staples. These foods do not support immune defence, growth and metabolic functioning but only provide energy (Meenakshi *et al.,* 2022). *S. torvum and S. nigrum* locally referred to *Ekwanho nsusua and nsusua* respectively are rich in minerals and vitamins (Abraham *et al.,* 2022). Traditionally they are used to boost the haemoglobin levels of pregnant mothers and children because of their high iron content (Agyei-Poku, 2017). The prickly shrub or small tree known as *Solanum torvum* has a

maximum height of 5 m. There are sporadic hooked prickles on stems. The leaves are lobed or entire, oval in shape, and alternating. The leaf's midrib is covered in spines, and its underside is lighter than its upper surface. White, tubular flowers with five pointed lobes are arranged in corymbiform cymes. Berries, or fruits, are small green spheres that grow in clusters and become yellow when ripe (Ogwu *et al.*, 2023). *Solanum nigrum* on the other hand grows up to 0.5 m tall and can be upright or wandering. The leaves are slender at both ends, ovate-oblong, and sinuate, toothed, or lobed. White, extra-axillary, sub-umbellate cymes of flowers are produced. When berries are mature, they can be red, yellow, or black. The smooth, yellow seeds have a tint of their own (Ningthoujam *et al.*, 2023).

TAXONOMICAL CLASSIFICATION AND DISTRIBUTION

Taxonomy of *Solanum torvum*, is as follows:
Kingdom: Plantae, Plants
Subkingdom: Tracheobionta, Vascular plants
Super division: Spermatophyta, Seeds plants Division: Angiosperma
Class: Dicotyledons Order: Tubiflorae
Family: Solanaceae Genus: Solanum
Species: torvum.

Solanum torvum fruit is a spherical, berry-shaped fruit with a diameter of between 1.0 and
1.15 cm. Around 300 to 400 flat, dark-brown seeds per fruit are present. The skin of the completely torn fruit is yellow, whereas the skin of the young berry is shiny green (Putri *et al.,* 2023). Native to West Indies, India, Myanmar, Thailand, Philippines, Malaysia, China and tropical America. Widely naturalised in South and South East Asia.

The taxonomy of *Solanum nigrum*, or black nightshade, is as follows: Kingdom: Plantae
Phylum: Angiosperms Class: Eudicots
Order: Solanales Family: Solanaceae
Genus: Solanum
Species: *Solanum nigrum*

These species are only semi cultivated in a few countries in Africa and Indonesia, and are largely utilized as a vegetable and fruit source through harvesting from plants growing spontaneously as weeds in cultivated fields, or in weedy plant communities, under trees, along fences and roads, in shaded areas, near buildings and on waste land. They therefore constitute a volunteer crop. Some communities semi cultivates the vegetable in home gardens or on fertile land portions near homesteads. There are a few reports of the cultivation of the garden huckleberry for its fruits in North America (Saleem *et al.*, 2009).

NUTRITIONAL COMPOSITION OF *Solanum torvum* AND *Solanum nigrum* FRUITS

The micronutrients vitamin A, B1, B6, calcium (0.28 mg), copper, folic acid, iron (24.5 mg), magnesium, niacin, and potassium are all found in abundance in *Solanum torvum*. It also contains fat (1.7 mg) and fibre (56.9 mg) (Baksh-Comeau *et al.*, 2016).

Fresh *Solanum torvum* contains 100 g of vitamin A (12 mg), vitamin C (130.8 mg), vitamin E (10.77 mg), protein (3.54 g), and carbohydrate (2.204 g) per 100 g) (Thenmozhi & US, 2012).

Solanum torvum (dry powdered) fruits include iron (76.869mg/kg), manganese (19.466mg/kg), calcium (221.583mg/kg), copper (2.642mg/kg), and zinc (21.460mg/kg), as well as carbs (7.033%), proteins (2.322%), lipids (0.278%), ash (0.143%), and crude fibre (3.993%). The amounts of vitamins A and C were also examined, and were shown to be 0.078 mg and 2.686 mg, respectively, per 100g (Akoto *et al.*, 2015).

According to reports, the fruit of *Solanum torvum* is a good source of protein, fibre, calcium, magnesium, iron, vitamin A, B-complex, and C. Young fruit has 59.51% moisture, 11.9% carbohydrates, 9.52% total sugar, 1.46% protein, and 37.4 mg of ascorbic acid per

100 grames.

According to reports, 100 grames of fruit include 5.22 mg iron, 31.98 mg sodium, mg potassium,
146.57 mg calcium, 1.37 mg copper, 7.51 mg manganese, and 3.41 mg zinc per 100 g (Bishnoi, n.d.).

Young *Solanum torvum* fruit contains 85.4 g of water, 2.4 g of protein, 0.4 g of fat, 10.7 g of carbohydrate, 6.1 g of fibre, 104 mg of calcium, 70 mg of phosphorus, 4.6 mg of iron, 390 g of beta-carotene, and 4 g of ascorbic acid per 100g (Otu Phyllis *et al.*, 2017) Iron, magnesium, zinc, salt, potassium, and other critical minerals, as well as vitamins and proteins, are abundant in the leaves of *Solanum torvum* (Dickson *et al.*, 2014).

In the fruit of *Solanum nigrum* the carbohydrate content in unripe fruits was higher when compared to values observed for the ripe fruits. The study also showed that the total ash content was higher in the unripe fruits whereas moisture content was not higher in the unripe fruits. The energy content in *Solanum nigrum* was therefore estimated to be higher in the unripe fruits (121.31 mg/ 100 g) than the ripe fruits (117.53 mg/100 g). The proximate estimation of *Solanum nigrum* berries (% dry matter basis) as: moisture 76.86±0.04, crude fat 12.18±0.02, ash 8.05±0.04, crude fibre 6.29±0.01, carbohydrate 55.85±0.03 with caloric value of 43.54±0.19%. Albeit, no mention was made to which variety of *Solanum nigrum* was used for the study or to identify if ripe or unripe fruits was used for the study (Enin *et al.*, 2023).

PHYTOCHEMICAL PROPERTIES OF *Solanum torvum* AND *Solanum nigrum* FRUITS

There has been a lot of research done on the chemical components of *Solanum torvum*. Fruit, leaves, and roots are among the sections used to isolate a variety of chemicals. An excellent source of alkaloids, flavonoids, saponins, tannins, and glycosides is this *Solanum torvum* (Amponsaa Brobbey *et al.*, 2016).

Solanum torvum is high in alkaloids, flavonoids, tannins, saponins, and glycosides. Overall alkaloid content (0.12%), total glycoalkaloids (0.038%), and glycosylated substances generated from solasodine, namely solasonine (0.0043%) and solamargine (0.0028%), were all determined (Darkwah *et al.*, 2020).

A steroid, terpenoid, saponin, tannin, alkaloid, fatty acid, 3-o-acetyl-stigmasta-5,25 diene-2,3- diol, methyl stearate, and 21,25-dimethylmelianodiol are among the phytochemical components of *Solanum torvum* (Karmakar *et al.*, 2015) & (Kayalvizhi *et al.*, 2012).

Solanum nigrum is a rich source of natural compounds with varying structural patterns and beneficial properties. To date, approximately 188 phytochemical compounds have been separated and identified from *Solanum nigrum*, containing steroids, alkaloids, organic acids, flavonoids, phenylpropanoids and their glycosides, as well as other compounds. Steroidal compounds consist of steroidal saponins (1–76) and steroidal alkaloids (77–101) and are considered to be the main bioactive components of *Solanum nigrum*, exhibiting various pharmacological activities, such as antitumor, anti-inflammatory, and antiviral activities. In addition, *Solanum nigrum* is rich in a large number of polysaccharides, which is a material basis for its various pharmacological activities, such as immune modulatory and antitumor activities (Chen *et al.*, 2022).

PHARMACOLOGICAL ACTIVITIES OF *Solanum torvum* AND *Solanum nigrum* FRUITS

ANTIMICROBIAL ACTIVITY

Solanum torvum fruit extracts in methanol have demonstrated antibacterial effectiveness against a range of clinical isolates from both humans and animals (Chah *et al.*, 2000).

Km. Ruby *et al.*, 2012 has investigated on theanti-bacterial activity of methanol and

water extracts of *Solanum nigrum* leaves was evaluated and phytochemical screening was carried out to know the compounds responsible for these activities. On the basis of the results obtained, it could be concluded that methanol could be used for extracting antimicrobial compounds from leaves (Kavishankar *et al.,* 2011).

ANTICANCER ACTIVITY

Anticancer phenolic chemicals have also been identified from the *Solanum torvum* plant leaves and seeds. *Solanum torvum* was discovered to be particularly efficient in inhibiting cell growth in mammary gland breast cancer cell lines (Shanthi & Saravanan, 2021). *Solanum torvum* contains methyl caffeine molecules, which act as an anti-cancer agent (Balachandran *et al.,* 2015). Sepide Miraj *et al.,* 2016 has evaluated on the suppression of EMT in MCF-7 breast cancer cells treated with AESN was evaluated. The results suggested that AESN could inhibit EMT of MCF-7 breast cancer cells mediated by attenuation of mitochondrial function.The present study provides new insight into the application of *Solanum nigrum*for colon carcinoma treatment that are worthy of further study (Lai, *et al.,* 2016).

ANTIDIABETIC ACTIVITY

Blood glucose levels are significantly reduced with *Solanum torvum*. The presence of phyto constituents comparable to alkaloids and flavanoid types in the extract may account for this anti-diabetic activity (Abdulkadir *et al.,* 2016) & (Kandimalla *et al.,* 2015).

Km. Ruby *et al.,* 2012 The aqueous and hydro-alcoholic extracts of different parts of *Solanum nigrum* plant, viz leaf, fruit and stem for hypoglycemic activity in Sprague Dawley rats. Thus it can be concluded that *Solanum nigrum* has the anti- diabetic property (Akubugwo, *et al.,* 2018).

ANTI-ULCER ACTIVITY

The anti-ulcer efficacy of *Solanum torvum* leaves against ethanol, indomethacin, pylorus ligation, and cold-restraint stress-induced stomach ulcer in rats was examined (Nguelefack, Feumebo, *et al.,* 2008). The ethanolic extract of *Solanum torvum* inhibits the development of Ehrlich's Ascites Carcinoma (EAC) cells significantly (Khazir *et al.,* 2014).

Km. Ruby *et al.,* 2012 has performed on the anti-ulcerogenic effects of the methanolic extract of *Solanum nigrum* berries on aspirin induced ulceration in rats with respect to antioxidant status in the gastric mucosa have been investigated. The results indicate that *Solanum nigrum* berries may exert its gastroprotective effect by a free radical scavenging action. *Solanum nigrum* berries may have considerable therapeutic potential in the treatment of gastric diseases (Jainu and Devi, 2004).

ANTI-INFLAMMATORY AND ANALGESIC ACTIVITY

Solanum torvum aqueous extract has strong anti-inflammatory and analgesic effects. Aqueous extracts of tannins and phenols have anti-inflammatory and analgesic properties that are linked to a number of different mechanisms, including the inhibition of the production of inflammatory mediators like prostaglandin and cyclooxygenase as well as the production of prostaglandin E2 (PGE2) through the arachidonic acid cascade, a crucial inflammatory mediator (Darkwah *et al.,* 2020).

Km. Ruby *et al.,* 2012 has investigated on the methanolic extract of whole plants of *Solanum nigrum* L. was investigated for anti-inflammatory activity on the experimental animal models. The methanolic extract decreased the edema induced in hind paw. The methanolic extract of *Solanum nigrum* (375 mg/kg b.w.) has showed significant anti-inflammatory (Arunachalam, *et al.,* 2009).

TRADITIONAL USES OF *Solanum torvum* AND *Solanum nigrum* FRUITS

Solanum tovrum Sw. [Solanaceae] is a tiny shrub that grows abundantly throughout Thailand and is often called "Turkey berry." Turkey berry' is an erect spiny shrub of about 4m tall evergreen and widely branched. It is native and cultivated in Africa and West Indies (Adjanohoun *et al.,* 1996).

Its edible fruits, commonly available in the market are used as a vegetable and are regarded as an essential ingredient in Thai cuisine. Its fruit and leaves, which are rich in alkaloids can however, be used for Medicinal or ritual purposes. The plant is cultivated in the tropics for its sharp tasting immature fruits. The fruits of *Solanum torvum* are used commonly in traditional medicine as antihypertensive (Fui, 1992). It has antioxidant (Sivapriya and Srinivas 2007), Cardiovascular, anti-platelet aggregation activities (Nguelefack *et al.,* 2008), antimicrobial activity against human and clinical isolates (Wiart *et al.,* 2004 and Chah *et al.,* 2000) and sedative, digestive, hemostatics and diuretic activities (Zhu *et al.,* 2003).

The traditional qualities of the Solanum species are well-known. Aside from that, the berries and leaves are used to treat various ailments. The leaves are used to treat gouty joints, joint discomfort, skin diseases, and anti-tuberculosis treatments. They are likewise answered to cause diaphoresis. Dropsy, nausea and neurodegenerative disorders are also treated with leaves. Cough relief can be provided by drinking a decoction of the berries and flowers. These are diuretic treatments for TB disease and pneumonia in the lungs. The berries juice is used to treat diarrhoea, ophthalmopathy and hydrophobia. It's also used to treat cardiovascular problems. Berries have traditionally been used for their stimulant, purgative and euphoric effects. They can likewise treat aggravation and skin conditions. Osteopathy, ophthalmopathy and hepatitis can all benefit from the roots. The whole plant is used as a demulcent, diuretic, digestive, diaphoretic, sedative, antispasmodic, antiseptic, laxative, swelling, cough and asthma treatment. Cardiomyopathy, nephropathy, leprosy, ophthalmopathy and general debility can be treated with this herb. The CNS and spinal reflexes are suppressed when the plant is decocted (Rupesh *et al., 2022).*

TOXICOLOGICAL ASPECTS OF *Solanum torvum* AND *Solanum nigrum* FRUITS

Solanum torvum is a plant commonly used in traditional medicine and as a food ingredient in many parts of the world. However, like many plants, it contains natural toxins that can cause adverse effects in humans. The presence of solanaceous steroidal glycoalkaloids like solanine that inhibit acetyl-cholinesterases and indirectly activate cholinergic receptors is considered responsible for toxicity (Glover *et al.,* 2016 and Singh, 2023).

Turkey berries have a dose-dependent level of toxicity [6]. When ingested in excess or processed incorrectly, the symptoms appeared. Typically, these berries are cooked in a curry before being eaten, which can make the glycoalkaloids they contain unstable and susceptible to degradation. However, in this case, even after boiling the berries, it shows toxicity which indicates that the glycoalkaloids may retain their stability under certain circumstances. *Solanum torvum* poisoning is a rare form of food poisoning that can cause symptoms in the gastrointestinal, nervous, and musculoskeletal systems. Berries exposed to environmental difficulties such as sudden temperature swings are prone to develop symptoms (Glover *et al.,* 2016).

It can lead to a range of symptoms from mild to life-threatening which includes nausea, vomiting, loose stools, ataxia,cranial nerve deficits, slurred speech, vertigo, hypertension, blurring of vision, disorientation, paralysis, and respiratory failure (Zulqarnain *et al.,* 2012).

Although S. nigrum is considered to be an edible plant, its toxicity is mainly due to the presence of solanine, a glycoalkaloid causing varying degrees of toxicity in a dose-dependent manner. The symptoms of poisoning in humans due to solanine are reported to include nausea, vomiting, diarrhea, headache, dizziness, loss of speech, fever, sweating, tachycardia, pupil dilation, blindness, mental confusion, convulsions, coma, and death. The amount of toxic compound in a plant depends on the climate, soil type, season, and maturity. The green unripe berries are generally considered more toxic than the ripe berries. It is probable that by boiling the plant, the toxic components are destroyed as the plant is

reported to be edible after cooking. Traditionally, consumption of nightshade vegetables like tomato, potato, and eggplant has been considered to be problematic for arthritic patients, leading to aggravation of joint pain. It has been reported that solanine present in the green parts of these vegetables is probably responsible for joint pain. However, scientific documentation on a correlation between S. nigrum consumption and inflammation of joints is lacking (Ramya *et al.,* 2011).

CONCLUSION

The fruits of *Solanum torvum* (Turkey berry) and *Solanum nigrum* (Black nightshade) represent valuable sources of essential nutrients and bioactive compounds, making them significant contributors to both nutrition and traditional medicine. Their rich composition of proteins, vitamins, minerals, dietary fiber, phenolics, and alkaloids underpins a wide spectrum of therapeutic properties, including antioxidant, anti-inflammatory, antimicrobial, antihypertensive, hepatoprotective, antidiabetic, and anticancer activities. Such multifunctional roles highlight their potential in promoting health and reducing the risk of chronic diseases like diabetes, cardiovascular disorders, liver diseases, and certain cancers.

In the context of functional foods and nutraceuticals, these fruits hold promise as affordable and accessible dietary interventions, particularly in regions where they are traditionally consumed. However, despite the well-documented ethnomedicinal use and preliminary scientific evidence, comprehensive clinical studies and mechanistic explorations remain limited. Future interdisciplinary research, integrating nutrition, pharmacology, food science, and biotechnology, is crucial to establish standardized dosage, safety profiles, and bioavailability of their active compounds. In summary, *S. torvum* and *S. nigrum* fruits exemplify the convergence of nutrition and therapeutics, offering an opportunity to transform traditional knowledge into scientifically validated strategies for health promotion and disease prevention.

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