HEALTH BENEFITS OF *SOLANUM TORVUM*- AN OVERVIEW

Abstract

Solanum torvum can also be called as sundakai; turkey berry belongs to Solanaceae family with a variety of therapeutic benefits. The whole parts of the *Solanum torvum* plant is widely utilized in traditional medicine all throughout the world. The fruits of *Solanum torvum* are nutritious and valued as a fundamental component of the diet of the South Indian people. Plant extracts of *Solanum torvum* are used to treat fever, wounds, tooth decay, gastric ulceration, coughs, sore throat, stomach ache, colds, skin diseases, reproductive problems, hypertension and diabetes. The main focus of this review is to highlight the common names, description, nutrient composition, health benefits, and phytochemicals of Solanum torvum.

Keywords: Solanum torvum, sundakai, turkey berry, nutrient composition, health benefit

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I. INTRODUCTION

Solanum torvum (Solanaceae) is a tiny shrub generally known as "Turkey berry" that is found across India, Malaya, China, the Philippines, and tropical America (Barbosa et al., 2012), (Wannasiri et al., 2017). This plant's roots stem, and leaves have been used for many years to cure a variety of illnesses. This plant is utilized as a herb in various Ayurveda therapies because of its sedative, diuretic, and digestive effects. It is also used to cure coughs (Sivapriya & Leela, 2007). Several pharmacological effects of *Solanum torvum* extracts include antioxidant, antihypertensive, cardiovascular, ant platelet aggregation, antifungal, anti-inflammatory, antibacterial, and antiviral activity (Barbosa et al., 2012) ,(Wannasiri et al., 2017).

One type of plant that has the potential to be turned into a traditional medicine and is effective as a traditional medicinal component is Solanum torvum. The leaves, fruit, and roots of the *Solanum torvum* plant are used in medicine to treat stomach discomfort and menstruation, stiff or bloated waists, persistent coughs, ulcers, heart pain, and high blood pressure. For therapeutic reasons, plant material is still collected from nature and used in the manner that has been done for centuries by boiling or eating raw. Since it is utilised for eye treatment, the plant has been used as traditional medicine in the community (Sirait, 2009). An indigenous *Solanum torvum* herb had been utilized as an alternative diabetes therapy. *Solanum torvum* help to reduce the incident of hypertension, lipid peroxidation, antiglycation, and radical scavenging (Nguelefack et al., 2009), (Mohan et al., 2009).

The fruits of *Solanum torvum* are commonly available in market. They are used as a vegetable and valued as a staple food for the South Indian populace. Fruit decoctions are prescribed for cough disorders and are thought to be helpful in situations of enlarged liver and spleen (Yuan et al., 2016),(Mohan et al., 2013),(Waghulde et al., 2011).

As an antihypertensive, *Solanum torvum* fruits are utilized. It contains anti-platelet aggregation, cardiovascular, and antioxidant properties. Sedative, digestive, hemostatic, and diuretic properties as well as antimicrobial efficacy on clinical and human isolates(Agrawal et al., 2010).

Solanum torvum root and stem have antitumor, anti-inflammatory, antiviral, and antibacterial action (Abdulkadir et al., 2016). The main phenolic compounds found in *Solanum torvum* fruits are phenolic acids, flavonoids, stilbenes, hydrolysable and condensed tannins, and lignans, which have some beneficial actions like antioxidant, antimicrobial, anti-inflammatory, prebiotic, and vasodilation activities. *Solanum torvum* is known to be a rich source of phenolic acids, catechins, anthocyanins, and proanthocyanins(Said et al., 2014)ˈ(Begam, 2015)(Abhishek et al., 2015).

II. COMMON NAME OF SOLANUM TORVUM

Solanum torvum, also called sundakai in Tamil, is grown for its fruits, which constitute a staple of the diets of the South Indian populace. The fruits of *Solanum torvum* are edible and frequently offered in Tamil Nadu marketplaces as either fresh fruits or in dried form (Kumar et al., 2016).

In India, Solanum torvum, also known as Sundakai and Kodusonde, is a frequently used remedy for enhancing vision, treating spleen and liver enlargement, acting as an antimicrobial agent, and having digestive, sedative, and diuretic properties(Rammohan & Reddy, 2011). Common names for *Solanum torvum* include "Devil fig," "pea eggplant," "prickly nightshade," and "wild eggplant" (Amponsaa Brobbey et al., 2016), (Ningsih et al., 2021).

It is also known as turkey berry, cucumber, gully-bean Thai eggplant, or devil's fig. It is locally known as tit begoon, gota begoon, or hat begoon in Bengali. *Solanum torvum* fruit is used as a vegetable by the common people of Bangladesh, particularly the tribes (Bari et al., 2010a). *Solanum torvum* is known by a number of local names, including Terong pipit, Pokak (East Java), Cepoka (Central Java), Takokak (West Java), and Rimbang (Sumatra and Melayu)(Putri et al., 2023).

III. DESCRIPTION OF SOLANUM TORVUM

A perennial plant in the Solanaceae family called *Solanum torvum* is bushy, upright, and spiky. Although *Solanum torvum* is sometimes referred to be a common traditional vegetable, it cannot be grown like other vegetables. Full sunshine is ideal for its growth (Ramamurthy et al., 2012). It is a crucial medicinal plant in tropical and subtropical nations, and it is extensively utilised in cuisine and traditional medicine all over the world (Yousafa et al., 2013).

It is a 2-4-metre-tall spreading, thin, evergreen shrub with few arms. The stems have branches with recurred reddish or pale-yellow prickles that are 2.5–10 mm long and 2–10 mm broad. It is mostly found in the tropics of Africa, as well as west India, Pakistan, Malaya, China, the Philippines, and the tropics of America(Amponsaa Brobbey et al., 2016),(Musarella, 2020),(Nguelefack, Feumebo, et al., 2008). The *Solanum torvum* has brownish-green stems covered in downy hair and sharp thorns, single-fingered leaves with lengths of 6 to 30 cm, wide ovoid shapes, pointed edges, pinched edges, light green, tightly threaded hands, and some with outboard spines. The flowers are white and arranged in clusters of 5 to 6 on a stalk. The pistils are yellow. The fruit is green when it is young and turns black when it is ripe(Rahmadiah et al., n.d.)

The leaves of *Solanum torvum* are huge and green, with a leaf length of 10-15 cm and a breadth of 8-10 cm(Jaiswal & Mohan, 2012), (Musarella, 2020). *Solanum torvum* flowers all year, with peak blooming in April-May and fruiting until the shrub reaches a height of 1-1.5 m (Saha & Datta, 2017).

When the berries are fully mature, they turn from green to yellow to brown and form clusters of small green spheres that resemble green peas(Christi et al., 2018). They have thin flesh and a lot of dark, flat, rounded seeds. They are beneficial to provide several health advantages in either fresh or dried form, and they hang from the tree in cluster formations (Rahmatullah et al., 2009),(Darkwah et al., 2020b),(SATHYA et al., 2019a).

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).

IV. NUTRIENT COMPOSITION OF SOLANUM TORVUM

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 grammes. According to reports, 100 grammes 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).

Solasonine, a steroidal gluco-alkaloid, is said to be present in leaves. They also include steroidal sapogenins, such as solaspigenine, neochlorogenin, and neosolaspigein. Furthermore, triacontanol, tetratriacontanic acid, z-tritriacontanone, sitosterol, stigma sterol, and campesterol have been discovered in them. Gluco-alkaloid solasonine, sterolin (sitesterol-Dglucoside), protein, lipids, and minerals are also present in fruits of *Solanum torvum* (Lu, Luo, Huang, et al., 2009).

Fruits from *Solanum torvum* are extremely high in vitamin C. Although being high in vitamin C, they also contain a lot of fibre and phytochemicals for food or pharmaceutical manufacturing, including alkaloids, saponins, sugars, phenols, and flavonoids. Alkaloids, flavonoids, saponins, glycosides, and tannins are abundant in *Solanum torvum* (Koomson et al., 2018).

Alkaloids, flavonoids, tannins, saponins, and glycosides are abundant in Solanum torvum. Solasonine and solamargine are two glycosylated solasodine-derived substances with total alkaloid contents of 0.12%, 0.038%, and 0.0028%, respectively (Darkwah et al., 2020b).

V. NUTRITIONAL BENEFITS OF SOLANUM TORVUM

Solanum torvum has traditionally been used to treat fevers, diarrhea, and discomfort. Several researchers have discovered that *Solanum torvum* possesses analgesic and anti-inflammatory properties (Gaelle Djoueudam et al., 2019). *Solanum torvum* plant extracts have been claimed to be effective in the treatment of hyperactivity, colds and coughs, acne, skin illnesses, and leprosy, with methyl caffeate, isolated from the fruit of the Solanum torvum, exhibiting an anti- diabetic effect in streptozotocin-induced diabetic rats(Gandhi, Ignacimuthu, Paulraj, et al., 2011), (Panigrahi et al., 2014),(Salahuddin, 2020).

Dried leaf powder of *Solanum torvum* is utilized for diabetes treatment in India. The leaf juice is utilised to lower body heat, while the unripe fruits are used to boost the body's immunity (Gandhi, Ignacimuthu, Paulraj, et al., 2011). Since its fruit and leaves have anti-microbial properties, the leaf paste is used to treat cuts and wounds in Central America and India(Christi et al., 2018). The *Solanum torvum* leaves provide an abundant source of vitamins, proteins, and critical minerals including iron, magnesium, zinc and potassium (Dickson et al., 2014).

The *Solanum torvum* leaves can be dried, blended, and combined with hot water to form a cold or cough medication. In Malaysia, the seeds are smoked to alleviate toothaches, while the roots are utilised as a poultice to heal foot cracks. In China, the roots are said to disseminate blood that has spilled into the surrounding tissue and cure pain. In India, plant extracts are used as an antidote to insect stings, and the fruit is consumed to ease stomach problems. The fruit's root powder can be used to cure leg fractures and headaches, as well as asthma treatment and liver therapy (Yousafa et al., 2013),(Amponsaa Brobbey et al., 2016).

The *Solanum torvum* leaves are used as a haemostatic, sedative, and diuretic. The ripening fruits are used to make tonics and hemopoietic agents as well as pain relievers (SATHYA et al., 2019a). It is said that the fruits and leaves extract of *Solanum torvum* can be used to cure coughs as well as enlarged liver and spleen. Cracks in the foot can be treated with root paste. For toothaches, people breathe in the smoke from burning seeds (Bari et al., 2010a).

The juice of *Solanum torvum* is typically recommended for peoples to avoid anemia since the fruit of this plant is abundant in nutrients that assist increase the volume of blood in the human body (Sundari et al., 2013). To treat coughs, the fruits are fried and consumed. Asthma, diabetes, and hypertension are also treated using the roots and leaves of *Solanum torvum* (Amponsaa Brobbey et al., 2016).

The *Solanum torvum* fruit is used to cure fever, cough, cold, diabetes, high blood pressure, asthma, tooth decay, cracked foot, reduce body heat, and microbial diseases, liver and spleen enlargement(Priyanka et al., 2014) ,(Kumar et al., 2016), (Yousafa et al., 2013), (Vijayakumari et al., 2012). Ripe fruits are employed in the formulation of tonics and hemopoietic agents, as well as in the treatment of pain (Kala, 2005). Steroidal glycosides, hydrocarbons, and steroids, antioxidant proteins utilised in traditional medicine, are present in the mature fruits of *Solanum torvum* (Abdulkadir et al., 2016). Moreover, it has been said that the fruits and seeds of *Solanum torvum* can treat conditions such as fever, cough, wounds, discomfort, liver issues, tooth decay, and reproductive disorders (Biney et al., 2021).

For the treatment of diabetes, hypertension, and asthma, *Solanum torvum* root extract is utilized (Rahmatullah et al., 2009). The tribal people of Kerala, India, utilise root tea to treat cough and fever. Recently, it was shown that *Solanum torvum* root extract might inhibit bacterial quorum sensing (Vadakkan et al., 2018).

VI. PHYTOCHEMICALS OF SOLANUM TORVUM

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).

Whole alkaloid concentration in *Solanum torvum* is 0.12%, total glycoalkaloids are 0.038%, and solasonine and solamargine, two glycosylated compounds generated from solasodine, are both 0.0043% and 0.0028% of the total composition of different compounds in *Solanum torvum* (Yousafa et al., 2013).

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., 2020a).

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).

Tannins, flavonoids, reducing sugars, saponin glycosides, alkaloids, phytosteroids, and terpenoids are among the primary secondary plant metabolites found in methanol extract of *Solanum torvum* leaves (Amponsaa Brobbey et al., 2016).

Alkaloids, flavonoids, saponins, tannins, glycosides, Vitamins E, B, and C, as well as iron, were detected in the methanolic extract of dried *Solanum torvum* fruits(Koffuor et al., 2011), (Sivapriya & Leela, 2007),(Yousafa et al., 2013), (Femi Ibikunle & Olofu Ogbadoyi, 2016). *Solanum torvum* also contains vitamins and other necessary organic components (Darkwah et al., 2020b).

Solanum torvum fruit has been observed to contain the phenolic substances catechin, gallic acid, pyrogallol, and caffeic acid (Gandhi, Ignacimuthu, & Paulraj, 2011), (Kalita et al., 2017). The fruit wall and seeds' phytochemical study revealed that they included glycosides, isoflavonoids, alkaloids, tannins, and carbohydrates (Kr Paul et al., 2017), (Abhishek et al., 2015), (Yousaf et al., 2013a), (Vargas-Magaña et al., 2014).

The antioxidant activity index of one gramme of concentrated *Solanum torvum* extract was reported to be 3.68 mg of Trolox and 360.53 mg of ascorbic acid equivalents. According to research on lipid peroxidation and superoxide anion activity, *Solanum torvum* is also a rich source of phenolic and flavonoid compounds that have the ability to inhibit the CYP2E1 enzyme and to scavenge free radicals (Kandimalla et al., 2015).

Triacontane derivatives, chlorogenone and neochlorogenone, isoflavonoid sulphate and steroidal glycosides, 22-b-ospirostanololigoglycosides, and 26-b-o-glucosidase have all been identified as chemical elements of *Solanum torvum* fruit(Balachandran et al., 2012). In the aqueous extracts of *Solanum torvum* fruits, phytochemicals such as alkaloids, saponins, flavonoids, polyphenols, and reducing sugars are present(SATHYA et al., 2019b)' (Salahuddin, 2020).

Extraction of phenolic and flavonoid contents from *Solanum torvum* seeds revealed a good amount of phenolic and flavonoid content, which might be a source of natural antioxidants (Waghulde et al., 2011). In *Solanum torvum* leaves, phytochemical analysis identified 32 chemical elements, mostly phenolic compounds, terpenoids, palmitic acid, palmitic acid ester, linoleic acid, linolenic alcohol, linolenic acid, and stearic acid(Naimon et al., 2015), (BERRY, 2021), (Balachandran et al., 2015),(Lu, Luo, & Kong, 2009). According to pharmaceutical research, the stem and root of *Solanum torvum* have beneficial medical benefits against tumours, germs, viruses, inflammation (Yousaf et al., 2013b).

VII. PHARMACOLOGICAL ACTIVITIES OF SOLANUM TORVUM

1. **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).

2. **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., 2020b). *Solanum torvum* aqueous extract has strong anti- inflammatory and analgesic effects (Loganayaki et al., 2010).

3. **Antibacterial and Antifungal:** The phytochemicals behind the strong antibacterial and antifungal activity of the extracts include flavonoids and polyphenolic tannins. Compared to the results shown in the leaves, stems and inflorescence extracts, methanolic extracts of the roots of *Solanum torvum* showed promising antibacterial and antifungal actions on all species examined (Bari et al., 2010b).

4. **Antihypertensive Activity:** Methanolic extract of *Solanum torvum* has been shown to lower blood pressure, modify vascular responsiveness to catecholamine's, and reverse metabolic abnormalities caused by fructose (Shaiq Ali et al., 2008). Intravenous injection of aqueous and methanol extracts of ripe *Solanum torvum* fruits lowered blood pressure (Nguelefack, Mekhfi, et al., 2008).

5. **Anti-viral Activity:** On human and animal clinical isolates of Herpes Simplex Virus, methanolic extracts of sun- dried fruit of *Solanum torvum* including alkaloids, flavonoids, saponins, tannins, and glycosides were shown to have anti-viral effects (Darkwah et al., 2020a).

6. **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).

   In the system of traditional medicine, the fruits of *Solanum torvum* are frequently used to treat diabetes mellitus. It has been reported that experimental rats were given oral doses of methyl caffeate (10, 20, and 40 mg/kg) derived from *Solanum torvum* plants for 28 days. As a result, *Solanum torvum* plants has antidiabetic activity(Gandhi, Ignacimuthu, Paulraj, et al., 2011).

7. **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).

   The anticancer potential of the ethanolic extract of *Solanum torvum* fruit was demonstrated by in vitro cytotoxicity data. Tests for cytotoxicity using extract concentrations between 50 g/ml and 1000 g/ml produced results ranging from 7.09% to 85.79%, respectively (Panigrahi et al., 2014).

8. **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).

VIII. CONCLUSION

This review highlights *Solanum torvum* common names, description, nutritional content, health benefits, and phytochemicals. This plant is widely available in local area and may be obtained for free. It offers several health benefits. *Solanum torvum* is abundant in macronutrients and micronutrients such as vitamins (A, E, C, B1, and B6), copper, folic acid, carbohydrate, and iron. Fever, wounds, tooth decay, gastric ulcers, coughs, sore throat, stomach discomfort, colds, skin illnesses, reproductive issues, hypertension, and diabetes are all treated with Solanum torvum.

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