

## An Overview on *Solanum torvum* Swartz; A Lesser Known Species

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**ABSTRACT:** Solanaceae is an economically important family, and the genus *Solanum* is the largest and most representative of the family. Many species of the genus are important commercial crops and consumed globally. However, few species are not well known and underutilized. One such species is *Solanum torvum*, commonly known as turkey berry. It is a perennial tall evergreen shrub about four metre tall with a prickly stem. The fruits are round in shape, and borne in clusters, with thin fleshed containing many flat and brown seeds. Immature fruits are used especially as a vegetable in some parts of the world. It is less known and underexploited plant. This review highlights the botany, uses of *S. torvum* as food in different parts of the world, uses of the plants in traditional medicine for treatment of various ailments, pharmacological activities of the plant and studies in vegetable grafting, as a rootstock against different biotic and abiotic stress.

**Keywords:** *Solanum torvum*, botany, ethnobotany, pharmacological activity, vegetable grafting.

### INTRODUCTION

The Solanaceae family includes 96 genera, with about 2300 species and is the third most economically important after the Poaceae and Fabaceae family in the plant kingdom (Ghatak *et al.*, 2017; Cuevas-Arias *et al.*, 2008). Many important economic plants such as *Solanum lycopersicum* (tomato), *S. tuberosum* (potato), *S. melongena* (brinjal), *Capsicum annuum* (pepper) etc., (Ghatak *et al.*, 2017) are members of the family. The genus *Solanum* is the largest and most representative of the family (Kaunda and Zhang 2019) with approximately about 1400 species and among the flowering plants it is one of the largest genera (Särkinen *et al.*, 2018). *Solanum* has many species which are cultivated and well known, however certain species are relatively unknown, among such is *Solanum torvum* Swartz. It is an underutilized species commonly known as Turkey berry and its immature fruit is consumed as a vegetable. It is widely distributed in India, Thailand, Malaya, China, Philippines and tropical America (Barbosa *et al.*, 2012; Agrawal *et al.*, 2010). The plant is easy growing and is found in the forest, river banks, fields and gardens or cultivated in the backyard

(Martina *et al.*, 2021). However, the plant is considered as a weed in some areas (Otu *et al.*, 2017).

### BOTANY

*Solanum torvum* is a perennial andromonoecious shrub originating from America (Martina *et al.*, 2021; Chou *et al.*, 2012). The plant is an erect, widely branched, spiny and tall evergreen of about 4 metre tall with a prickly stem (Musarella, 2020; Agrawal *et al.*, 2010). The stems densely tomentose with the older stem bark brown to dark grey and the young stem and the branches are green in colour and pubescent with trichomes. Leaves are simple, evergreen, alternate solitary or in pairs and broadly ovate. The leaf petiole is about 2-4 cm, leaves are 5-21 cm long and 4-13 cm wide, densely tomentose, armed or unarmed, with an acute tip and rounded to oblique base, margin sinuate or usually 5-7-lobed, with the upper surface darker than the lower one. Inflorescence is dense, compact upto 6 cm long and 1-4 times branched. Andromonoecious and pentamerous flowers with slender and hairy petal, 2-3 mm forms a calyx of 4-6 mm long. The petals are white and cream in colour of about 1 cm long forming a stellate white corolla of 1.5-2 cm in diameter. The

androecium consists of five yellow stamens with about 6-8 mm long and 1 mm wide stamens. A conical ovary, glandular, surmounted by 10-12 mm style, glabrous ending with a capitate stigma made up the gynoecium

part and it projects over the androecium (Musarella, 2020; Lim, 2013). The fruit grows in cluster and are round in shape, thinly fleshed and contain many flat and brown seeds (Otu *et al.*, 2017).



**Fig. 1.** *Solanum torvum* Swartz.

### FOOD USE

The young and immature fruits of *S. torvum* are used as vegetable. Different dishes are prepared varying from one region to another. It is eaten fresh or dipped in *Nam Prik* (paste made with spicy chili and pounded shrimps/dried fish) in Thailand and the immature fruits are also cooked in red or green curry. Young fruits are used in preparation of soups, sauces and chopped together with brinjal or tomato fruits in Ivory Coast. In Indonesia, the immature fruits are consumed raw, cooked or together with other dishes. It is also consumed as vegetable in India; the young fruits are eaten directly or utilized in preparation of different dishes (Lim, 2013).

### ETHNOBOTANICAL USE

Nature has been the provider for human basic needs and not the least, medicines for millennia. For thousands of years, many plants were being utilized in the traditional

medicine systems such as the traditional Chinese medicine, Ayurvedic and Unani medicine, etc., and nature still continues to provide the medicinal needs of mankind (Gurib-Fakim, 2006; Farnsworth and Soejarto 1991). The most dependent on the medicinal plants are generally the people from the rural areas. Apart from the use of plants as medicine, it also provides a significant source of income through selling of harvested material (Hamilton, 2004). Different ethnobotanical use of the plant has been reported in different parts of the world. Almost all part of the plant; leaves, fruits, seeds, roots etc. have been recorded to be used in the traditional medicine for the treatment of different ailments such as toothache, skin diseases, cough, fever etc.,. The ethnobotanical use of the plant for the treatment against different disease from different countries, its vernacular names, method of preparation and administration are given in the Table 1.

**Table 1: Traditional uses of *Solanum torvum* Swartz.**

Country	Vernacular name	Used for/against	Part used	Method of preparation and administration	Reference
Indonesia	Inggir-inggir	Eye medication, poisoning and insect venom	Leaves	-	Nasution <i>et al.</i> (2018)
India	Byako/Byaa/Sathi Byako	Headache, fever and cough, toothache, tooth decay, reducing blood sugar, colic and asthma	Fruits, roots and seeds	-	Arya <i>et al.</i> (2017)
Papua New Guinea	Koroh	Dry cough	Young leaves	Mashed to release succus and administered orally	Waruruai <i>et al.</i> (2011)
India	Banbegun	It is applied to cure boils	Ripe fruits or roots	The decoction of ripe fruit or is added to mustard oil and boiled	Sur <i>et al.</i> (1987)
Bangladesh	Bengar	Hopping cough	Fruits	-	Uddin <i>et al.</i> (2006)
Bangladesh	Kajo-ba	Used to expel thread worms	Fruits	Fruits are cooked in curries; to expel thread worm, boiled fruit with rice is taken at night for 2-3 days	Alam (1992)
India	Borang Kharangjeh	Anthelmintic	Seeds	As a boiled vegetable or raw	Namsa <i>et al.</i> (2011)
India	Kopir	Cough and tonsillitis	Fruits	Berry is taken as raw as well as in cooked form	Deo <i>et al.</i> (2021)
India	Sundaikaai	Body cooling	Leaves	Juice orally	Yabesh <i>et al.</i> (2014)
Cameroon	-	Malaria	Young leaves	Young leafs are triturated and administered by instillation in nose	Betti (2004)
Nigeria	Nditot	Ulcer	Fruits	Fruits are crushed in warm water and use externally	Ekpo <i>et al.</i> (2008)

India	Sundai	Stomache, colic, headache, menstruation pain and liver pain	Leaves and fruits or fruits in powder form	-	Kumar <i>et al.</i> (2019)
Philippines	Tawng-tawng	Fever, wounds and tooth decay	-	Poultice	Calangi <i>et al.</i> (2019)
India	Tawkpui	Skin disease, wounds and toothache	Fruits and bark	Grounded bark against toothache	Ralte <i>et al.</i> (2018)
India	Sing Kote	Toothache	-	-	Rethy <i>et al.</i> (2010)
Cameroon	-	Female infertility, gastritis, poisoning and pneumonia	Fruits, bark and leaves	-	Jiofack <i>et al.</i> (2009)
India	Kodu/Kopii Piuro /Mishang Byako /Baak/ Sete Bake/ Pata Byak	Diabetes and stomach disorder	Fruits	Boiled	Yanka <i>et al.</i> (2019)
Ghana	Amajuradi	Measles and back pain	Roots, fruits and leaves	Decoction and administered orally	Adeniyi <i>et al.</i> (2018)
Indonesia	Tarutuk	As bitter relievers and for lowering blood sugar	Fruits	Fruit is mixed in cuisine with other vegetable	Nurrani and Kinho (2013)
India	Samatae/ Byake	Toothache	Fruits	Fruits are crushed and applied on the teeth	Rinyo <i>et al.</i> (2018)
India	Tawkpui	Toothache and tooth decay	Seeds	Crushed and applied	Lalfakzuala <i>et al.</i> (2007)
Bangladesh	Khumka	Asthma, diabetes and hypertension	Leaves and roots	The juice is extracted and administered orally	Rahmatullah <i>et al.</i> (2009)
Indonesia	Rimbang	Eye drop	Fruits	-	Aththorick and Berutu (2018)
China	Shi ha	Inner heat and toothache	Roots	Decoction and administered orally	Ghorbani <i>et al.</i> (2011)
India	Sundaikkai	Vermifuge	Fruits	Cooked	Mohan (2008)
Nepal	Ban bihi	Urinary problem (hematuria)	Whole plant	Decoction and administered orally	Bhattarai (2020)
Cuba	Pendejera blanca	Flu, inflammation, allergies, spots skin, asthma, fever	Leaves and root	Decoction, infusion, expression (juice), oral and topical	Heredia-Díaz <i>et al.</i> (2018)
Nigeria	Igbayanrin-elegun	-	Leaves	-	Soladoye <i>et al.</i> (2010)
Indonesia		Urinary tract problems	Leaves	-	Nisa <i>et al.</i> (2021)
China	tiān xīng shù	Itching	Leaves	Bath	Li and Xing (2016)
Ghana	Abedrow	Malaria	Fruits and leaves	Boil fruit with leaves and administered orally	Asase <i>et al.</i> (2010)
Bangladesh	Goth begun	Fever, gastritis, flatulence and stomach pain	Whole plant	Root extract is taken two to three tea spoonfuls twice daily for fever. Half teaspoon powder of whole plant mixed with one glass of water taken twice daily for 12-15 days for gastritis, flatulence and stomach pain.	Uddin <i>et al.</i> (2013)
India	-	Cough	Fruits	Fruit fried in ghee and taken together with honey to cure cough in children	Pushpangadan and Atal (1986)
Bangladesh	Linghawi	Worm	Fruits	Processes plant parts are administered orally administered	Uddin <i>et al.</i> (2015)
Malaysia	Cheweng	Hypertension	Roots	Sun dried root is chopped into tiny pieces and decocted administered orally	Ayuni <i>et al.</i> (2018)
Nepal	Bihī -N	Headache and fever	Fruits	Raw and mature fruits are taken	Pangeni <i>et al.</i>

					(2020)
Nigeria	Oriwo-eni	Swollen wound	Seeds	The seeds are grind applied on swollen part	Ugbogu and Chukwuma (2019)
Indonesia	Takokak	High blood pressure	Fruits	-	Malini <i>et al.</i> (2017)
Cameroon	Azon kombe	Peptic ulcer	Fruits	-	Noumi and Dibakto (2000)
Bangladesh	Borshiborduk, Kontakari	Fever, pain weakness and diarrhoea	Roots and fruits	Tablet made from paste of root is taken once daily for two days. And fruit paste is taken with honey one or two spoonful thrice daily	Faruque and Uddin (2011)
France	Magrot	Thoracic pain, chill and fever and hypertension	Leaves	Infusion, decoction and oral administration	Longuefosse and Nossin (1996)

## PHARMACOLOGICAL ACTIVITY

**Antidiabetic activity.** Gandhi *et al.*, 2011 studied the anti diabetic activity of *S. torvum* fruit methanol extract. Different dose 200 and 400 mg/kg/day of the extract were administered orally for 30 days to Streptozotocin induced diabetic rats. The blood glucose level was reduced by 17.04 % and 42.10 % in diabetic rats by 200 and 400 mg/kg/day dose respectively. Comparing to the control diabetic rats, the levels and activities of other biochemical parameters were also significantly restored in the *S. torvum* fruit methanol extract administered rats. Inhibition against rat intestinal  $\alpha$ -glucosidase (sucrase and maltase) was observed from *S. torvum* fruit extracts. And upon enzyme-assay guided fractionation of the extract, methyl caffeate was isolated as the inhibitor (Takahashi *et al.*, 2010).

**Anti bacterial activity.** Anti bacterial activity of leaves, stem, roots and inflorescence of *S. torvum* extracted by chloroform and methanol were tested on fifteen (six gram positive and nine gram negative) human pathogenic bacteria. Root methanolic extract showed promising anti bacterial in comparison to that of leaves, stems and inflorescence extracts (Bari *et al.*, 2010). Fruit of *S. torvum* extracted with methanol inhibited growth activity of bacteria (Chah *et al.*, 2000). Screening antimicrobial activity of ethanolic extract of *S. torvum* fruits against six bacteria (*Klebsiella pneumoniae*, *Escherichia coli*, *Bacillus subtilis*, *Staphylococcus aureus*, *Salmonella typhi* and *Pseudomonas aeruginosa*) recorded significant levels of antibacterial activity on four tested bacterial strains viz., *Klebsiella pneumoniae*, *Escherichia coli*, *Bacillus subtilis* and *Staphylococcus aureus* (Jaabir *et al.*, 2015). In vitro effects of *S. torvum* leaf petroleum ether extracts against *Staphylococcus aureus*, *Salmonella typhimuriam*, *Escherichia coli*, *Klebsiella pneumonia*, *Pseudomonas aeruginosa* and *Proteus vulgaris* was studied by Sabarinath *et al.* (2018) by measuring the inhibition zone diameter formed in plate culture and concluded that the leaves possess antibacterial activity. Antibacterial activity of the ethanolic extract of *S. torvum* leaves was also evaluated by broth microdilution assays (Naimon *et al.*, 2015). Five pathogenic bacteria; *Staphylococcus aureus*, *Staphylococcus intermedius*, *Staphylococcus epidermidis*, *Bacillus cereus* and *Pseudomonas aeruginosa* were included in the study. Growth

inhibition of the extracts was noted with minimum inhibitory concentration and minimum bactericidal concentration values that ranged between 1.95 and 31.25 mg/mL, and among all the tested bacteria, the strongest antibacterial activity was noted in *Bacillus cereus*.

**Anti-ulcerogenic activity.** Aqueous and methanol extracts of *S. torvum* leaves showed anti-ulcerogenic properties (Nguelefack *et al.*, 2008).

**Hepatoprotective activity.** *S. torvum* fruits hydroalcoholic extract revealed potential hepatoprotective activity at a dose level of 200 mg/kg recorded on different biochemical parameters like SGPT (Serum glutamate pyruvate transaminase), SGOT (Serum glutamate oxaloacetate transaminase), cholesterol, bilirubin, total protein and LDH after CCl<sub>4</sub> administration to albino rats. However, in comparison to the standard drug Silymarin at a dose of 25 mg/kg, the overall hepatoprotection exhibited by the extract was low (Kayalvizhi *et al.*, 2012).

**Anti cancer activity.** Ethanolic extract of *S. torvum* fruit recorded significant cytotoxic effect on Ehrlich's Ascites Carcinoma cell (Panigrahi *et al.*, 2014). Another experiment was conducted by Balachandran *et al.* (2015) to study the anticancer activity of methyl caffeate isolate from *S. torvum* fruit. Hexane, ethyl acetate and methanol extracts of the fruit were evaluated for cytotoxic properties against MCF-7 cells using the 3-(4, 5-dimethylthiazol-2-yl)-2, 5-diphenyl tetrazolium bromide assay. In comparison to hexane and methanol extracts, ethyl acetate extract showed good cytotoxic activities. Using ethyl acetate extract methyl caffeate was isolated to study its activity against MCF-7, A549, COLO320, HepG-2 and Vero cells and showed potent cytotoxic properties against MCF-7 cells.

**Anti-Inflammatory.** The body's non specific and defensive response to tissue damage is known as inflammation (Rammohan *et al.*, 2010). An experiment was conducted by Rammohan *et al.* (2010) to evaluate the anti-inflammatory activity of *S. torvum* seed and fruit wall methanol extracts by Carrageenan induced rat paw edema method. Significant anti-inflammatory activity was observed in all the extracts, however superior activity was recorded in seed methanol extract of 500 mg/kg body weight. Anti-inflammatory activity of aqueous extract of *S. torvum* leaves studied using

Carrageenan experimental model was also reported by Ndebia *et al.* (2007).

## VEGETABLE GRAFTING

In grafting, two living plant parts known as the scion and the rootstock are united with the establishment of vascular continuity between them and thereby function as a single plant. It is unique horticulture technology of asexual propagation and is being practiced in East Asia from many years (Suansia and Samal 2021; Kubota *et al.*, 2009; Mudge, 2009). Different methods used in vegetable grafting are cleft grafting/wedge grafting, tongue approach grafting/ side grafting (TAG), tube grafting/ Japanese grafting (TG), hole insertion grafting (HIG), slant grafting/ one cotyledon grafting and pin grafting (Suansia and Samal 2021). Used of *S. torvum* as a rootstock against different biotic and abiotic stress has been reported in different studies.

Eggplant fruit grafted on *S. torvum* reduced the concentration of Cadmium by 63–74% in Cadmium-polluted soil and unpolluted soil in comparison to *S. melongena* and *S. integrifolium* grafts (Arao *et al.*, 2008). Effects of grafting on Cadmium accumulation in the shoots of *S. melongena* (eggplant), *S. lycopersicum* (tomato) and *Capsicum annum* L. (pepper) scion plants on *S. torvum* rootstock was evaluated by Yuan *et al.* (2021). Significant reduction in the Cadmium accumulation by up to 85 % in the shoots of eggplant, tomato and pepper scions was recorded. Bletsos *et al.* (2003) studied the effect of grafting on verticillium wilt (*Verticillium dahlia*) of eggplant on *S. torvum* and *S. sisymbriifolium* rootstock. Significantly lower incidence of disease averaging 28.1 % and 52.6 % was recorded in early production and 37.6 % and 79.3 % in late production on scions grafted on *S. torvum* and *S. sisymbriifolium* rootstock respectively. On the other hand, 96 % and 100 % of disease incidence was observed in early and late production periods on the ungrafted plants. A study on grafting of tomato cultivar on *S. torvum* against bacterial wilt (*Ralstonia solanacearum*) was reported by Smith and Saravanakumar (2022). Significant reduction in wilt incidence of 10 % and less was observed on grafting of the tomato cultivar Rodeo 14 on *S. torvum* in comparison to plants grafted on commercial rootstock (RST-04-106-T), for non-grafted and self grafted under semi protected and field conditions, 45-100 % wilt incidence was recorded. For non grafted controls at 28 days severe wilt incidence of over 60 % was recorded. However, complete resistance was noted on susceptible tomato plants grafted onto *S. torvum*. High incidence of disease of over 90 % was recorded in the non grafted plants at 49 days after transplanting while for the grafted plants 5 % wilt incidence was observed.

## CONCLUSIONS

*Solanum torvum* is a relatively lesser known vegetable, consumed by different group and communities across the world particularly in the tropic and sub tropical zones. Botanically, it is a perennial shrub and though cultivated in backyard and home garden in some region,

it is considered as a weed in some area. Traditional use of the different parts of the plant has been reported in different parts of the world. Ethnobotanically, it use ranges from skin infection treatment, toothache, stomach ache, diabetes etc. Pharmacological activity of the plant has also been reported such as antidiabetic activity, anti bacterial activity, anti-ulcerogenic activity, hepatoprotective activity, anti-inflammatory and anti cancer activity. Different studies have also reported the potential use of the *S. torvum* as a rootstock against biotic and abiotic stress for enhancing production. However, more studies and trials may be conducted further to utilize the plant to its full potential.

**Conflict of Interest.** None.

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