



## Phytochemical composition and *In vitro* antibacterial activity of Turkey (*Solanum torvum*) berries extract against *Bacillus subtilis*

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### Abstract

Antimicrobial agents are essentially important in reducing the worldwide trouble of infectious diseases. However, emergence and propagation of multidrug resistant strain in pathogenic bacteria have become a significant public health threat as there are fewer, or even sometimes no, effective antimicrobial agents available for the infection caused by pathogenic bacteria. Commonly used medicinal plants of our community could be an excellent source of drugs to fight off this problem. This study is focused on exploring the antimicrobial properties of the plant *Solanum torvum* that are commonly being used as traditional medicines. Natural Antioxidants are the substance that are present naturally, if it present in low concentrations also compared to those of an oxidisable substrate significantly delays or prevents oxidation of that substance. Considering the vast potentiality of plant phytochemical as sources for antimicrobial drugs, this study aimed to investigate *in vitro* antibacterial of *Solanum torvum* extracts against the most common microbial pathogen.

**Keywords:** antimicrobial; *Solanum torvum*; antioxidants; bacteria; phytochemical

### Introduction

Turkey berry as a vegetable has varied beneficial components ranging from nutritional, phytochemical, and pharmacological among others. Chemical entities of this plant has been used as antihypertensive, antioxidants, anti-platelet aggregation activities, anti-microbial activity, seductive, digestive, hemostatic diuretic activities among others, with scientifically proven activities related with traditional concept (Grussu, *et al.*, 2011; Said *et al.*, 2014) [7, 10]. *Solanum torvum* Swartz (Turkey Berry) is also known as devil's fig, prickly nightshade, shoo-shoo bush, wild eggplant, and pea eggplant. It is a bushy, spiny erect, and perennial plant belonging to the family Solanaceae. The berries grow in clusters of tiny green spheres which look like green peas when fully ripen, it becomes yellow to brown Adjanohoun *et al.*, 1996 [1]. They are thin fleshed and contain numerous flat, round, brown seeds. They hang on the tree in cluster forms and are useful to yield many health benefits either in fresh or dried form Rahmatullah *et al.*, 2009. In Bangladesh it is common in dry regions and often occurs gregariously. It is locally known as tit begoon, gota begoon or hat begoon in Bengali and commonly known as turkey berry, susumber, gully-bean thai eggplant or devil's fig. Common people of Bangladesh especially the tribes use the fruit of *S. torvum* as vegetables in their daily diet (Ghani, 1998). Due to its rapid spread as a weed in disturbed lands, it is difficult to tell which populations are native and which are introduced. In Jamaica, this berry is called susumba or gully beans and is usually cooked in a dish. It is believed to be full of iron and is consumed when one is low in iron. It is a very good anti-inflammatory medicine in Ayurvedic medicine Adjanohoun *et al.*, 1996 [1].

A lot of natural antioxidants is available, but some antioxidants are manufactured synthetically at present and mixed with food products also. The synthetic antioxidants when taken *in vivo* lead with a lot of side effects. Generation of free radicals or reactive oxygen species (ROS) during metabolism and some other activities beyond the antioxidant capacity of the biological system gives rise to oxidative stress. This stress may leads to heart diseases, neurodegenerative diseases, cancer development of chronic and age-related degenerative diseases Amin *et al.*, 2006 [2]. Extracts of the plant are reported to be useful in the treatment of hyperactivity colds and cough, pimples, skin disease and leprosy. Nutritionally, turkey berry is an excellent source of the following micro-nutrients; vitamin A, B1, B6, Calcium (0.28mg), copper, folic acid, iron (24.5mg) magnesium, niacin as well as potassium and it also has fat (1.7mg) and fibre (56.9mg). The fruits of *Solanum torvum* are used commonly in traditional medicine as antihypertensive. It has antioxidant, Cardiovascular, anti-platelet aggregation activities, anti-microbial activity against human and clinical isolates.

### Methodology

#### Collection of Sample

*Solanum torvum* can consume in the fresh and dried form. Though it has lot of health benefits, usage of turkey berry is very less in our daily diet. The fresh and healthy *Solanum torvum* were identified and collected from Mavaravilai area of Kanyakumari district. The selected samples were cleaned with tap water to make it free from foreign particles. After washing the turkey berries are allowed to sundry for 10-15 days and then it was milled to make it into powder form.



Fig 1

**Phytochemical Screening (Sofowora, 1993)**

This screening was carried out with the methanolic extracts using chemical methods and qualitative analysis of the major constituents present in the *Solanum torvum* extracts was determined using the standard procedures. The powdered *Solanum torvum* was subjected into quantitative analysis of phytochemicals by estimating their amounts using standard procedures.

**Antioxidant Activity**

Antioxidant activity of the extract was analysed by Nitric oxide Radical scavenging activity. The absorbance of the resultant solution was measured using spectrophotometer.

**Nitric Oxide Radical Scavenging Assay**

Nitric oxide radical scavenging activity was determined according to the method reported by Garrat (1964). The capability of scavenging nitric oxide radical was calculated using the following equation

$$\text{Percentage inhibition} = \frac{(\text{Absorbance of control} - \text{Absorbance of test})}{\text{Absorbance of control}} \times 100$$

**Nutrient Analysis**

Nutraceuticals or functional foods are natural bioactive, chemical compounds that have health promoting, disease preventing or medicinal properties. Carbohydrate, sugar, protein, amino acid were estimated through a standard procedures.

**Formulation of Products**

Dried *Solanum torvum* was selected for the preparation of *S. torvum* incorporated products. The products such as soup powder and idly powder were selected for the formulation. The products were prepared based on the standard product preparation methods.

**Sensory Evaluation, Keeping Quality and of the Formulated Products**

Sensory assessments were evaluated based on the quality descriptions i.e., appearance, colour, flavour, taste, texture and overall acceptability using a score card. Keeping quality was done to find out the storage behaviour of the products. They were kept as such in room temperature for 2 months.

**Antibacterial Activity**

Antibacterial activity of various extracts of Sundakai coat was evaluated by the well diffusion method on nutrient agar medium (Forbes *et al.*, 1990) [6]. This was confirmed by the inhibitory effect on bacterial growth as reflected by the inhibited zone compared to known antibiotics. The sterile nutrient agar medium (20 mL) in petridishes was uniformly smeared using sterile cotton swabs with test pure cultures of *Bacillus subtiles*. Nutrient agar media was prepared by dissolving 0.3 beef extract, 0.3 yeast extract, 0.5 peptone, 0.5 NaCl and 1.5% agar in 1liter of distilled water. The wells of 5 mm diameter were made using sterile cork borer in each petriplates and the various extracts of Sundakai fruit coat were added, a blank well loaded without test compound was regarded as control. For each treatment 10 replicates were maintained. The plates were incubated at 37°C for 24 h and the resulting zone of inhibition was measured by comparing control and the standard antibiotic.

**Results and Discussion**

***Solanum torvum***

*Solanum torvum* was collected and powdered then subjected into qualitative and quantitative phytochemical analysis, antioxidant activity and nutrient analysis. The products were formulated, sensory evaluated and done a shelf life study. All these datas were collected, tabulated and discussed as below:

**Phytochemical Analysis**

In the present study phytochemical analysis of *Solanum torvum* revealed presence of terpenoid, flavanoid, reducing sugar, alkaloid, saponin, tannin, steroid, amino acid and glycoside (Table-1). The phytochemicals which showed its presence in qualitative analysis were subjected into quantitative analysis (Table-2). Phytochemical constitutes such as tannins, flavonoids and several aromatic compounds or secondary metabolites of plants serves as defense mechanism against predation by many microorganisms. The curative properties of medicinal plants are perhaps due to the presence of various secondary metabolites such as alkaloid, flavonoid, tannins, phenolic compounds, saponins and phytosterols (Britto and Sebastian, 2012). The presence of alkaloids, saponin, flavonoids, phenolic compounds, tannins, phytosterol and terpenoids are used in analgesic, and antiplasmodic and bacteriocidal activities (Stary, 1998). Thus the preliminary screening test may be useful in the detection of the bioactive principles and subsequently may lead to the drug discovery and development.

**Table 1:** Qualitative analysis of *Solanum torvum* extract

S.No	Phytoconstituent	<i>Solanum torvum</i> Extracts			
		Control	Aqueous	Chloroform	Ethanol
1.	Terpenoid	+	+	+	+
2.	Flavonoid	-	-	+	+
3.	Reducing Sugar	+	-	+	+
4.	Phenol	-	-	-	-
5.	Alkaloid	-	+	+	+
6.	Saponin	+	-	-	+
7.	Tannin	+	+	+	+
8.	Steroid	+	+	+	+
9.	Amino acid	+	-	-	+
10.	Glycoside	-	-	+	-

**Table 2:** Quantitative analysis of *Solanum torvum* extract

S. No	Phytoconstituent	<i>Solanum torvum</i>
1.	Terpenoid	74.36±0.014
2.	Reducing Sugar	43.54±0.001
3.	Saponin	24.54±0.003
4.	Tannin	55.12±0.000
5.	Steroid	21.07±0.011
6.	Amino acid	17.64±0.020

**Antioxidant Activity**

*Solanum torvum* was found to be a very potent antioxidant.

*Solanum torvum* extracts showed antioxidant activity on aqueous, ethanol, chloroform (Table-3).

**Table 3:** Nitric Oxide scavenging activity of *Solanum torvum* extract

S.No	Concentration of extracts	Control	Aqueous Extract	Ethanol Extract	Chloroform Extract	Gallic Acid
1.	25µl	58.27±0.014	52.36±0.028	55.92±0.000	55.17±0.012	65.73±0.054
2.	50µl	59.35±0.012	52.98±0.024	57.21±0.021	58.91±0.004	66.29±0.023
3.	75µl	61.36±0.016	53.29±0.103	58.28±0.028	61.50±0.040	68.81±0.037
4.	100µl	61.92±0.014	56.00±0.066	60.55±0.183	62.04±0.047	70.85±0.044

Apart from their role of health benefactors, antioxidants are added in foods to prevent or delay oxidation of food, initiated by free radicals formed during their exposure to environmental factors such as air, light, and temperature Hras *et al.*, 2000 [8]. At present, most of the antioxidants are manufactured synthetically. Plants are the potential source of natural antioxidants. Natural antioxidants or phytochemical antioxidants are the secondary metabolites of plants. Flavonoids are phenolic compounds, present in several plants, which inhibit lipid peroxidation and lipoxygenases *in vitro* and in the presence of free metal ion (Fe<sup>3+</sup>) Yingming *et al.*, 2004. In this present study, three methods, namely hydrogen peroxide method, DPPH radical scavenging method, and reducing power ability method, were used to find and correlate the antioxidant activity of the extracts.

**Nutrient Analysis**

*Solanum torvum* powder had the nutrients such as protein, carbohydrate, starch, amino acid and sugar (Table -4). The selected berries are having some nutritional valuable minerals. The micronutrients present in the fruits are most important for their antioxidant and antimicrobial activity Tarwadi and Agte *et al.*, 2007. Hydrogen peroxide is also able to diffuse easily through cell membrane. The generation of hydrogen peroxide by activated phagocytes is known to play an important part in the killing of several bacterial and fungal strains Thilagavathi *et al.*, 2005 [14].

**Table 4:** Nutrient Analysis of *Solanum torvum* extract

S.No	Nutrient contents	Control
1.	Total Protein	384.36±0.010
2.	Total Carbohydrate	297.54±0.000
3.	Starch	39.72±0.001
4.	Amino acid	25.32±0.010
5.	Sugar	271.64±0.020

**Sensory Evaluation of the Formulated Product**

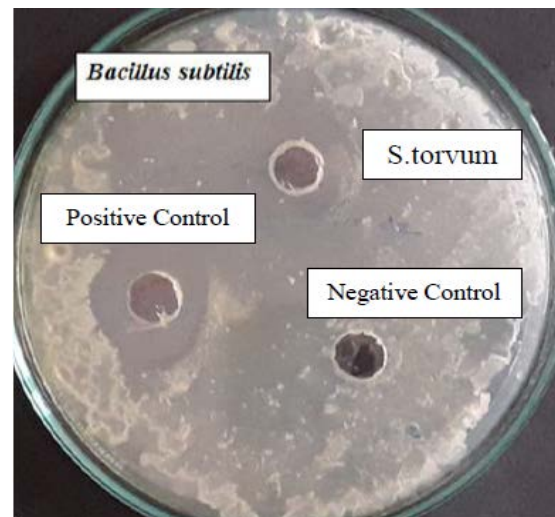
Due to the presence of various phytochemicals and nutrients, the *Solanum torvum* powder was formulated into products such as Idly powder and Soup powder. *Solanum torvum* incorporated Idly powder and Soup powder were formulated and evaluated. The formulated products were sensory evaluated with the standard products. *Solanum torvum* was kept in room temperature and refrigerator separately.

**Table 5:** Sensory parameters of Idly powder

S. No	Sensory parameters	Standard	Idly powder
1.	Appearance	4.73±1.41	4.8±0.4
2.	Texture	4.73±1.41	4.93±0.26
3.	Taste	4.67±0.62	4.73±0.45
4.	Flavour	4.73±1.41	4.93±0.26
5.	Colour	4.73±1.41	4.73±0.45
6.	Overall acceptability	4.73±1.41	4.93±0.26

**Antibacterial Activity of *Solanum torvum***

The antibacterial activities of the selected extract (Zone of inhibition of mm diameter) were given in the Fig 3. Among the different samples (5 mg, +, - control), The *Solanum torvum* extract and +, - control controlled the range of 5.8, 3.2 and 1.9 mm of zone of inhibition in *Bacillus subtilis* respectively. Chehregani *et al.* (2007) [4] reported that some species of *Allium* had antibacterial activity against some tested bacteria. El-Adley *et al.* (2007) [5] studied antibacterial effects of low power laser light and volatile oil of Fennel (*Foeniculum vulgare* var. dulce) on Gram-positive and Gram-negative bacteria and found remarkable antibacterial activity against tested plants, where the diameter of inhibition zone ranging from (6-20 mm). The present findings are similar to those of Chehregani *et al.* (2007) [4] and El-Adley *et al.* (2007) [5]. The present investigation revealed that the methanol extracts of root of *S. torvum* are highly active against *Bacillus subtilis*, respectively.

**Fig 2**

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