



In Vitro Antioxidant and Phytochemical Analysis of *Solanum aethiopicum* (Garden Egg Leaf) and *Telfairia occidentalis* (Fluted Pumpkin Leaf)

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Abstract	Article History
This study evaluated and compared the in vitro antioxidant activity and phytochemical constituents of methanol leaf extracts of <i>Solanum aethiopicum</i> and <i>Telfairia occidentalis</i>. The phytochemical analysis of both <i>Solanum aethiopicum</i> and <i>Telfairia occidentalis</i> revealed the presence of alkaloids, saponins, flavonoids, terpenoids, glycosides, and steroids in both plant extracts, whereas tannins were absent in <i>Solanum aethiopicum</i> but present in <i>Telfairia occidentalis</i>. The results showed that the methanol leaf extracts of <i>T. occidentalis</i> and <i>S. aethiopicum</i> were able to scavenge nitric oxide in a dose-dependent manner, with a concentration of 50 µg/ml giving the least percentage scavenging activity (38.20 ± 0.32 and 36.20 ± 0.12), while a concentration of 250 µg/ml gave the highest percentage scavenging activity (80.39 ± 0.14 and 74.35 ± 0.14), respectively. The results also showed that the methanol leaf extracts of <i>T. occidentalis</i> and <i>S. aethiopicum</i> were able to scavenge hydrogen peroxide (H_2O_2) in a dose-dependent manner, with a concentration of 50 µg/ml giving the least percentage scavenging activity (44.28 ± 0.30 and 40.23 ± 0.14), while a concentration of 250 µg/ml gave the highest percentage scavenging activity (80.39 ± 0.14 and 75.33 ± 0.22), respectively. The results of the nitric oxide scavenging activity and hydrogen peroxide scavenging activity, as measures to assess the in vitro antioxidant potential of the two extracts, revealed that <i>T. occidentalis</i> has higher antioxidant scavenging activity when compared to <i>Solanum aethiopicum</i>. The recorded high antioxidant activity may be due to the presence of phytochemicals in the plants. We conclude that the methanol leaf extracts of <i>T. occidentalis</i> and <i>S. aethiopicum</i> have in vitro antioxidant scavenging activity against nitric oxide and hydrogen peroxide radicals, and the observed antioxidant activity may be due to the presence of phytochemicals in the plant extracts. Keywords: In vitro antioxidant activity, phytochemical analysis, <i>Solanum aethiopicum</i>, <i>Telfairia occidentalis</i>, nitric oxide scavenging	Received: 16 Apr 2025 Accepted: 22 May 2025 Published: 31 May 2025 Scan QR code to view*  License: CC BY 4.0*  Open Access article.
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Introduction

Vegetables make up a major portion of the diet of humans in many parts of the world and are considered essential for well-balanced diets (Shukla *et al.*, 2016). Leafy vegetables crops are group of vegetables crops which are used mainly for their leaves whether eaten raw or cooked. They provide adequate

amount of dietary fibres, minerals, vitamins and other nutrients to people in developing countries (Randhawa, 2015). They also contain an immense variety of bioactive non-nutritive health promoting compounds such as antioxidants and phytochemicals which provide health benefits beyond basic nutrition (Hemmige *et al.*, 2017). Leafy vegetables are also

medicinal herbs and plant and from time immemorial, medicinal plants are a rich source of bioactive phytochemicals or bio nutrients. Studies carried out during the past 2-3 decades have shown that these phytochemicals play an important role in preventing chronic diseases like cancer, diabetes, coronary heart disease, viral and bacterial diseases (Iheukwumere *et al.*, 2025a; Iheukwumere *et al.*, 2025b). Plants, herbs and spices contain phyto-nutrient or phytochemicals which possess antioxidant activity, antiviral activity and antibacterial activity (Okpe *et al.*, 2012; Anameze *et al.*, 2023; Iheukwumere *et al.*, 2025c; Iheukwumere *et al.*, 2025d). Plants, herbs and spices has been demonstrated to possess significant antioxidant properties in various studies suggesting its potential protective ability against oxidative stress and therefore play an important role in the chemo-prevention of diseases that have their etiology, progression and pathophysiology in reactive oxygen species (Ilechukwu *et al.*, 2014; Ilechukwu and Okafor, 2020; Ilechukwu, 2022; Ifemeje *et al.*, 2025).

Solanum aethiopicum (Garden egg leaf) is a vegetable crop belonging to the family *Solanaceae*. The genus *Solanum* includes both the edible and non-edible species. Garden egg leaves are native to West African and is predominately cultivated in Nigeria, grown and consumed more in the southern part of the country. The leaves of this garden egg are specific to the Bitter Eggplant which is known as ‘Mkpuru Anyara’ in Igbo. It is characterized by its small roundish nature, green in colour and has a bitter- sweet taste. There is debate on the specific species of garden egg. *Solanum aethiopicum* is suggested in some source (National Research Council of the National Academies, 2006), which includes types such as garden egg, scarlet eggplant, and gilo. Others suggest the species *Solanum. gilo* is synonymous to the *S. aethiopicum gilo* group (Danquah and Ofori, 2012). *Telfairia occidentalis* is widely cultivated for its palatable and nutritious leaves. The leaves when compared with other tropical vegetables have high nutritive value. Its protein content is higher than those of other commonly used leafy vegetables. The leaves are rich in vitamins and minerals such as calcium, phosphorous, iron, magnesium etc. the seed is also eaten as food. The oil obtained from the seed is used in cooking (Akaroda 1990).

Methodology

Reagents and Chemicals

All chemicals and reagents used were pure and of analytical grade and products of British Drug house (BDH), England; May and Baker, England; Sigma Aldrich, USA.

Plant material

The fresh leaves of *Solanum aethiopicum* and *Telfairia occidentalis* were purchased based from local market in Awka Anambra state, south east Nigeria. The samples were identified by Prof. C. Ukpaka a botanist in the department of Biological sciences Chukwuemeka Odumegwu Ojukwu University Anambra State Nigeria.

Preparation of sample and material

Plant samples were washed in tap water and rinsed with distilled water. It was allowed to dry with room temperature for 3 weeks and then pulverized and filtered through a sieve

(about 0.5mm pore size) to obtain a fine dry powder. The powdered sample were stored in the polythene bags and placed at room temperature until they were used. The glass wares used were washed with detergents, rinsed in distilled water and dried.

Extraction

One hundred gram (100g) of powdered sample were weighed into a beaker and 500ml of 70% methanol was added. It was continuously stirred and left to stand for 72 hours at room temperature to allow for extraction. The solution was filtered using Whatman filter paper and concentrated in water-bath. The extract obtained were stored in the refrigerator until required for use.

Qualitative Phytochemical Screening

Detection of Flavonoids

Ten (10ml) of each extracts (separately) were treated with few drops of sodium hydroxide solution. Formation of intense yellow colour, which becomes colorless on addition of dilute acid, indicates the presence of flavonoids.

Detection of Phenols (Ferric Chloride Test)

Extracts were treated with 3-4 drops of ferric chloride solution. Formation of bluish black color indicates the presence of phenols (Prashant *et al.*, 2011).

Detection of Tannins

A ml (1 ml) of the extract was added in a test tube followed by addition of tannic acid. The formation of white precipitate indicates the presence of tannins.

Test for Alkaloids (Wagner's Test)

2ml of the extract were treated with 1ml of Wagner's reagent in test tube. The formation of reddish- brown precipitate indicates the presence of alkaloids in the extract.

Detection of Saponins (Foam Test)

1ml of the concentrated extract was diluted to 5ml with distilled water and shaken vigorously. The formation 1cm layer of foam that persisted indicates the presence of saponins.

Test for Steroids: 1g of plant extract was dissolved in a few drops of acetic acid and a drop of conc. H₂SO₄ was added. The green colour indicated the presence of steroids.

Hydrogen Peroxide Scavenging Effects

The ability of the leaf samples to scavenge hydrogen peroxide was assessed by the method of Ruch *et al.* (1989).

A solution of H₂O₂ (40mM) was prepared in phosphate buffer. Leaf samples at the concentration of 10mg/10µl were added to solution H₂O₂ (0.6ml) and the total volume was made up to 3ml. The absorbance of the reaction mixture was recorded at 230nm in a spectrophotometer (Genesys 10-S, USA). A blank solution containing phosphate buffer, without H₂O₂ was prepared. The extent of H₂O₂ scavenging of the samples was calculated as

$$\% \text{ scavenging of hydrogen peroxide} = \frac{(A_0 - A_1) \times 100}{A_0}$$

A₀ - Absorbance of control

A₁ - Absorbance in the presence of sample

Measurement of Nitric Oxide Scavenging Activity

The extent of inhibition of nitric oxide radical generation *in vitro* was followed as per the method reported by Green *et al.* (1982). Sodium nitroprusside in aqueous solution, at physiological pH, spontaneously generates nitric oxide, which interacts with oxygen to produce nitrite ions that are estimated spectrophotometrically at 546nm. The reaction was initiated by adding 2.0ml of sodium nitroprusside, 0.5ml of PBS, 0.5ml of leaf samples (50mg) and incubated at 25°C for 30 minutes. Griess reagent (0.5ml) was added and incubated for another 30 minutes. Control tubes were prepared without the samples. The absorbance was read at 546nm against the reagent blank, in a spectrophotometer (Genesys 10-S, USA).

Statistical Analysis

The data obtained from the study were analyzed using one-way ANOVA with the Statistical Package for the Social Sciences (SPSS, version 23) and expressed as mean $\pm$ standard error of the mean (SEM). Differences between means were evaluated using Duncan's Multiple Range post hoc test.

Results and Discussion

There is an increase in the rate of searching for plant-derived drugs and dietary supplements in recent years. Scientists in the field of natural sciences are exploring the nature for natural plant products and phytochemicals that have therapeutic potentials which could help in the treatment of various

disorders/diseases. All plants produce chemical compounds as part of their normal metabolic activities. The qualitative phytochemical evaluation of aqueous leaf extract of *Telfairia occidentalis* and *Solanum aethiopicum* showed that both extracts are rich in alkaloids, phenols, saponins, glycosides, flavonoids and steroids (Table 1). Tannins is absent in *S. aethiopicum* but present in *T. occidentalis*. This is in conformity with work of Olugbenga *et al.* (2022); Obi and Davidson (2022); Anosike *et al.* (2012) which reported presence of similar phytochemical compound. These bioactive constituents are known to possess medicinal activity as well as physiological activity. Tannins are polyphenols that are obtained from various parts of different plants belonging to multiple species. They are usually found in larger quantity in the barks of trees where they act as blockage to bacteria and fungi and protect the cell. Tannins are well known for their antioxidant and anti-microbial properties, as well as for soothing relief, skin regeneration, anti-inflammatory and diuretics. Flavonoid belongs to the family of polyphenols. They are water insoluble and are found in most plant materials. Flavonoids are well known for their anti-oxidants, anti-carcinogenic, anti-microbial and anti-tumor properties. Epidemiological studies have demonstrated that heart diseases are inversely related to flavonoid intake. Studies have shown that flavonoids prevent the oxidation of low density lipoprotein thereby reducing the risk for the development of atherosclerosis.

Table 1: Qualitative Phytochemical Screening Results for methanol leaf extract of *T. occidentalis* and *S. aethiopicum*

Phytochemicals	<i>T. occidentalis</i> leaf	<i>S. aethiopicum</i> leaf
Alkaloids	+	+
Glycosides	+	+
Steroids	+	+
Terpenoids	+	+
Flavonoids	+	+
Tannins	+	-
Saponins	+	+

Key + represents present; - represent absent.

Hydrogen peroxide occurs naturally at low concentration levels in the air, water, human body, plants, microorganisms and food. H_2O_2 is rapidly decomposed into oxygen and water and this may produce hydroxyl radicals ($\bullet OH$) that can initiate lipid peroxidation and cause DNA damage. Methanol leaf

extract of *Telfairia occidentalis* (Table 2) efficiently scavenged hydrogen peroxide which may be attributed to the presence of phenolic groups and antioxidants that could donate electrons (Oladele *et al.*, 2017).

Table 2: H_2O_2 scavenging activity of methanol leaf extract of *T. occidentalis* and *S. aethiopicum*

Conc. In $\mu g/ml$	% scavenging activity of <i>T. occidentalis</i>	% scavenging activity of <i>S. aethiopicum</i>	% scavenging activity of ascorbic acid
50	44.28 $\pm$ 0.30	40.23 $\pm$ 0.14	62.41 $\pm$ 0.11
100	55.35 $\pm$ 0.12	51.36 $\pm$ 0.20	69.29 $\pm$ 0.25
150	64.14 $\pm$ 0.25	62.24 $\pm$ 0.15	75.08 $\pm$ 0.18
200	75.45 $\pm$ 0.14	69.41 $\pm$ 0.18	80.28 $\pm$ 0.23
250	82.31 $\pm$ 0.12	75.33 $\pm$ 0.22	88.35 $\pm$ 0.16

Values are expressed as mean $\pm$ SD (n=3).

The methanol leaf extract of *Telfairia occidentalis* and *Solanum aethiopicum* exhibited good NO mitigating potentials (Table 3). Scavenging activity leading to the reduction of the nitrite concentration in the assay medium. The toxicity of NO increases when it reacts with superoxide to form the

peroxynitrite anion (ONOO⁻), which is a potential strong oxidant that can decompose to produce $^{\circ}OH$ and NO_2 .

The extent of inhibition of nitric oxide radical generation *in vitro* was measured spectrophotometrically and the result

showed that *Telfairia occidentalis* and *Solanum aethiopicum* (2018) which demonstrated similar dose dependent effect. *Telfairia occidentalis* was able to inhibit nitric oxide generation in a dose dependent manner. This is in conformity with the works of Wopara *et al.* *Telfairia occidentalis* was able to inhibit nitric oxide generation more than *Solanum aethiopicum*.

Table 3: Nitric oxide scavenging activity of Methanol leaf extract of *Telfairia occidentalis* and *Solanum aethiopicum*.

Conc. In µg/ml	% scavenging activity of <i>T. occidentalis</i>	% scavenging activity of <i>S. aethiopicum</i>	% scavenging activity of ascorbic acid
50	38.20 ± 0.32	36.20 ± 0.12	41.32 ± 0.15
100	46.26 ± 0.28	43.33 ± 0.19	56.20 ± 0.12
150	57.32 ± 0.33	52.27 ± 0.08	62.30 ± 0.21
200	68.26 ± 0.18	63.45 ± 0.22	75.26 ± 0.13
250	80.39 ± 0.14	74.35 ± 0.14	84.20 ± 0.08

Values are expressed as mean ± SD(n=3)

Conclusion

This research work studied the phytochemical and in vitro antioxidants activity of two common green leafy vegetables found in Nigeria (*T. occidentalis* and *S. aethiopicum*). The results revealed that the *T. Occidentalis* has higher nutritional values than *Solanum aethiopicum*. The phytochemical analysis also revealed that the samples contain active chemical compounds at different levels such as alkaloids, saponins, flavonoids, terpenoids, glycosides, steroids and tannins which is absent in *Solanum aethiopicum*. From the Nitric oxide and hydrogen peroxide scavenging activity determinations, it can be deduced that *T. Occidentalis* has higher antioxidant activity than *S. aethiopicum*. The two African vegetables have been shown to be nutritionally and therapeutically valuable and they have the potential of providing precursors for the synthesis of useful drugs.

Conflict of interests: The authors declare no conflict of interests.

Authors Contributions: All authors contributed towards the study design, experiment execution, data analysis, and manuscript drafting.

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Impact of Pre-Sowing Physical Treatments on The Seed Germination Behaviour of Sorghum (*Sorghum bicolor*)

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