



Research Article

Phytochemical Screening and Nutritional Compositions of
Solanum angivi (LAM) Fruit from Northeastern Nigeria Yobe
State

Musbau, S¹, Asiru, R.A.² and Hamma, A.B.³

¹Department of Microbiology, Yobe State University, Damaturu, Yobe State, Nigeria

²Department of Microbiology, Bayero University Kano Nigeria

³Department of General Studies, Shehu Sule College of Nursing and Midwifery, Damaturu, Yobe State, Nigeria

*Corresponding author's Email: mustee6@gmail.com, doi.org/10.55639/607.02010009

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ABSTRACT

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Some plants and their fruits are important sources of protein and minerals. Some of them even have traditionally recognized medicinal properties. Hence, the present study aimed to evaluate the proximate, mineral, and phytochemical composition of the fruits of *S. angivi*. The fruits of this plant were collected and subjected to nutritional and phytochemical investigation. Qualitative and Quantitative phytochemical screening of the aqueous, and chloroform extracts of *S. angivi* L. for different bioactive compounds show the presence of alkaloids, flavonoids, tannins, saponins, phenols, steroids, glycosides, anthocyanin and triterpenoids which was found present in chloroform extraction but absent in water extraction. However, chloroform extraction shows the highest percentage yield quantitatively. The proximate analysis shows the Moisture content of fresh *S. angivi* L. fruit to be (74.2 ± 0.1%). Ash content (15.22±0.04%), Crude Fat (4.20±0.01%), Crude protein (24.14±0.05%), Crude fiber (19.234±0.05%), and Carbohydrate to be (39.00±0.04%). Analysis of the mineral composition of *S. angivi* L. shows that it is a good source of Potassium, Calcium, Sodium, Magnesium, Phosphorous, Iron, Copper, and Zinc all of which are nontoxic to man when taken at moderate and recommended doses. The study concluded that the fruits of *S. angivi* L. are nutritionally rich, can offer a natural solution to dietary deficiencies, and are medically important in treating some diseases.

Corresponding author: Musbau S., **Email:** mustee6@gmail.com

Department of Microbiology, Yobe State University, Damaturu, Yobe State, Nigeria

1.0 INTRODUCTION

Plants are an essential resource of conventional medicines used against different ailments. Rural people with centuries-old traditional knowledge transferred from generation to generation still rely on plant resources for various purposes, such as food, fodder, and medicines (Dike, 2010). The increasing global focus on nutrition and health has increased interest in underutilized crops' nutritional quality and bioactive components. Among these is *Solanum anguivi*, commonly known as the African eggplant or forest bitter berry, whose Hausa name is "Gautan Tsunsu". It has garnered attention for its potential health benefits and nutritional value. Indigenous to various African regions, this plant is traditionally consumed for its unique taste and purported medicinal properties. A quantitative analysis of the diverse phytochemicals present in fruits is essential for tackling challenges associated with chronic diseases. Research has shown that these phytochemicals can provide protective benefits against various ailments. It is widely acknowledged that a diet abundant in fruits, vegetables, grains, and legumes can lower the risk of conditions such as cancer, heart disease, hypertension, diabetes, and obesity (Uruquiaga & Leighton, 2000).

Recent research has underscored this crop's impressive array of essential nutrients and bioactive compounds, marking it as a significant player in enhancing dietary diversity and combatting nutritional deficiencies (Adeniji *et al.*, 2023). These studies have revealed that the crop is rich in vitamins and minerals and contains phytochemicals that may contribute to various health benefits. In light of this growing body of evidence, there has been a notable shift in consumer awareness regarding fruits and vegetables' nutritional and medicinal properties. As a result, plant breeders are increasingly directing their efforts towards improving the chemical composition of these crops. This focus aims to optimize their health benefits, responding to consumer demand for more nutrient-dense food options (Agnieszka, 2007). Solanaceae is a plant family comprising about 2300 species, nearly one-half of which belong to the genus *Solanum* (Zhu *et al.*, 2000). The fruit is used in folklore medicine to treat high blood pressure, and roots are helpful in the treatment

of cough, ulcers, asthma, nervous disorder, and fever (Daramola *et al.*, 2011). The berries of *S. anguivi* L. can be consumed fresh, semi-ripe, ripe, dried, or ground into flour. *S. anguivi* L. berries are mainly characterized by their bitterness due to various phenolic compounds conferring their antioxidant properties (Adeyeye *et al.*, 2006). Some researchers investigated the proximate and nutritional composition of five different *Solanum* species commonly found in Nigeria (Adanlawo *et al.*, 2008). Despite the tremendous nutritional value and medicinal importance of *S. anguivi* fruits, more information is needed on the nutritional and phytochemical investigation of *S. anguivi* L. fruits in Yobe State. Hence, the present study aimed to evaluate the proximate, mineral, and phytochemical composition of the fruits of *S. anguivi*.

2.0 MATERIAL AND METHODS

2.1 Plant Materials

Fresh green fruits of *Solanum anguivi* L. were purchased from the Damaturu market. The Biological Science Department at Yobe State University identified and authenticated the fruits and gave a herbarium number YSUH 208. The fruits were thoroughly washed with distilled water and used for analysis.

2.2 Preparation of Extracts

The fresh fruit was crushed and immersed in water, and chloroform solution in a 100ml flat bottom flask and was macerated for one week respectively to separate the bioactive components. The collected extract was filtered and used for the qualitative phytochemical analysis (Oyeyemi *et al.*, 2015).

2.3 Phytochemical Screening

2.3.1 Test for Alkaloids: To a few ml of filtrate, a drop or 2 ml of Mayer's reagent was added by the side of the test tube. A white or creamy precipitate indicated the test as positive.

2.3.2 Test for Flavonoids: The filtrate of 1 ml was mixed with 2 ml of 2% solution of NaOH. An intense yellow color was formed which turned colorless on the addition of a few drops of diluted hydrochloric acid which indicated the presence of flavonoids.

2.3.3 Test for Phenolic Compounds: To 1ml of the filtrate, a few ml of 1% lead acetate solution was added and the formation of a precipitate

indicates the presence of tannins and phenolic compounds.

2.3.4 Test for Tannin: The filtrate of 1 ml was mixed with 2 ml of 2% solution of FeCl₃. Blue-green or black coloration indicated the presence of tannin.

2.3.5 Test for Saponin: 1 ml of filtrate was diluted with 20 ml of distilled water and shaken well in a graduated cylinder for 15 mins. The formation of foam to a length of 1cm indicated the presence of saponin.

2.3.6 Test for Steroids: The filtrate of 1ml was mixed with 2ml of chloroform and concentrated sulfuric acid was added sidewise. A red color produced in the lower chloroform layer indicated the presence of steroids.

2.3.7 Test for Glycosides: To a few ml of filtrate, 1ml of water and then diluted NaOH solution were added. Formation of yellow color indicates the presence of glycosides.

2.3.8 Test for Anthocyanin: One ml of filtrate, 2 ml of 2N HCL, and 2 ml of ammonia were mixed. The initial appearance of pink-red color

turning into blue-violet indicates the presence of anthocyanin.

2.3.9 Test for Triterpenoids: To 1ml of filtrate, 2ml of trichloroacetic acid was added. The formation of a red color precipitate indicates the presence of triterpenoids.

2.4 Nutritional Composition Analysis

Proximate composition (moisture, crude protein, crude fat, ash, and crude fiber) was determined by the standard methods of the Association of Official Analytical Chemists (AOAC, 2023). Moisture content was determined by drying 2g of the sample to a constant weight in a crucible placed inside an oven at a temperature of 105°C. Ash content was determined by igniting one gram sample in a muffle furnace maintained at 550°C for 5 hr. The protein content was calculated by multiplying the total organic nitrogen by 6.25 to convert it to crude protein. Crude Fat was obtained by extracting 5g of the sample in a Soxhlet apparatus using petroleum ether as solvent with a boiling range of 60-80°C. Fiber and Carbohydrate content was determined by calculation equation respectively.

$\% \text{Total Carbohydrate} = [100 - \% (\text{Protein} + \text{Fat} + \text{Moisture} + \text{Ash} + \text{Fiber})]$.
(Oyeyemi *et al.*, 2015)

Each analysis was carried out in triplicate. Minerals such as Copper, Calcium, Potassium, Sodium, Iron, Zinc, Phosphorus, and Manganese were determined by an atomic absorption spectrophotometer (AA-6300 Thermo Fisher) using an air-acetylene flame.

3.0 RESULTS AND DISCUSSIONS

Phytochemical screening of the aqueous and chloroform extracts of *S. anguivi* L. for various bioactive compounds revealed the presence of alkaloids, flavonoids, tannins, saponins, phenols, steroids, glycosides, anthocyanin, and triterpenoids. Notably, triterpenoids were found in the chloroform extract but were absent in the aqueous extract (Table 1). A white, creamy precipitate indicates the presence of alkaloids; a yellow coloration signifies flavonoids; and a dark green coloration points to tannins and phenols. Stable foam formation suggests the presence of saponins, while the appearance of a red color in the upper layer alongside a yellow color in the lower layer indicates steroids. A red

precipitate denotes triterpenoids, and a mild brown ring shows the presence of glycosides in both extracts.

Quantitative phytochemical analysis demonstrates that solvent extraction yields more bioactive components than aqueous extraction. This could be attributed to the enhanced extraction capacity of organic solvents compared to water. Similar findings were reported by Oyeyemi *et al.* (2015), where all phytochemical compounds were detected except for glycosides in *S. anguivi* L. The variations in phytochemical compounds may be due to varietal differences and the geographical distribution of the Solanum family.

The bioactive components identified in *S. anguivi* L. have potential medicinal properties, including antimicrobial, antitumor, anti-inflammatory, liver protection, and metabolic regulation. Including these components in the diet may enhance immune function (Xiang *et al.*, 2021).

Table 1: Qualitative phytochemical screening of *S. anguivi*.L fruit

S. No.	Parameters	Fruit Extract	
		<i>Water</i>	<i>Chloroform</i>
1.	Alkaloids	++	++
2.	Flavonoids	++	++
3.	Tannin	++	++
4.	Saponins	++	++
5.	Steroid	++	++
6.	Glycosides	++	++
7.	Phenols	++	++
8.	Anthocyanin	+	+
9.	Triterpenoids	-	+

Key= ++ (moderate), + (slightly present/trace), and – (absent)

Table 2: Quantitative phytochemical screening of *S. anguivi* L. fruit

S/No.	Parameters	Fruit Extract	
		<i>Water</i>	<i>Chloroform</i>
1.	Alkaloids	0.06±0.1	0.83±0.1
2.	Flavonoids	0.13±0.3	0.58±0.3
3.	Tannin	0.06±0.1	0.18±0.1
4.	Saponins	1.07±0.2	2.34±0.2
5.	Steroid	0.49±0.2	1.69±0.2
6.	Glycosides	1.57±0.1	2.09±0.1
7.	Phenols	1.26±0.6	2.17±0.6
8.	Anthocyanin	Not detected	0.25±0.1
9.	Triterpenoids	0.13±0.1	0.17±0.1

The moisture content of fresh *S. anguivi* L. fruit was measured at (74.2 ± 0.1%). This figure is lower than the findings of Adeyeye *et al.* (2006), who reported a moisture content of 91.9% in *S. anguivi* L. fruit, and Denis *et al.* (2010), who noted 87% in *Solanum indica* fruit. This variation may be influenced by factors such as climate and soil composition of the collection site, the type and variety of the fruit, and the storage conditions. Fruits that are high in water content and rich in vitamins, minerals, and fiber can nourish the body while helping to replenish lost fluids. The obtained result on ash content on

a dry basis (15.22±0.04%) was higher than the content reported by Adedeye *et al.* (2006) (8.7%); Oyeyemi *et al.* (2014) (8.89%); Dan *et al.* (2014) (6.9%) in *S. anguivi* L. fruit. Ash content is a reflection that the fruits are rich in mineral elements.

The proximate composition on a dry basis such as carbohydrate (39.00±0.4%), protein (24.14±0.05%), and fat (4.20±0.01%) of *S. anguivi* L. Adeyeye *et al.* (2006); reported a lower concentration of carbohydrate, protein, and fat in *S. anguivi* L (23.3%; 5.4%; 3.6%) respectively. Although the obtained result on

proximate composition was found to be lower than the report of Ali (2012) reported that the crude fat content in *Solanum indica* fruit is $40.67\pm 0.68\%$, $25.47\pm 0.27\%$, and $5.26\pm 0.50\%$. The protein content of the investigated eggplant fruits was $24.14\pm 0.05\%$, indicating that they are a good source of protein and can meet the recommended daily requirements for humans. The low-fat content observed in *S. anguivi* L. ($4.20\pm 0.01\%$) may help prevent constipation and colon cancer. While crude lipids are a major energy source, their consumption should be moderated to avoid obesity and related

cardiovascular diseases. This fruit's low crude fat content further supports its potential to prevent constipation and colon cancer. Additionally, the high fiber content of *S. anguivi* L. fruit ($19.234\pm 0.05\%$) classifies it as a fiber-rich vegetable, which could be beneficial in treating various conditions, including obesity, diabetes, cancer, and abdominal disorders. The fiber content in *S. anguivi* L. fruit is higher than the findings of Dan *et al.* (2014), $11.8\pm 0.7\%$, and 15.5% of Adeyeye *et al.* (2006), as reported for the same species (Table 3).

Table 3: Proximate Composition of *S. anguivi* L. fruit

S. No.	Constituents	Percentage composition (%)
1.	Moisture content	74.21 ± 0.1
2.	Ash content	15.22 ± 0.04
3.	Crude Fat	4.20 ± 0.01
4.	Crude Protein	24.14 ± 0.05
5.	Crude fibre	19.23 ± 0.05
6.	Carbohydrate	39.00 ± 0.04

%Total Carbohydrate = $[100 - \% (\text{Protein} + \text{Fat} + \text{Moisture} + \text{Ash} + \text{Fiber})]$.

(Oyeyemi *et al.*, 2015)

The results of the mineral composition revealed that *S. anguivi* L fruits constitute a good source of potassium (501.13 ± 2.03 mg), calcium (365.20 ± 2.14 mg), sodium (360.11 ± 2.14 mg), magnesium (255.01 ± 0.11 mg), phosphorus (249.01 ± 1.02 mg), Iron (41.16 ± 0.02 mg), copper (20.45 ± 0.12 mg), Zinc (6.56 ± 0.12 mg) and manganese (2.58 ± 0.12 mg), as presented in Table 4. The obtained result was higher than the content reported by Adeyeye *et al.* (2006); Dan *et al.* (2014) and Oyeyemi *et al.* (2015).

Table 4: Mineral Composition of *S. anguivi* L. fruit

S/No.	Constituents (mg)	Percentage composition (%)
1.	Potassium	501.13 ± 2.03
2.	Calcium	365.20 ± 0.17
3.	Sodium	360.11 ± 2.14
4.	Magnesium	255.01 ± 0.11
5.	Phosphorus	249.01 ± 1.02
6.	Iron	41.16 ± 0.02
7.	Copper	20.45 ± 0.12
8.	Zinc	6.56 ± 0.12
9.	Manganese	2.58 ± 0.12

4.0 CONCLUSION

The presence of bioactive phytochemicals and essential minerals in *S. anguivi* L. fruits supports their medicinal use. These fruits are rich in nutrients, providing a natural solution for addressing dietary deficiencies and promoting overall well-being. Therefore, it is important to encourage the consumption and cultivation of these lesser-known eggplants, particularly in Yobe State and across Nigeria.

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