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Impact of Extracts from Fluted Pumpkin (*Telfairia occidentalis*) Leaves on Antimicrobial and Antioxidant Properties

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Abstract: This study aimed to evaluate the impact of solvent extracts from Fluted psumpkin leaves (*Telfairia occidentalis*) sold in Idah, Nigeria, on antimicrobial and antioxidant properties. Maceration extraction method was used to extract the powdered plant sample using different solvents (acetone, ethanol, methanol, and water). The 2, 2-diphenyl-1-picrylhydrazyl (DPPH) assay and agar disc diffusion method were employed to screen the plant extracts for their antioxidant and antimicrobial properties, respectively. Ascorbic acid was used as a standard for the antioxidant activity, while Gentamycin and Nystatin antibiotics were used as positive controls for bacterial and fungal susceptibility bioassays. The findings of this study showed that all the solvent extracts of fluted pumpkin (*Telfairia occidentalis*) had strong antioxidant properties, with the extract from methanol exhibiting the highest antioxidant activity with the lowest IC_{50} value of 72.96 µg/ml, this was followed by the ethanol extract (IC_{50} = 75.20 µg/ml), acetone extract (IC_{50} = 125.57 µg/ml), and then the water extract with an IC_{50} value of 142.49 µg/ml. Ascorbic acid standard produced an IC_{50} value of 14.77 µg/ml. All the extracts also showed very good antibacterial and antifungal activities against the bacterial and fungal isolates tested (*Staphylococcus aureus, Escherichia coli*, *Aspergillus niger*, and *Aspergillus flavus*) which generally increased with increase in concentration of the extracts. This study showed that the fluted pumpkin leaves are excellent antioxidant and antimicrobial agents.

1. Introduction

Worldwide, resistance to antimicrobial agents and oxidative stress is posing public human health problems, leading to lengthening of patients' sickness, elongation of patients' hospital stays, increasing the risk of disease spreading, and in most cases raising mortality rates (Pingali *et al*., 2018; Kabir and Lawan, 2025). The availability and affordability of many commonly given antibiotics around the world have been further jeopardized by the rise of multidrug-resistant bacteria (Falcone and Paterson, 2016, Van, 2017). Consequently, it raises morbidity, mortality, and medical expenses while decreasing the efficacy of treatment plans (Opperman and Nguyen, 2015). There is an inadequate research and development pipeline in the face of escalating levels of antibiotic resistance, and there is an urgent need for additional steps to provide fair access to novel and existing antibiotics, diagnostics, and medications (Danjuma *et al*., 2025). Since ancient times, people have used natural remedies to

improve their health, and contemporary medicine has relied heavily on medications derived from natural sources. Many antimicrobial substances have previously been found in both natural and synthetic products for the treatment and management of infectious pathogens (Chohan *et al.,* 2010; Shriram *et al*., 2018; Ouahhoud *et al*., 2022; Yarmolinsky *et al*., 2024). Therefore, more research is urgently needed to tackle these problems worldwide.

Due to the unparalleled chemical diversity of medicinal plants, natural products derived from them, whether in the form of pure compounds or standardized extracts, offer countless opportunities for new therapeutic leads (Mamta *et al.,* 2023). Usually, secondary metabolites, natural compounds, are created by microbes and plants in reaction to outside stimuli like dietary modifications. Because of their exceptional structural diversity and diverse pharmacological effects, they are widely used in the pharmaceutical industry (Mohamed *et al.,* 2018). Interest in edible plants, particularly, has increased globally due to growing demand for chemical diversity in screening programs and the search for therapeutic drugs from natural products (Danjuma *et al*., 2024).

Radiation exposure, specific environmental contaminants, and byproducts of regular metabolism all cause the body to create free radicals, which are harmful to the human body system. Because of their highly reactive nature, they can harm cell components and induce a variety of disorders (Pingali *et al*., 2018). Free radicals are neutralized by different types of systems in the body which include antioxidant enzymes like glutathione peroxidase, catalase, and superoxide dismutase, and small molecules of nutrient-derived antioxidant (vitamin C, flavonoids, vitamin E, carotenes, glutathione, taurine, and uric acid (Vana, 2017). A delicate balance exists between antioxidants and free radicals in healthy individuals (Bouammali *et al*., 2024; Mrani *et al.,* 2024). The pathophysiology of diabetes, liver damage, nephrotoxicity, inflammation, cancer, cardiovascular diseases, neurological disorders, and aging has all been linked to free radicals (Deborah, 2017). Research efforts are being dedicated to the use of herbal medications for the treatment and management of various diseases because of their low cost, high efficacy, non-narcotic nature, and reduced adverse effects (Loukili *et al*., 2022; Ouandaogo *et al*., 2023; Diass *et al*., 2023; Godwin *et al*., 2024).

Because of their characteristics, antioxidants, whether, synthetic or natural chemicals can prevent oxidative stress and slow down the oxidation of proteins, DNA, and lipids (Luo *et al*., 2020). When the production of these dangerous free radicals surpasses the antioxidant defenses' ability to protect, oxidative stress occurs (Hossaini *et al*., 2021). When reactive species, mostly reactive oxygen species (ROS), assault the cells and tissues of living things, oxidative stress results in biomolecular damage (Sisi *et al*., 2015; Andrisic *et al.,* 2018). The physiopathology of numerous illnesses, including cancer, atherosclerosis, cardiovascular, metabolic, and neurodegenerative diseases, as well as brain aging, is linked to this oxidative damage (Poprac *et al.,* 2017). Many foods and drinks naturally contain antioxidants, which aid in preventing cellular damage brought on by free radicals, which is linked to conditions including cancer and heart disease (Sharaddha *et al.,* 2025).

As a member of the cucurbitaceae family, *Telfairia occidentalis* is a plant with dark green leaves that also produces a pod of edible seeds. It is widely grown throughout Western Africa and is of great commercial significance in eastern Nigeria. Fluted pumpkin is known by different names in different languages and countries. The English names of *Telfairia occidentalis* are Fluted pumpkin, oyster nut, oil nut, fluted gourd and Telfairia nut; It is called Costillada in Spanish, Krobonko in Ghana, Oroko, pondokoko and Gonugbe in Sierra Leone, Ugwu in Igbo-Nigeria, Aworoko or Eweroko in Yoruba-Nigeria, and Ikong by the Efik/Ibibio-Nigeria (Eseyin *et al*., 2024). Characterized by broad lobed leaves, *Telfairia Occidentalis* is culinary used for cooking stews, soups, yam and vegetables, sauces and even for medicinal purposes. When cultivated, *Telfairia Occidentalis* develops tendrils that usually

creep and spread on the surface of the ground. Ugwu leaves are rich in dietary properties like calcium, iron, potassium, and manganese. The leaf is a very rich source of fiber, minerals, vitamin A, B2, C2 and E; it is also packed with antioxidant properties to protect the body against disease (Desire *et al.,* 2022).

The nutritional value of *Telfairia occidentalis* leaves have been reported and documented in the literature and is widely consumed in Idah, Kogi State and other parts of Nigeria and even throughout the Sub-Saharan Africa. But despite the wide traditional applications of *Telfairia occidentalis* as food and medicines, there are scanty findings in the literature as regard to the bioactivity study of the plant (Desire *et al.,* 2022). Therefore, this study aims to evaluate the impact of extracts from *Telfairia occidentalis* leaves sold in Idah on antimicrobial and antioxidant properties.

Figure 1: Sample leaves of Fluted Pumpkin

2. Methodology

2.1 *Sourcing and preparation of Fluted Pumpkin leaf Samples*

In this study, the fresh and healthy leaves of *Telfairia occidentalis* were purchased from vegetable vendors selling vegetables by the road side opposite second gate of the Federal Polytechnic Idah, Kogi State Nigeria. Idah Local Government is located about 104 km away from Lokoja, the capital of Kogi State, and 305 km away from the Nigeria's capital city of Abuja in the north central Nigeria. The collected leaf samples were handled with utmost care by wrapping them in suitable a plastic sheet to avoid contamination before transporting them to the laboratory for analysis. Authentication of the plant sample was carried out by Botany unit of the Department of Science Laboratory Technology and the samples deposited in the Chemistry Laboratory, Department of Science Laboratory Technology, Federal Polytechnic Idah, Kogi State, Nigeria (Danjuma *et al*., 2025).

2.2 Extraction of the plant sample

The collected plant leaf samples of fluted pumpkin were washed thoroughly using running tap water followed by subsequent rinsing in distilled water before air-drying them at room temperature under shade and then grounded into powder using laboratory mortar and pestle. The powdered plant materials were packed in a dried and air-tight plastic bag and kept until extraction. A total of 300 g of powdered plant materials were weighed by sensitive digital weighing balance. The weighed powdered sample was macerated with 95 % ethanol in a 1500 mL Erlenmeyer flask for two days at room temperature with occasional agitation and shaking. The extract was separated from the marc using gauze and the resulting liquid was filtered using Whatman filter paper No. 1. The filtrate was freeze-dried completely to obtain crude ethanol extract. This extraction procedure was separately repeated for

methanol, acetone, and water solvents to obtain crude methanol, acetone, and water extracts. The extracts were kept in suitable containers before the analysis began (Kebede *et al*., 2021; Danjuma *et al*., 2024).

2.3 DPPH Radical Scavenging Assay

The modified method of Danjuma *et al.* (2024) was employed for the DPPH radical scavenging assay. Concentrations of 1000 µg/ml, 500 µg/ml, 250 µg/ml, 125 µg/ml, 62.5 µg/ml, 31.2 µg/ml, 15.6 µg/ml, and 7.8 µg/ml were prepared from the stock solution of the extracts using serial dilution. One milliliter of the aliquot from each of the extracts in a tube was added separately with 4 mL of DPPH solution. Subsequently, the tubes were swirled and allowed to stand in the dark for about 30 minutes and the absorbance of the mixtures was taken using a T60 U Spectrophotometer at 517 nanometer. Ascorbic acid was used as a positive control, while an aliquot-free DPPH solution was used as a control, and the results were expressed in percentage. The following equation was used to estimate the DPPH radical scavenging activity (Hossain *et al*., 2021; Bouslamti *et al*., 2023; Danjuma *et al*., 2024).

$$\text{Percent Inhibition (\%)} = \frac{\text{Absorbance of Control} - \text{Absorbance of Sample}}{\text{Absorbance of Control}} \times 100 \quad (1)$$

2.4 Antimicrobial Screening

2.4.1 Source of Microorganisms

The microorganisms used in this study were two bacteria (*Escherichia coli* and *Styphylococcus aureus*) and two fungi (*Aspergillus niger* and *Aspergillus flavus*) collected from the Microbiology department, Federal Polytechnic Idah, Nigeria.

2.4.2 Bioassay Procedure

The disc diffusion method was employed. The Nutrient Agar (NA) and Potato Dextrose Agar (PDA) were used for bacterial and fungal testing, respectively. The media were prepared according to the manufacturers' instructions. The prepared plates containing the media were dried for about 20 minutes to remove excess moisture formed at the surface of the agar medium. Standard inoculums of the isolates were swabbed on to the surface of prepared and solidified agar. The prepared extract disc containing different concentration of the plant and standard antibiotics (4000 µg/ml, 2000 µg/ml, 1000 µg/ml, and 500 µg/ml) were placed into the surface of the inoculated media at interval in order to prevent any form of mixing and interference of inhibition zones. The plates were inoculated at 37^0C for 24 hours. Gentamycin and Nystatin were used as controls for bacterial and fungal testing, respectively. The plates were observed for growth and the inhibition zone was measured using a ruler (Kebede *et al.,* 2021; Danjuma *et al*., 2025).

3. Results and Discussion

3.1 Antioxidant Properties

Tables 1, Table 2 and **Figure 2** showed the DPPH radical scavenging activity of the extracts in this study. The findings showed that all the extracts demonstrated a free-radical scavenging capacity and the extract obtained with methanol showed the highest antioxidant activity (IC50 = 72.96 µg/ml). The second extract with antioxidant activity was ethanol (IC50 = 75.20 µg/ml), followed by acetone (IC50 = 125.57 µg/ml), and then water (IC50 = 142.49 µg/ml). Afrizal *et al.,* (2021) believed that the antioxidant activity of a substance is considered very high if the IC50 values are lower than 50 µg/ml, and strong if the IC50 values fall between the range of 50 to 100 µg/ml, moderate if the IC50 values

fall between 101 and 250 µg/ml, and inactive if the IC50 values are greater than 500 µg/ml. Therefore, based on the IC50 values of the extracts presented in table 2, all the leaf extracts of *telfairia occidentalis* in this study were strong antioxidants. A study by Olukemi *et al* (2016) found that the DPPH radical scavenging assay of methanol extract of *Telfairia occidentalis* showed significant activity in a concentration dependent manner. They concluded that the antioxidant potential of this *Telfairia occidentalis* is mainly due to the presence of phenolic compounds which were found in the plant.

Table 1: Absorbance of the extracts and the standard. The absorbance of control was 0.815

	Extracts				
Conc. (µg/ml)	**Methanol**	**Ethanol**	**Acetone**	**Water**	**Ascorbic Acid**
1000	0.1113	0.1669	0.1548	0.2517	0.0101
500	0.1508	0.2092	0.1818	0.2852	0.0149
250	0.2119	0.2643	0.2508	0.3469	0.0244
125	0.2803	0.3505	0.3057	0.4808	0.0281
62.5	0.4156	0.4069	0.4072	0.5446	0.0349
31.25	0.4881	0.4543	0.4242	0.5732	0.0392
15.62	0.5246	0.5687	0.4890	0.6513	0.0457
7.81	0.6636	0.6407	0.5091	0.6770	0.1043

The antioxidant property is influenced by the amount and sequence of hydroxyl groups on the aromatic ring. It is widely agreed that the ability to donate hydrogen and prevent oxidation improves as the number of hydroxyl groups on the phenolic ring increases. Phenolic compounds represent a highly diverse class of phytochemicals, which are abundantly present in plants such as fruits, vegetables, tea, olive oil, and tobacco. In recent times, there has been increasing interest in substances with antioxidant properties, either as components of food or as targeted preventive pharmaceuticals. As a result, antioxidants have become indispensable in food preservation technology and modern healthcare. Plants with antioxidative and pharmacological attributes are widely recognized for their phenolic compounds, particularly phenolic acids and flavonoids. The effective discovery of natural antioxidant sources requires reliable methods for evaluating antioxidant activity (Sharaddha *et al*., 2025).

Table 2: Percent inhibitions (in %) of the extracts and the standard

	Conc. (µg/ml)								
Extracts	**1000**	**500**	**250**	**125**	**62.50**	**31.25**	**15.62**	**7.81**	**IC50 (µg/ml)**
Ascorbic acid	98.76	98.16	97.00	96.54	95.71	95.18	94.13	87.20	14.77
Methanol	86.34	81.49	74.00	65.60	49.00	40.11	35.62	18.57	72.96
Ethanol	79.51	74.33	67.56	56.99	50.07	44.25	30.22	21.38	75.20
Acetone	81.00	77.69	69.22	62.48	50.03	47.94	40.00	37.53	125.57
Water	69.11	65.00	57.43	41.00	33.17	29.66	20.08	16.93	142.49

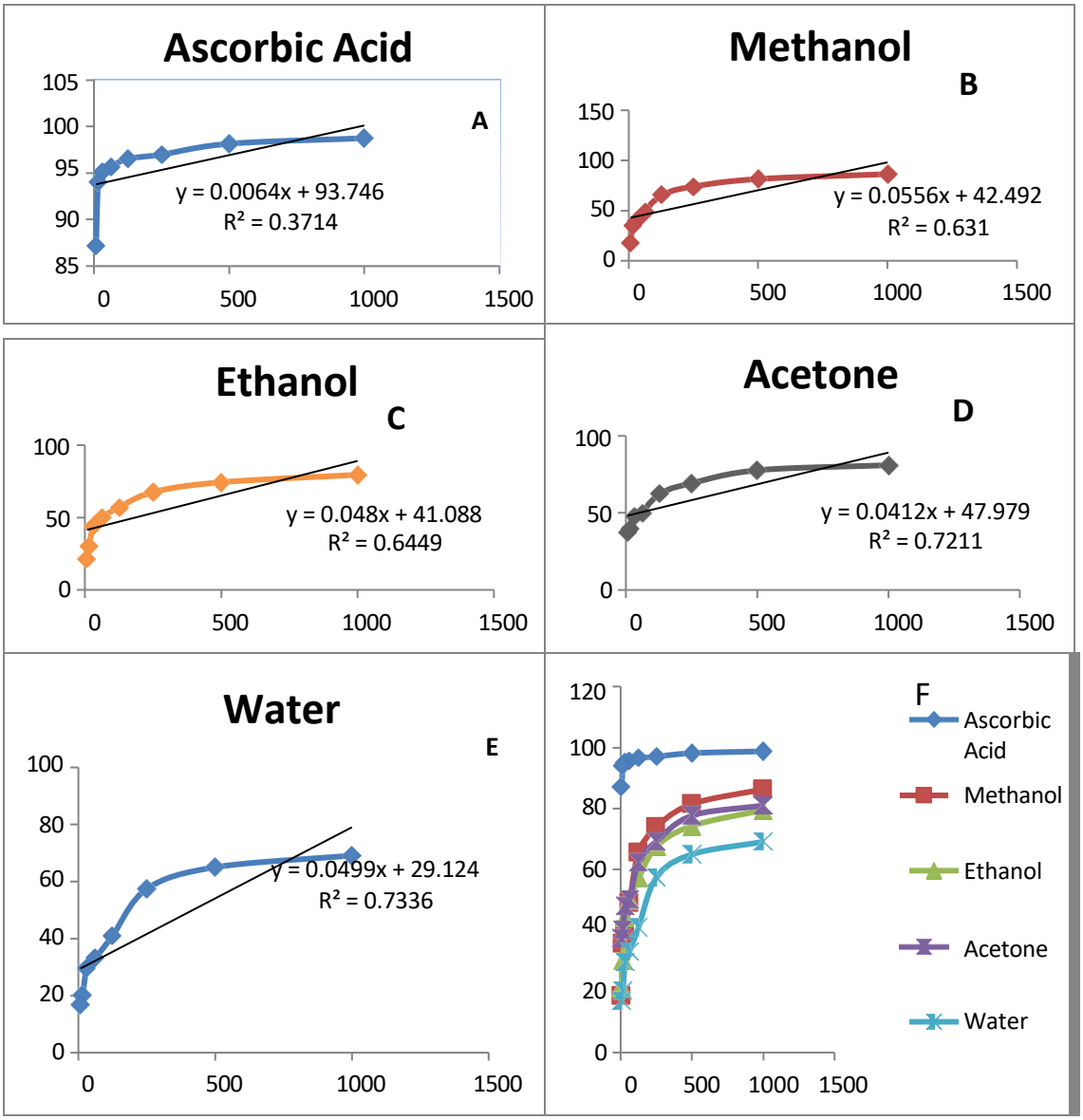

Figure 2: Absorbance of the extracts and the standard

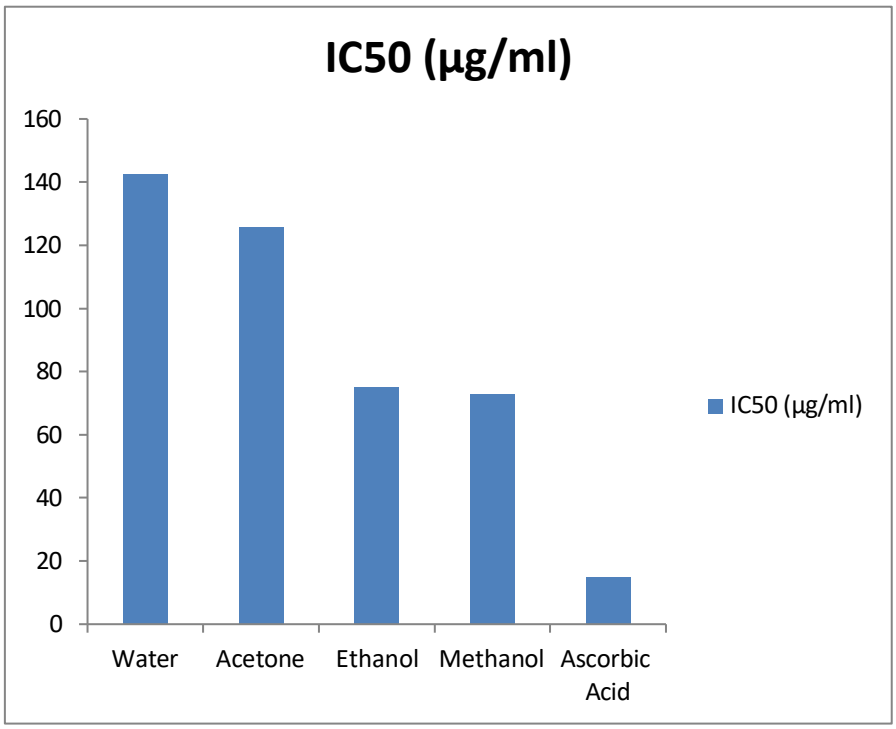

Figure 3: IC50 of the extracts and the standard

Figure 3 showed that the DPPH radical scavenging effect of *T. occidentalis* increased in the order of ascorbic acid < methanol extract < ethanol extract < acetone extract < water extract. The DPPH is a free radical due to presence of spare electron that decolorizes the entire molecule. The synthesis of 2,2-diphenyl-1-picrylhydrazyn, which has a yellow appearance, caused the DPPH to appear less violet when the antioxidant proton was donated to it (Bhat and Rajanna, 2017).

4. 2Antimicrobial Activity of the Extracts of *Telfairia occidentalis*

Table 3: Antibacterial activity of the leaf extracts of *T. occidentalis*. Gentamycin zone of inhibition = 20 mm for both *S. aureus* and *E. coli*

Extracts	Microorganisms	Conc. µg/ml			
		4000	2000	1000	500
Acetone	*S. aureus*	17	13	11	10
	E. coli	10	09	09	07
Ethanol	*S. aureus*	09	08	05	03
	E. coli	10	07	06	04
Methanol	*S. aureus*	11	10	09	08
	E. coli	13	11	09	07
Water	*S. aureus*	14	12	10	08
	E. coli	13	11	09	05

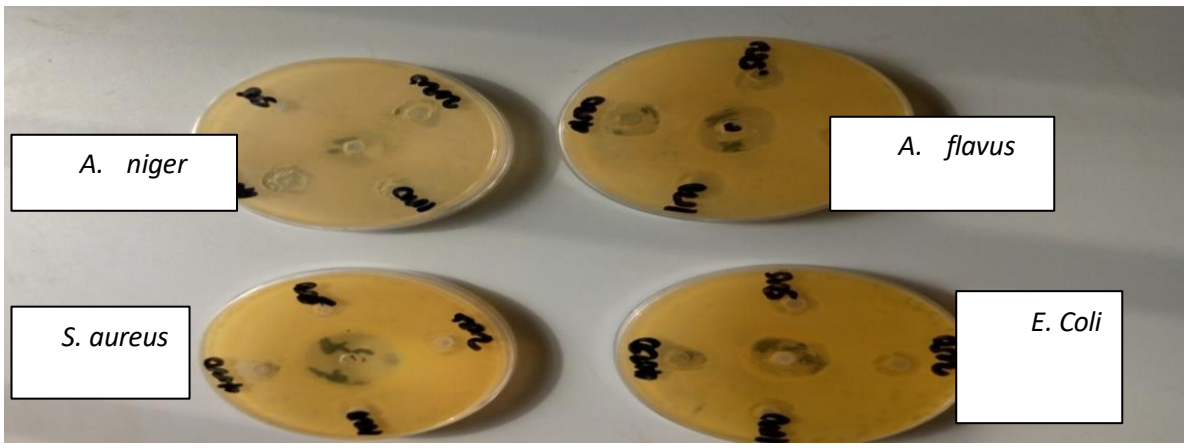

Figure 4: Sample antimicrobial susceptibility discs

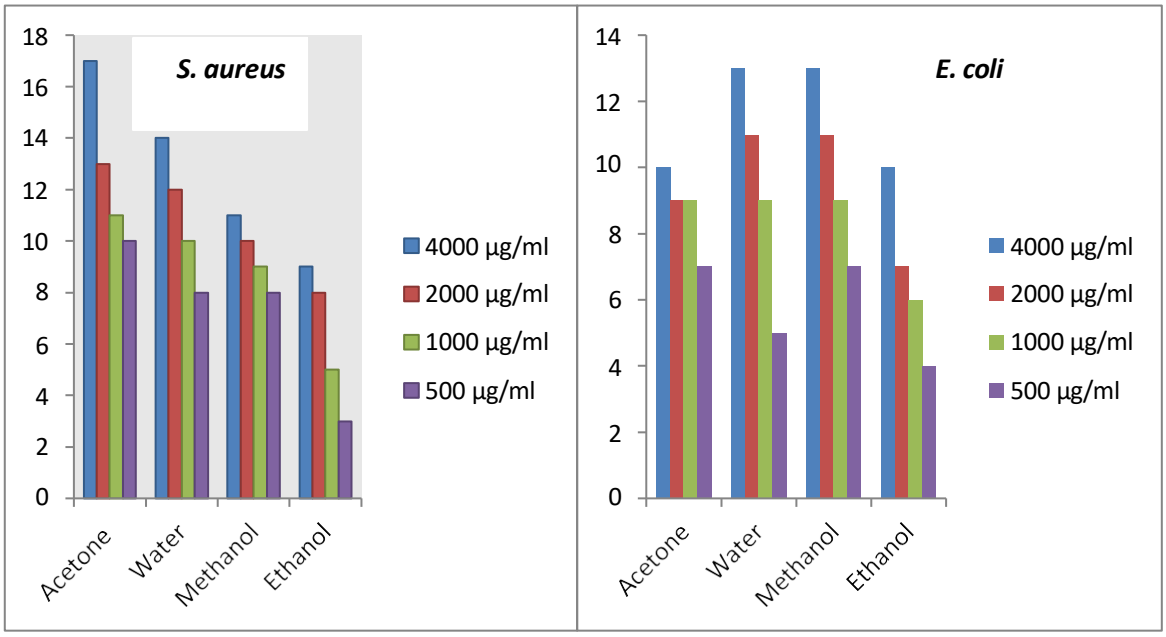

Figure 5: Bar graph showing zone of inhibition and concentrations of the *S.aureus* and *E. coli*

Table 4: Antifungal activity of the leaf extracts of *T. occidentalis.* Nystatin = 20 mm for *A. Flavus* and 19 mm for *A. niger*

Extracts	Microorganisms	Conc. µg/ml			
		4000	2000	1000	500
Acetone	*A. flavus*	15	14	09	06
	A. niger	15	10	09	08
Ethanol	A. flavus	13	12	09	05
	A. niger	11	10	08	05
Methanol	*A. flavus*	13	11	10	06
	A. niger	10	08	06	04
Water	*A. flavus*	08	07	06	04
	A. niger	06	05	04	03

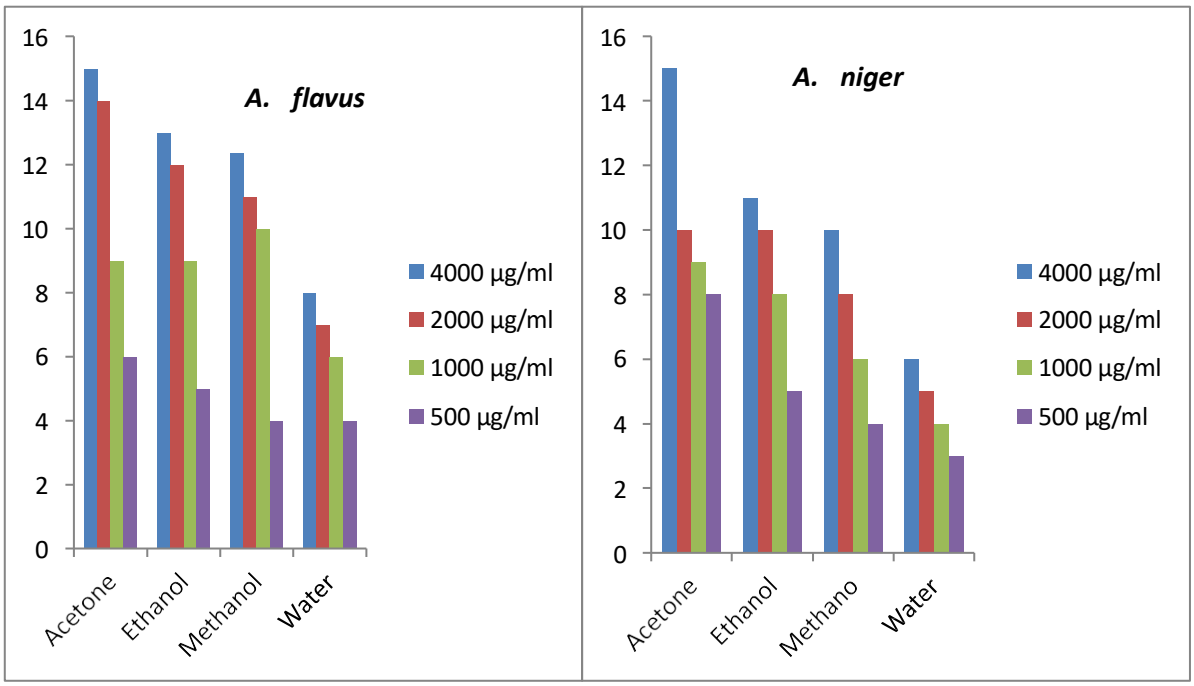

Figure 6: Bar graph showing zone of inhibition and concentration of *A. flavus* and *A. niger*

Antimicrobial agents such as antiseptics, antibiotics, antivirals, antifungals and antiparasitics are therapeutic materials used to prevent or treat infections. Such antimicrobials can kill microorganisms or prevent their growth by targeting key steps in cellular metabolism such as the synthesis of biological macromolecules, the activity of cellular enzymes, or cellular structures such as the cell wall, cell membranes. **Tables 3**, **table 4** and **figure 4** contains the antibacterial and antifungal zone of inhibitions of *T. occidentalis* leaves extracts in this study. According to the results, acetone extract had the highest antibacterial activity (largest zone of inhibition), followed by water extract, methanol extract, and ethanol extract, respectively. *Staphylococcus aureus* was less resistive to the extracts in comparison with *Escherichia coli*. In contrast, the most powerful antifungal extract was the acetone extract, this was followed by ethanol extract, methanol extract, and then water extract. *Aspergillus flavus* was less resistive to the extracts compared with the *Aspergillus niger*. The antimicrobial activity generally increased with increase in concentration in all the extracts. An antimicrobial research finding by Nwakanma *et al.* (2014) found that the leaf extracts of *Telfairia occidentalis* showed antimicrobial activity against *staphylococcus* aureus and *Escherichia coli*. Antimicrobials are therapeutic substances used to prevent or treat infections. The development of nanoparticles with antibacterial activity is one of the solutions for combating bacteria that are multi-resistant to antibiotics

Conclusion

The *T. occidentalis* leaf extracts have shown appreciable antimicrobial and antioxidant activities comparable to the currently prescribed modern standard drugs tested. However, further studies on safety, cytotoxicity, and clinical efficacy trial have to be investigated. Also, the isolation and identification of bioactive natural products and antibiotics from *Telfairia occidentalis* leaves, roots, and stems need to be done so as to find novel precursor molecules for new effective antimicrobials and antioxidants. The outcomes of this research reveal that *Telfairia occidentalis* leaves are antioxidant and antimicrobial potential agents that could be used in medicine and nutritional purposes

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***Compliance with Ethical Standards**:* This article does not contain any studies involving human or animal subjects.

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