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Evaluation of Antioxidant and Antibacterial Activities of *Telfairia occidentalis* Leaves Sold in Idah, Kogi State, Nigeria

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Abstract

Antimicrobial resistance is a serious global challenge, and this make the search for new antibiotic agents necessary. The antibacterial and antioxidant activities of the different solvent extracts (n-hexane, ethyl acetate, acetone, and ethanol) of *telfairia occidentalis* leaves were evaluated by using agar disc diffusion method and DPPH radical scavenging assay, respectively to test the plant's capacity to act as a new potential source of antibacterial and natural antioxidant agent. The results showed that *telfairia occidentalis* leaves are very good antibacterial agents, with ethanol extract exhibiting the largest activity, this was followed n-hexane extract, ethyl acetate extract, and the least was acetone extract. Moreover, the results of the DPPH radical scavenging activity of *telfairia occidentalis* leaf extracts showed excellent antioxidant activity, which increased in the order: ascorbic acid (IC50 = 22.0428 µg/ml) < ethanol (IC50 = 30.9680 µg/ml) < n-hexane (IC50 = 67.1265 µg/ml) < acetone (IC50 = 80.0867 µg/ml) < ethyl acetate (IC50 = 92.8238 µg/ml). Therefore, the findings revealed that the leaves of *telfairia occidentalis* are excellent antibacterial and antioxidant agents with noticeable nutritional properties.

Keywords: Telfairia occidentalis, Antioxidants, Antibacterial, Antibiotic resistance, Extracts

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1. Introduction

The rising incidence of antibiotic resistance poses a significant global challenge, especially within the healthcare, leading to the resurgence of more intricate infections and adverse socioeconomic consequences, thereby necessitating the exploration of alternative antibiotic agents (Dafa *et el*., 2024; Barriere, 2015; Tillotson, 2017; Alfi *et al.*, 2021). A steady stream of molecular mechanisms of resistance acquisition and the growing number of immune compromised individuals worsen this scenario (Blair *et al.*, 2017; Hall and Mah, 2017; Millar, 2015). Infectious diseases have killed over 14 million people worldwide, according to recent WHO data, with many people at high risk (Zhang *et al.*, 2019). Bacterial infections were also noted as the second most common cause of death worldwide. Approximately 2 million deaths have been directly and 5 million deaths indirectly ascribed to bacterial antibiotic resistance, which is the cause of these alarming epidemiological findings (Bai *et al.*, 2022). And worse still, by 2050, it is predicted that antimicrobial resistance may cause 10 million deaths annually. Factors such as poverty, poor cleanliness, antibiotic overuse and misuse, and limited access to high-quality healthcare, low- and middle-income economies have regrettably continued to be the most severely impacted by this problem (Allel *et al.*, 2023). These factors make the search for novel and potent antibacterial agents necessary (Leonard *et al.*, 2024).

A number of researches have focused on the biotic components found in some medicinal plants utilized in folk medicine, in addition to the pharmacological characteristics of these plants (Santos *et al.*, 2015; Negreiros *et al.*, 2016). *Telfairia occidentalis*is one of these medicinal plants that have been shown to have important therapeutic qualities, making it a useful addition to both conventional and alternative medicine. There have been reports of antibacterial, hematological, analgesic, anti-inflammatory, and glucose-level-lowering qualities in *T. occidentalis* leaves. It is found that seed oil from *T. occidentalis* may help male infertility by improving testicular function and increase sperm count. Additionally, eating a fluted pumpkin offers protection from human oxidative stress as a result of antioxidants like glutathione and tocopherol being present in (Lgboecheonwu *et al.*, 2023; Ominakinde *et al.*, 2018).

Free radicals can be either beneficial or detrimental to the organism. Recent research suggests that synthetic antioxidants like butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), and butylated hydroquinone among others may have carcinogenic effects, which has called for a search for more effective and novel antioxidants (Wankupar *et al*., 2015). The body produces free radicals as a result of radiation exposure, some environmental contaminants, and as by-products of regular metabolism (Vana, 2017). The highly reactive nature of free radicals can cause damage to cell components and lead to a variety of disorders (Deborah 2016). The body uses a variety of systems to

counteract free radicals, including antioxidant enzymes such as glutathione peroxidase, catalase, and superoxide dismutase as well as tiny molecules of antioxidants obtained from nutrients (C, flavonoids, vitamin E, carotenes, glutathione, taurine, and uric acid). Healthy people have a delicate equilibrium between antioxidants and free radicals (Choudhury, 2017). Food and medicinal plants both contain large amounts of antioxidants (Haddou *et al*., 2023; Loukili *et al*., 2022; Aourabi *et al*., 2021). Because of their many biological actions, these natural antioxidants are essential for preserving health (Diass *et al*., 2023; Bouslamti *et al*., 2023). Being scavengers of free radicals or active oxygen species, antioxidants are essential for human health (Akbar *et al*., 2022). This study aims to evaluate the antibacterial and antioxidant properties of the leaf extracts of *T. occidentalis* sold in Idah, Kogi State Nigeria.

Fig 1: *Telfairia occidentalis* leaves

2. Materials and methods

2.1. Plant material

In the month of June, 2025 we purchased the fresh and healthy sample leaves of *Telfairia occidentalis* from vegetables sellers by the second gate of the Federal Polytechnic Idah, Idah Local Government, Kogi State, Nigeria. The samples were thoroughly washed with tap water and dried at room temperature followed by grounding them into powder using laboratory mortar and pestle and kept in an air and water tight container till use (Desire *et al*., 2022; Danjuma *et al*., 2025).

2.2. Preparation of the extracts

The powdered sample (300 g) was macerated in 95 % ethanol for two days and then filtered. The filtrate was concentrated using a rotary evaporator at 30^0C to obtain the crude extract, and 10 grams of the crude extract was fractionated using n-hexane, ethyl acetate, and acetone. The fractions were concentrated at 30^0C and labelled (Desire *et al*., 2022; Danjuma *et al*., 2024).

2.5. Antioxidant activity

The ability of *T. occidentalis* to scavenge free radicals was assessed in this study by employing the DPPH radical scavenging assay where a solution containing 0.1 M of DPPH was made by dissolving 39.4 grams of DPPH in 100 millilitres of methanol solvent. Ten milligrams of the extract was subsequently diluted in 10 ml of 95 % ethanol creating a 1000 µg/ml stock solution. Using two-fold serial dilution method, the stock solution was diluted to get the following concentrations: 800.00 µg/ml, 400.00 µg/ml, 200.00 µg/ml, 100.00 µg/ml, 50.00 µg/ml, and 25.00 µg/ml respectively. In a 96-well plate, the sample/DPPH mixture was shaken and incubated for 30 minutes kept in the dark at room temperature, and the absorbance at 517 nm was then determined. The radical-scavenging activity of the extracts was expressed as percentage of inhibition (I %) using the formula below (Danjuma *et al.*, 2024):

$$\text{Percentage Inhibition (\%)} = \frac{(A_{control} - A_{sample})}{A_{Control}} X100 \quad (1)$$

Where:

$A_{control}$ is the absorbance of the reaction control and A_{sample} is the absorbance of the extract. The ability of the extracts to inhibit a certain biological or biochemical function called inhibition concentration (IC50) was calculated from the graph of inhibition against concentration of the extracts using the IC50 software (ic50.org). The experiments were done in triplicate and vitamin C (Ascorbic acid) was used as a positive control in this study.

2.5. Antimicrobial Susceptibility Testing

Antibacterial activity of *T. occidentalis* leaves in this study was done using paper disc diffusion method by Chepkemoi *et al*. (2025) and Danjuma *et al*. (2025) with slight modifications.

2.5.1 Bacterial Strain

The bacterial isolates used were *Staphylococcus aureus* and *Escherichia coli* collected from Microbiology Laboratory, Umaru Musa Yaradua University Katsina and were cultivated on Mueller-Hinton Agar (MHA) plates to confirm their effective growth under normal conditions. The colonies were painstakingly chosen from the MHA plate and inoculated into 10 milliliters of Mueller-Hinton Broth (MHB) to develop an active bacterial culture. The culture was subjected for incubation at a temperature of 37°C for one day to achieve the required bacterial concentration and before they were subjected for antibacterial analysis. We further prepared fresh MHA plates for the agar well diffusion method (Chepkemoi *et al.*, 2025).

2.5.2 Method of Agar Well Diffusion

The antibacterial activity of *T. occidentalis* leaves extracts against *S. aureus* and *E. coli* was assessed using the agar well diffusion method. Hinton-Mueller conditions were used to solidify agar plates. Five wells, each 6 mm in diameter were made per plate using a sterile cork borer, with a 3 cm space between wells. Each extract was added to its corresponding well in 100 micro liters. Inhibition zones were measured after the plates were incubated for one day at 37°C. The negative control was DMSO which was an indicator that the inhibition was due the extracts and not the solvent itself while the positive control used was Amoxicillin (Chepkemoi *et al*., 2025).

2.5.3 Measurement of Inhibition Zones

After the prepared plates were incubated for 24 hours at 37°C under carefully monitored conditions following inoculation with the bacterial culture, a millimeter ruler were used to measure the zones of inhibition (bacterial growth) on the plates. A quantitative assessment of each plant extract's antibacterial activity was given by these inhibitory zones. The zones' diameters were meticulously noted, making sure the data gathered was accurate. The most efficient herbal remedies for *S. aureus* and *E.coli* were determined by comparing various extracts and the control (Danjuma *et al*., 2025).

3. Results and discussion

3.1. Antioxidant activity of T. occidentalis

The antioxidant potential of *T. occidentalis* leaf extracts was measured by DPPH free radical-scavenging method. All the four extracts of *T. occidentalis* exhibited potential antioxidant activity (**Table 1** and **Figures 2-7**). The results showed that free radical scavenging activity increases with increase in concentration of solvent extracts. Among the leaf extracts, ethanol gave highest IC50 (IC50 = 30.9680 µg/ml) compared with ascorbic acid standard (IC50 = 22.0428 µg/ml), n-hexane came second with an IC50 of 67.1265 µg/ml. Acetone and ethyl acetate came third and fourth with IC50 0f 80.0867 µg/ml and 92.8238 µg/ml, respectively. This finding is similar to the findings of Desire *et al.* (2022) who reported ethyl acetate demonstrating highest activities in DPPH, followed by ethanol extract, dichloromethane extract, and n-hexane extract.

For many years, herbal plants—especially phenolic chemicals including phenolic acids, flavonoids, tannins, stilbenes, and anthocyanins—have been utilized as sustainable, safe, and efficient sources of natural antioxidants or free radical scavengers (Parveen *et al.*, 2025; Nouioura *et al.*, 2024; Akbari *et al.*, 2022).

Table 1: Absorbance and Percent inhibition of solvent extracts (n-hexane, ethyl acetate, acetone, and ethanol). Absorbance of the standard (Ascorbic acid) is 0.726

Extracts	Conc. (µg/ml)						
	800	400	200	100	50	25	IC50 (µg/ml)
N-hexane	0.1501 (79.32)	0.2040 (71.90)	0.3203 (55.88)	0.4335 (40.28)	0.5590 (23.00)	0.6160 (15.15)	67.1265
Ethyl Acetate	0.1396 (80.76)	0.1555 (78.58)	0.3338 (54.01)	0.4382 (39.32)	0.4985 (31.33)	0.5606) (22.77)	92.8238
Acetone	0.2646 (63.55)	0.2924 (59.72)	0.4350 (40.08)	0.5110 (29.61)	0.5908 (18.61)	0.6606 (09.39)	80.0867
Ethanol	0.1001 (86.21)	0.1234 (83.00)	0.2153 (70.34)	0.3412 (52.99)	0.3734 (48.56)	0.5075 (30.09)	30.9680
Ascorbic Acid	0.0381 (94.76)	0.0577 (92.05)	0.1081 (85.11)	0.1116 (84.62)	0.1989 (72.59)	0.2437 (66.43)	22.0428

Key: Percent inhibition are enclosed in brackets

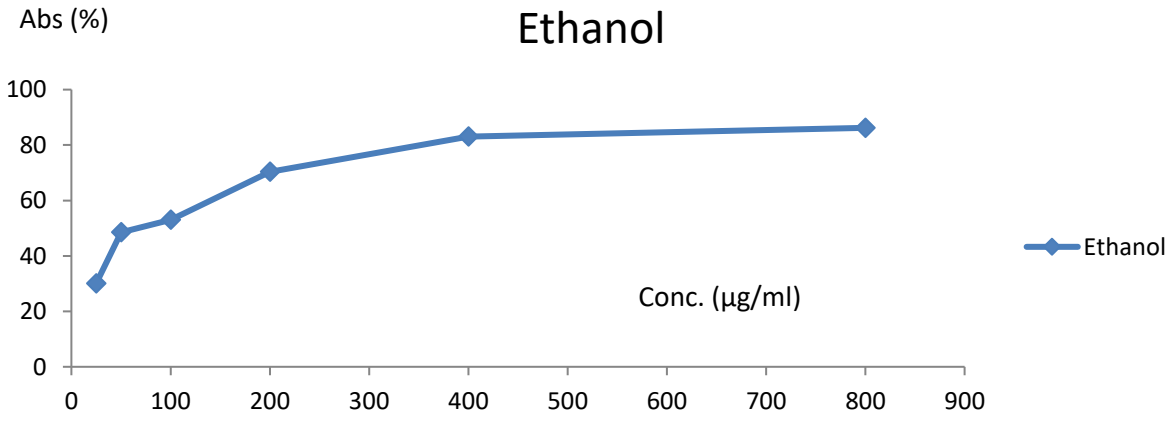

Fig 2: Absorbance against concentration of ethanol extract

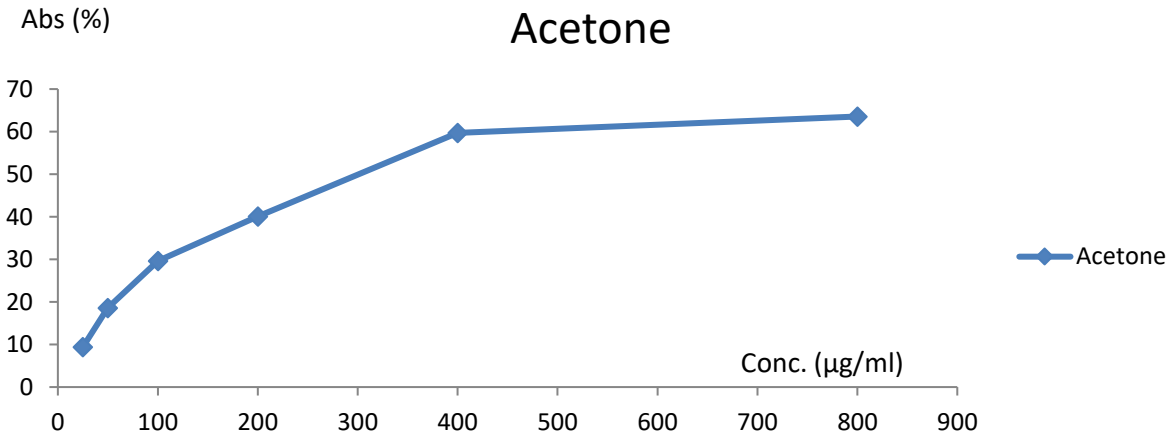

Fig 3: Absorbance against concentration of acetone extract

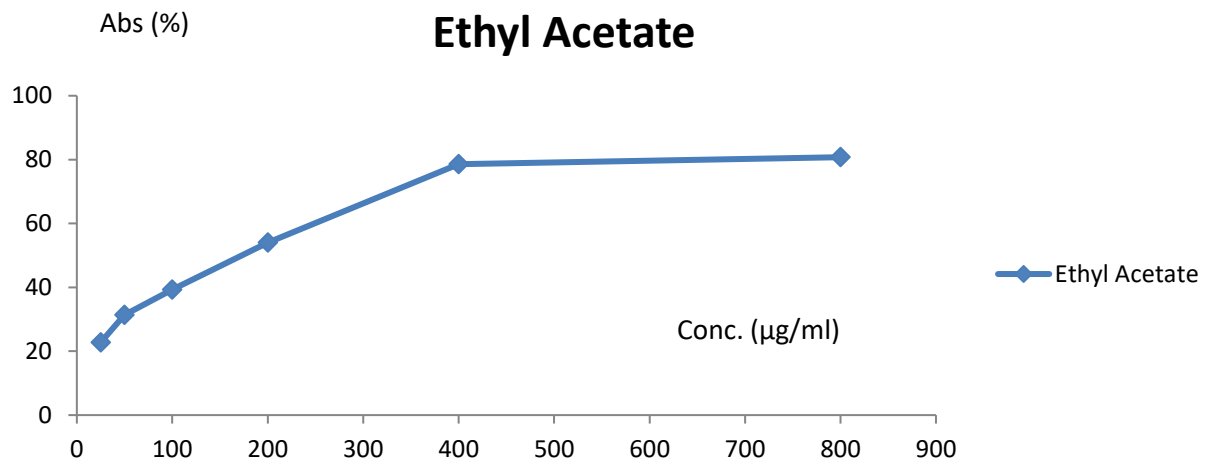

Fig 4: Absorbance against concentration of ethyl acetate extract

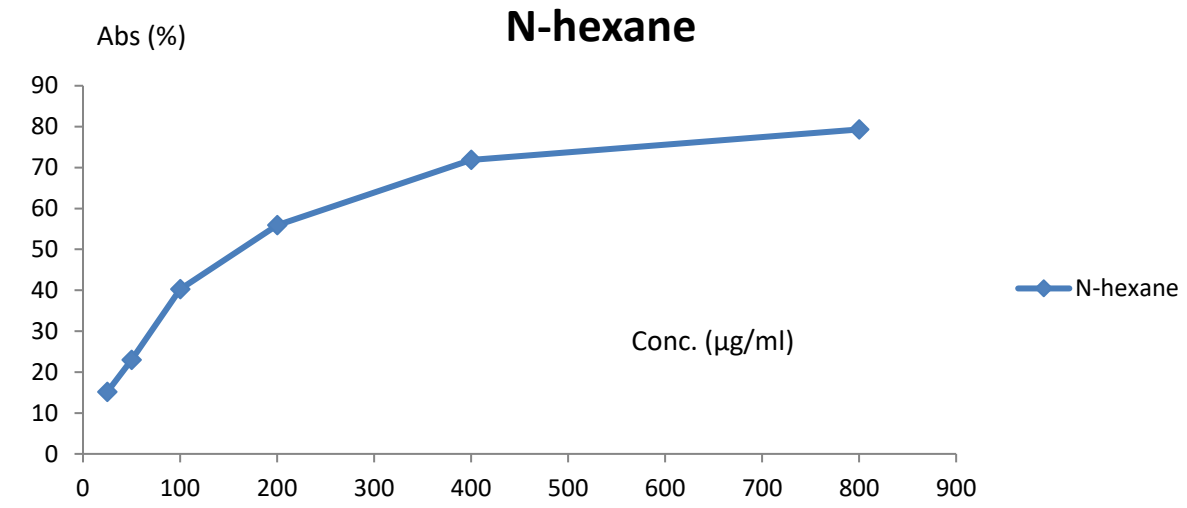

Fig 5: Absorbance against concentration of n-hexane extract

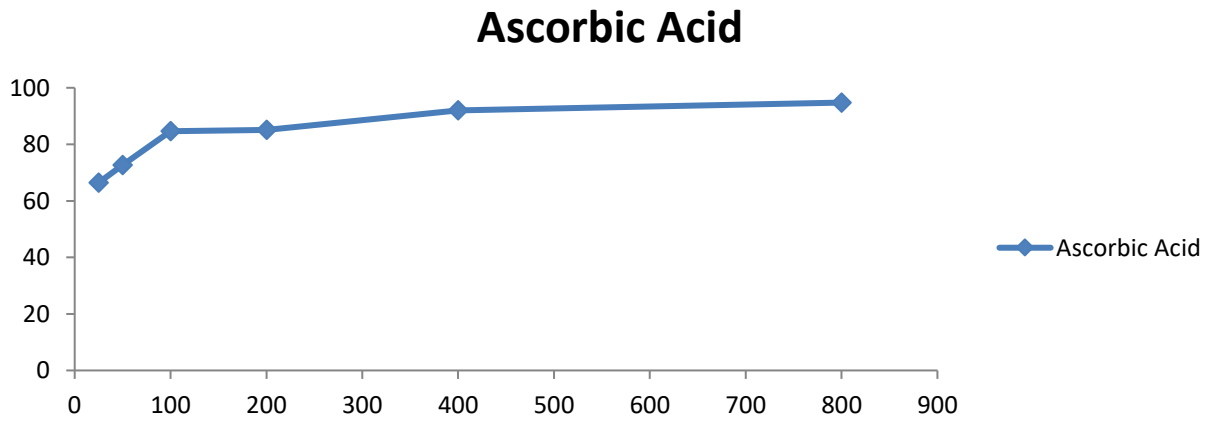

Fig 6: Absorbance against concentration of ascorbic acid extract

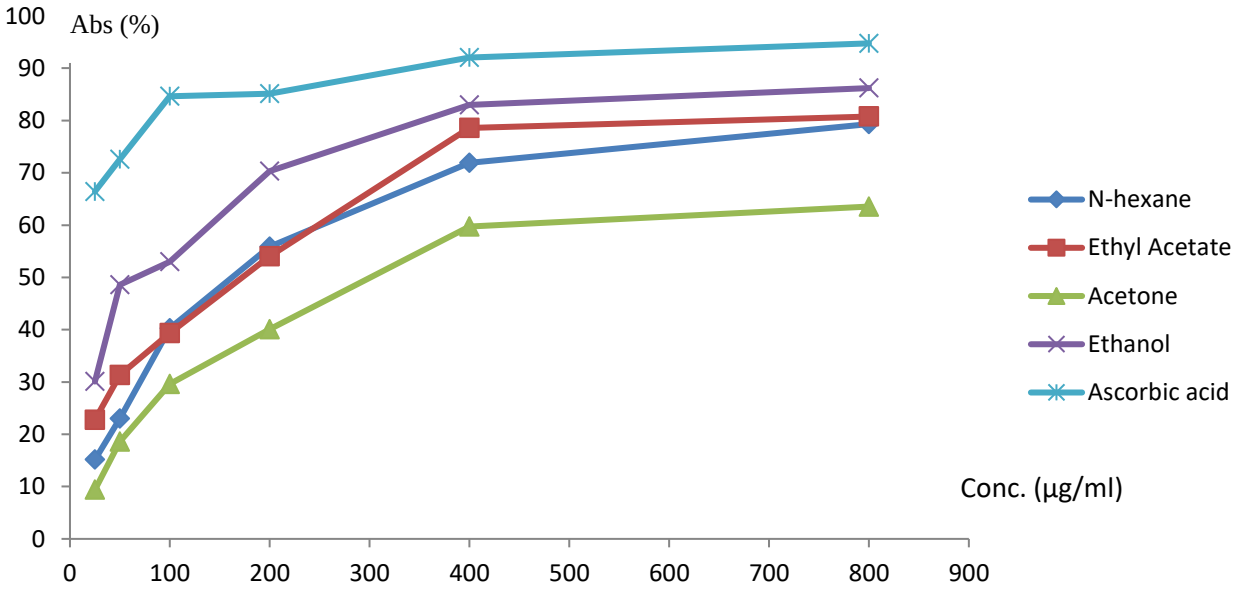

Fig 6: Absorbance against concentration of all the extracts and the standard (ascorbic acid)

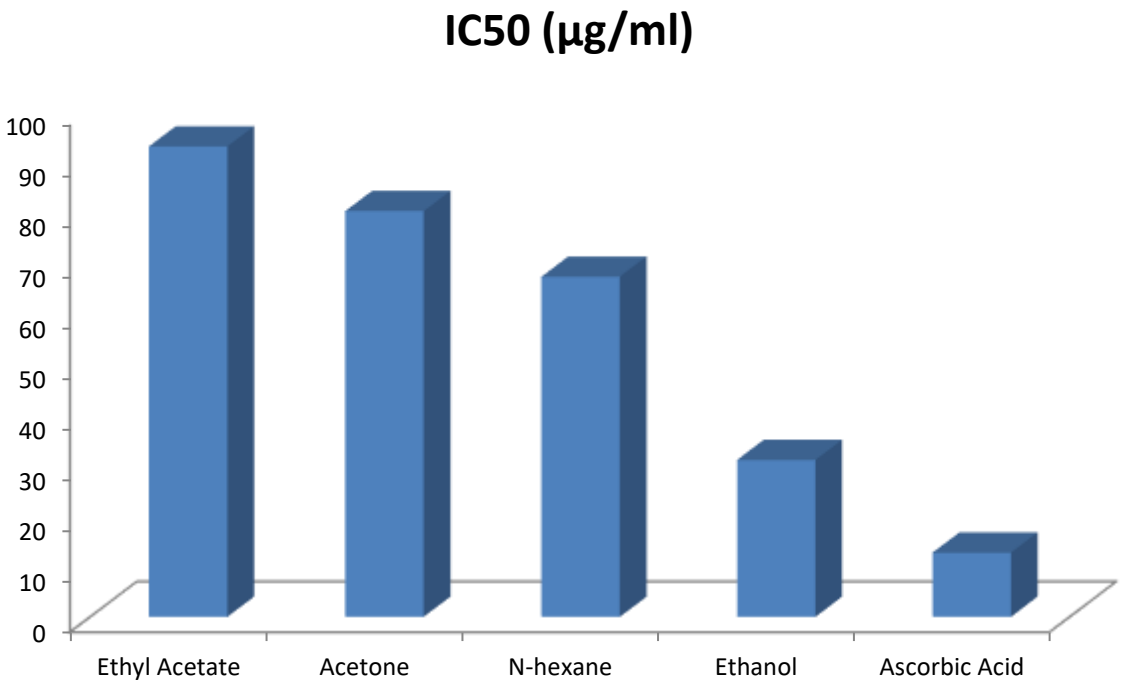

Fig 7: IC50 of all the extracts of *telfairia occidentalis* and the standard

Figure 7 shows that the DPPH radical scavenging effect of *T. occidentalis* increased in the order of ascorbic acid < ethanol extract < n-hexane extract < acetone extract < ethyl acetate. The lower the IC50 the greater the antioxidant activity of the extract.

3.2 Antibacterial Activity of *T. occidentalis*

The antibacterial activity of the leaf extracts of *Telfairia occidentalis*was screened against gram positive bacteria (*Staphylococcus aureus*) and gram negative bacteria (*Escherichia coli*) and the results obtained are tabled in **Table 2** and **Figures 8 and 9**. The leaves extracts of *T. occidentalis* showed significant antibacterial activity withethanol extract exhibiting the highest antibacterial activity (largest zone of inhibition), followed by n-hexane extract, ethyl acetate extract, and then acetone extract. Amoxicillin which was the antibiotic standard produced zones of inhibitions of 25 mm and 24 mm for *S. aureus* and *E. coli*, respectively. This indicates that amoxicillin is more effective in inhibiting bacterial growth than the plant leaves extracts. It was observed that the gram positive bacteria, *S. aureus* displayed largest zone of inhibition than the gram positive *E. coli*. The zones of inhibition generally increased with increasing concentrations.

Since ancient times, therapeutic plants—also known as medicinal herbs—have been identified and employed in conventional medicine. For a variety of purposes, such as defense and protection against insects, fungus, illnesses, and herbivorous mammals, plants manufacture hundreds of chemical compounds. Approximately 350,000 to almost half a million species, or 10% of all vascular plants, are used medicinally. Plants have been used as medicine since ancient times and continue to be used today. Natural substances derived from the leaves, bark, roots, seeds, or flowers of plants are used as herbal remedies or supplements. Herbs have frequently been in and out of favor in the medical sector since then. A variety of plants with therapeutic qualities are referred to as medicinal plants (Taye *et al*., 2021).

Table 2: Inhibition zones (in mm) for *S. aureus* and *E. coli*.

		Conc. (mg/ml)			
Extracts	**Isolates**	**120 mg/ml**	**90 mg/ml**	**60 mg/ml**	**30 mg/ml**
N-hexane	*S. aureus* (Positive)	15	13	07	03
	E. coli (Negative)	11	10	05	02
Ethyl Acetate	*S. aureus* (Positive)	13	12	06	02
	E. coli (Negative)	10	08	07	04
Ethanol	*S. aureus (*Positive)	18	14	11	07
	E. coli (Negative)	15	13	09	05
Acetone	*S. aureus (Positive)*	10	08	06	03
	E. coli (Negative)	09	08	04	02

Positive Control (Amoxicillin) = 25 mm and 24 mm for *S. aureus* and *E. coli* respectively

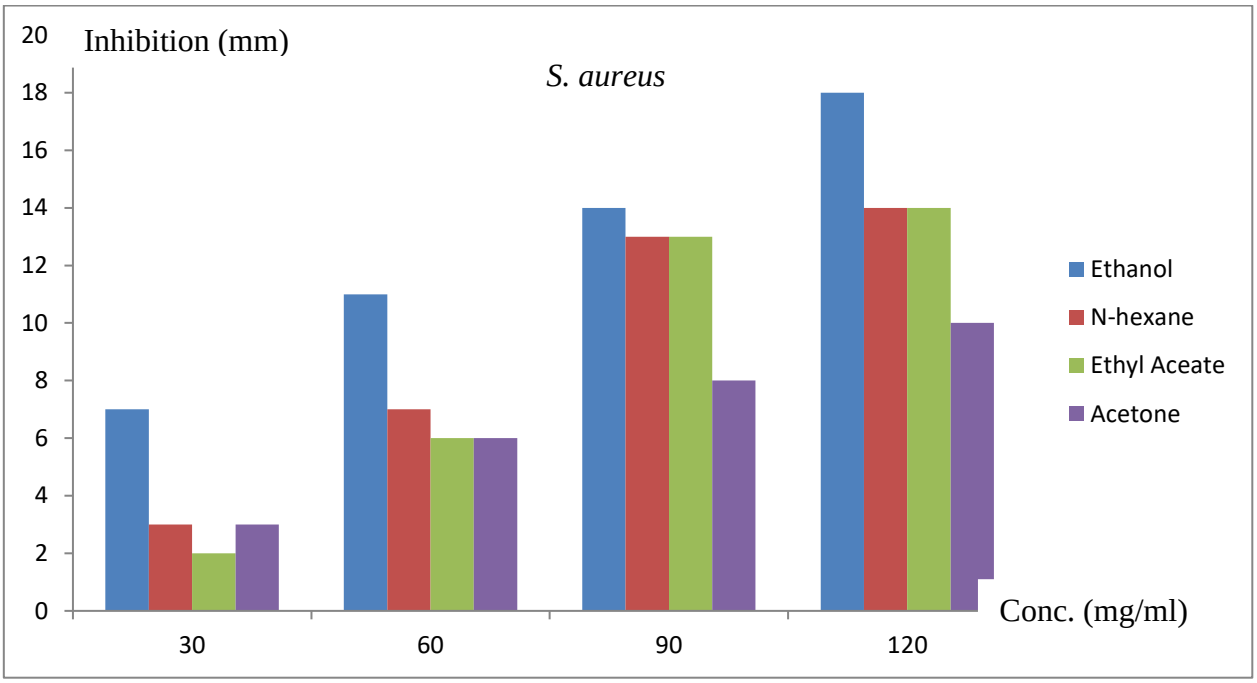

Fig 8: Zone of inhibition for *S. aureus*

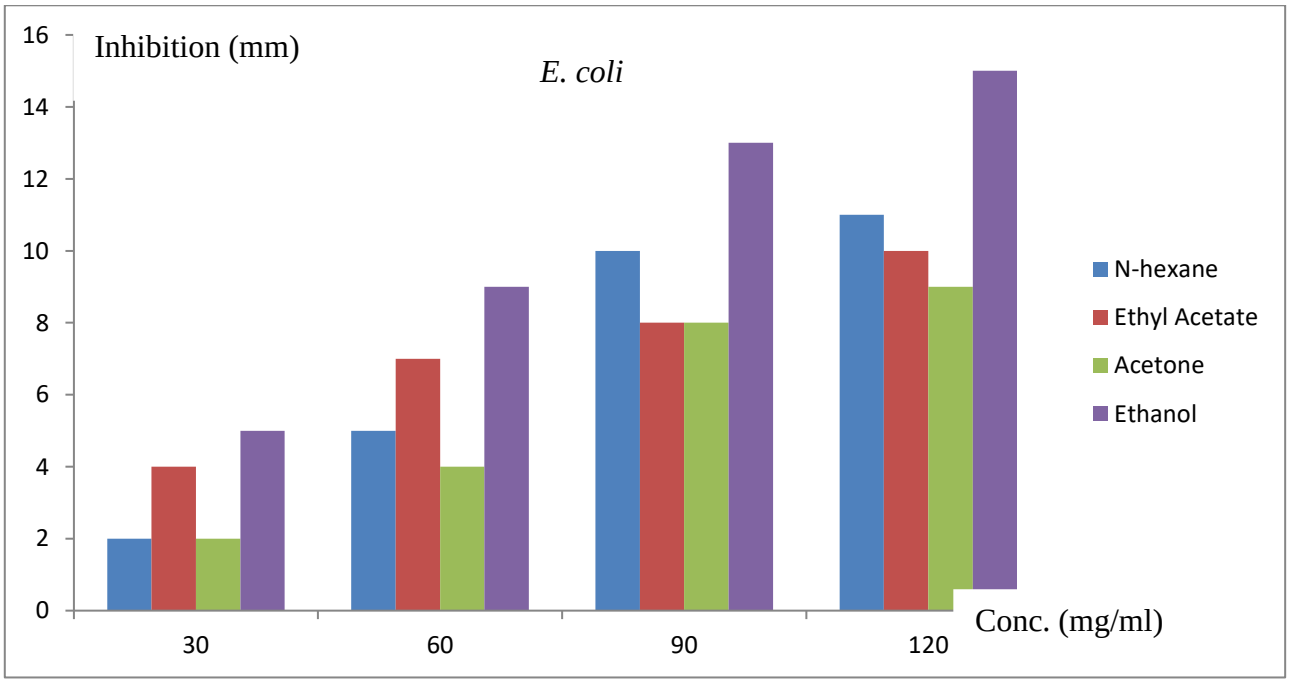

Fig 9: Zone of inhibition for *E. coli*

Literature shows more information about the phytochemical screening of the ethanol extract and different fractions revealed the presence of flavonoids, alkaloids, tannins, saponin, cardiac glycoside and anthraquinones (Desire *et al.*, 2022). Furthermore, the GC-MS analysis recorded a total of 39 compounds from extract; 9 major constituents; oleic acid, (10.27%), acetic acid (9.66%), hexanoic acid (7.66%), phytol acetate (7.22%), 18,19-seccoyohimban-19-oic acid (6.69%), iso-propyl

9,12,15-octadecatrienoate(6.20%), n-hexadecanoic acid, methyl ester (5.83%), trans-geranyl geraniol (4.21%) and 9,12- octadecadienoic acid (4.11%),39 compounds from DCM with 8 major constituents; (1,1-bicyclopropyl)-2-octanoic acid (25.87%), quinic acid (9%), acetic acid (6.66 %), 9-octadecadienoic acid (z,z) (5.63 %), benzofuran (5.34%), oxirane (4.11%), phytol, acetate (2.52 %) and vitamin E (2.37%), and 37 compounds from ethyl acetate fraction with 7 major constituents; stigmasterol (17.09%), vitamin E (14.73%), stigmasterol (11.25%), 4,22-stigmastadiene-3-one (9.40%), 7,22-ergostadienol (5.84%), dotricontane (3.88%) and eicosane (3.07%) (Desire *et al.*, 2022). This richness may explain the biological activities obtained (Chijindu *et al.*, 2024; Akpasi *et al.*, 2023; Desire *et al.*, 2022).

Conclusion

The leaf extracts of *T. occidentalis* are effective antioxidants and antibacterial agents, and are suggested to serve as new potential sources of natural antioxidant and antibacterial agents for both food and pharmaceutical companies.

Conflict of Interest

The authors declare that there is no conflict of interest.

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