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Phytochemical screening, Active ingredients analysis by GC-MS and Antimicrobial Efficacy of Ethanolic Leaf Extract of Coat buttons (*Tridax procumbens*)

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Abstract

Tridax procumbens is widely used in traditional medical practice for the treatment of different ailments. To study its antimicrobial activity and identify its active molecules, dried leaves of T. procumbens were subjected to extraction using 50% ethanol. Phytochemical screening was done following established methods. Active ingredients were characterized by gas chromatography-mass spectrometry (GC-MS). The results showed that tannins and cyanogenic glycosides (carbohydrates) were present. Antibacterial activity studies by the disc diffusion method revealed that the ethanol extract had broad-spectrum activity on Gram-positive and Gram-negative organisms. Minimum inhibitory concentration (MIC) was 0.7 – 2.7 mg/ml and 21.3 – 170 mg/ml for the Gram-negative and Gram-positive bacteria, respectively. Minimum bactericidal concentration (MBC) range of 1.3 – 170 mg/ml and 42.5 – 170 mg/ml was observed for Gram-negative bacteria and Gram-positive bacteria, respectively. GC-MS chromatograph revealed the presence of Propane-1,3-diamine, Propane-1,1-diol diacetate, Cyclopropylmethanol, 5-methyl-4,6-pyrimidinediol,3,5-dihydroxymethyl-6-methyl-2,3-dihydro-4H-pyran-4-one, 5-(hydroxymethyl)-2-furaldehyde, decyltetracosane, besides fatty acids and other aliphatic molecules. These molecules are most likely involved in the observed therapeutic potentials of the plant

Keywords: *Tridax procumbens*, phytochemicals, minimum inhibitory concentration (MIC), ethanolic leaf extract, antibiotic resistance, GC-MS

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1. Introduction

From antiquity to the dawn of civilization, man has continued to use plants to cure him from innumerable ailments that attack him. From literature depicting ancient practices, various parts of plants have been used in Siddha, Ayurveda, and Unani medicine for the treatment of human diseases (Baile and Parmar 2025). Traditional/herbal remedies contribute significantly to national health care programmes because these drugs are easily available at low cost and people have faith in them. About 80% of the population in third-world nations depend on traditional medicine for their primary health care, and about 85% of these traditional medicines are plant-based (Hoenders et al. 2024).

Commonly known as coat buttons or Tridax daisy, *Tridax procumbens* is a flowering plant species in the family Asteraceae (Compositae) (Thalkari et al. 2020). It is native to America, where it was introduced to tropical, subtropical, and mild temperate regions (Sawant and Godghate, 2013). It is found in most countries and grows primarily during the rainy season. The plant is known by different names in different languages. Among Nigerian tribes, its native names are: Yoruba: *Igbalode* or *Muwagun* (Olowokudejo *et al.,* 2005); Igbo: *Agbara*; Hausa: *Gyatuma, chiyawan fara*; Tiv: Ambi a ikyomon; Idoma: *Achi-Ogbono* and *Inwavo mwata* in Igede (Agishi 2010). *Tridax procumbens'* Asteraceae or *Compositae* family (commonly referred to as the aster, daisy, composite, or sunflower family), an exceedingly large and widespread family of flowering plants (Angiospermae) (Thalkari et al. 2020).

Coat button (*Tridax procumbens*) is one of several pharmacologically active plants (Baile and Parmar 2025) found around us. Traditionally, it is used for the treatment of bronchial catarrh, dysentery, malaria, diarrhea, high blood pressure and to check haemorrhage from cuts, bruises, wounds, and to prevent hair fall (Sawant and Godghate, 2013). It possesses anti-diabetic (Durgacharan *et al.,* 2008), anti-bacterial (Chitra *et al*., 2011), anti-plasmodial (Rappiah-opong *et al*., 2011), anti-hepatotoxic, anti-oxidant (Reddipalli 2008), and a wide range of antimicrobial (Sneha and Ruchi 2010) properties. The plant is also reported to have anti-inflammatory and immuno-modulatory properties on experimental animals (Pitout and Laupland, 2008). Mohale *et al.* (2014) also reported on its effect against nosocomial infections and multidrug-resistant pathogens. It has been extensively

used in Ayurvedic system of medicine and is dispensed as "Bhringraj" by some practitioners of Ayurveda (Thalkari et al. 2020; Baile and Parmar 2025).

Active components can be derived from any part of the plant, like leaves, flowers, roots, fruits, seeds, etc (Chaachouay and Zidane 2024). For instance, the flowers and leaves are reported to have antiseptic, insecticidal and parasiticidal properties (Pathak *et al.* 1991; Sahoo and Chand, 1998). The plant also shows various pharmacological activities like antidiabetic, antihepatotoxic & anti-oxidant, analgesic, and marked depressant action upon inhalation (Vyas *et* al., 2004; Jain 2006; Hemalatha *et al*., 2008; and Bhagwat *et al.,* 2010). The Tivs' and the Igedes' of Benue State, Nigeria, also extensively use the whole plant for antipyretic (fever reduction), relief of backache, and stomach ache, etc. To maximize the prophylactic benefits of the plant, the Igedes of Benue state, Nigeria, use its leaves in soup preparation while children chew it for its sweetness (Okwo, S. personal observation)

There are several reports on the antimicrobial activity of different herbal extracts in different regions of the world (Chung *et al.,* 2004; Nair *et al.,* 2004 and De Boer *et al.,* 2005). Moreover, considering the side effects of drugs and the development of resistance in pathogenic microbial strains against existing antibiotics, much attention has been paid to extracts and biologically active compounds isolated from plant species used in herbal medicine (Essawi and Srour 2005).

Medicinal plants are the richest bio-resource of drugs of traditional systems of medicine, modern medicines, nutraceuticals, food supplements, pharmaceutical intermediates, and chemical entities for synthetic drugs (Chaachouay and Zidane 2024). Despite the several chemical compounds currently synthesized in the laboratory and available for screening for therapeutic properties, natural products, particularly of plant origin remain the most important sources of new drugs (Chaachouay and Zidane 2024), owing to their versatile applications (Baile and Parmar 2025).

The plant has several traditional medicinal uses. Its active ingredients have been reported from international studies. However, literature is scarce on studies of the plant within the Benue Valley of Nigeria. Thus, this work aimed to test ethanolic extracts of *Tridax procumbens* obtained from Benue Valley, Nigeria against selected widespread species of Gram-positive and Gram-negative pathogenic microorganisms of public health importance commonly found within Makurdi metropolis of Benue State, Nigeria, and to carry out the qualitative analysis and attempt a tentative identification of the active constituents present in the ethanol leaves extract of the plant from GC-MS analysis using mass spectra library.

2. Materials and Methods

Three organisms each of Gram-negative (*Escherichia coli, Proteus mirabilis* and *Klebsiella* species*)* and Gram-positive (*Staphylococcus aureus, β-haemolytic streptococcus* and *Streptococcus species)* were used as test organisms. These were pure cultures, identified clinical isolates obtained from the medical laboratory department, Hospital of Immaculate Conception, Makurdi, Benue State. Ciprofloxacin 500 mg was used as a standard antibiotic. Ethanol was chosen for the extraction because the ethanolic extracts, as compared to the aqueous extract, possess higher amounts of polyphenols (Tiwari *et al*., 2011).

2.1 Materials and Reagents

The instruments used include: Gas chromatography coupled with a mass spectrometer (GC-MS) (GCMS-QP2010 Plus Shimadzu, Japan), Adams electric weighing balance (model AQT 1500), rotatory evaporator (Model 349/2 Corning/England), Whatman No. 1 filter paper.

The reagents were: 50% ethanol, normal saline, nutrient agar, dimethyl sulphoxide (DMSO), Dragendorff's reagent, Wagner's reagent, Mayer's reagent, ammonium solution, among others. All reagents used were analytical grade products of Sigma Aldrich and BDH.

2.2 Extraction of Plant Material

Tridax precumbens was collected from the Botanical Gardens of the Benue State University, Makurdi. The authentication of the plant was done by a botanist at the Department of Plant Sciences and Biotechnology, Makurdi and a voucher specimen was deposited with the same.

The leaves were shade-dried for three weeks and then ground to coarse powder. 25 g of the powdered leaves were measured and macerated in 150 mL of 50% ethanol for 48 hours. The extract obtained was filtered through a Whatman No. 1 filter paper. The filtrate was evaporated to dryness on a rotatory evaporator. The extract was concentrated at 40°C under reduced pressure and stored in the refrigerator for subsequent analysis.

2.3 Antimicrobial Disc Diffusion Preparation

Disks measuring 6 mm in diameter were cut out from Whatman No 1 filter paper of uniform thickness. This was then transferred into a Bijou bottle and sterilized by autoclaving at standard conditions. A stock of 170 mg/mL was used. A doubling dilution was made from the stock by adding 1 mL of normal saline into nine (9) separate tubes starting from the second tube to the 10^{th} tube.

2.4 Antimicrobial Assay by Disc Diffusion Method

Kirby-baurer disc diffusion method was used to determine the susceptibility of the isolated microbes to the extract. The isolated organisms were suspended in nutrient broth. 1 mL of the broth culture of each organism was aseptically inoculated into nutrient agar in glass Petri dishes. The extract-impregnated disc was placed on the inoculated nutrient agar in Petri dishes and incubated at 37 °C for 24 hours. The antimicrobial activity was determined by measuring the inhibition zone around each disc using a microcalibre.

2.5 Determination of Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC)

The minimum inhibitory concentration (MIC) of the extract was determined using 10-fold doubling dilution method, i.e. the lowest concentration of the extract that prevented growth of the organism was taken as the minimum inhibitory concentration (mg/mL). The one that showed no growth of the organism was taken as the minimum bactericidal concentration.

2.6 Phytochemical Screening

The crude extracts obtained were used for qualitative tests for the constituent phytochemicals according to Trease and Evans, (1996), and Yarkwan (2020), and briefly reproduced as follows:

2.6.1 Test for Alkaloid

0.2 g of the extract was heated with 5 mL of 2% HCl in a steam bath. The mixture was filtered and a 1 mL portion of the filtrate was treated with 2 drops of the following reagents:

I. **Dragendorff's reagent**: a red precipitate indicates the presence of an alkaloid.
II. **Wagner's reagent**: a reddish-brown precipitate indicates the presence of an alkaloid.

2.6.2 Test for Flavonoids

0.2 g of the macerated samples of *T. procumbens* were treated with 10 mL of ethyl acetate in boiling water for 3 minutes. The mixture was filtered off and the filtrate used for the ammonium test as follows. A quantity of the filtrate was shaken with 1 mL of the diluted ammonium solution. The layers were allowed to separate. The formation of a yellow precipitate at the ammoniacal layer indicates the presence of flavonoids.

2.6.3 Test for Tannins

0.1 g of the sample powder was boiled with 5 mL of 45% ethanol for 5 minutes. The mixture was cooled and filtered. 1 mL of the filtrate was diluted with distilled water, and 2 drops of ferric chloride solution were added. A transient greenish to black colour indicates the presence of tannins.

2.6.4 Test for Steroid

About 9 mL of ethanol was added to 1 g each of the ground samples and refluxed for a few minutes and filtered. The filtrate was concentrated in a water bath, and 5 mL of hot water was added. The mixture was allowed to stand for 1 hour and filtered off. The filtrate was extracted with 2.5 mL of chloroform, and 0.5 mL of the extract was treated with 1 mL of conc. H_2SO_4 to form a lower layer. A reddish-brown precipitate indicates the presence of steroids.

2.6.5. Proteins Test by Xanthoproteic Test: Extract was treated with few drops of concentrated HNO_3 and the formation of a yellow colouration indicates the presence of proteins.

2.6.6. Test for Reducing Sugars

0.1 g of the ground leaf was shaken vigorously with 5 mL distilled water and filtered. 1 mL of the filtrate was added to equal volumes of Fehling's solutions A and B and shaken vigorously. A brick-red precipitate indicates the presence of reducing sugar.

2.6.7 Test for Cardiac Glycosides

To 5 mL of ethanolic extract 2 mL of glacial acetic acid and one drop of ferric chloride solution were added, followed by 1 mL of concentrated sulphuric acid. The formation of a brown ring indicates the presence of deoxy sugars.

2.6.8. Test for Saponins

From the sample, 0.1 g portion was weighed out and boiled with 5 mL of distilled water for 5 minutes. The mixture was filtered while still hot. The filtrate was used for the following tests:

2.6.8.1 Frothing Test: 1 mL of the filtrate was diluted with 4 mL of distilled water, the mixture was shaken and observed for the formation of an emulsion.

2.6.8.2. *Emulsion Test*: 1 mL each of the filtrates was added to 2 drops of olive oil. The mixture was shaken and observed for the formation of an emulsion.

2.6.9 Test for Terpenoids

To 5 mL of ethanolic extract, 2 mL of chloroform and 3 mL of concentrated sulphuric acid were added to form a layer. The formation of reddish-brown color at the interface indicates the presence of Terpenoids.

2.6.10 Test for Phlobatannins

To 1 mL of aqueous extract, 1% aqueous hydrochloric acid was added and boiled. The deposition of red precipitate indicates the presence of phlobatannins.

2.7 G C - MS Analysis

2.7.1 General Analytical (Analytical Line 1[AOC-20i]) Conditions

The general analytical conditions are given in 1 below:

Table 1: General Analytical Conditions as employed for GC – MS analysis

Analytical Parameter	Measurement
Number of Rinses with Pre-solvent	4
Number of Rinses with Solvent (post)	4
Number of Rinses with Sample	3
Plunger Speed (Suction)	High
Viscosity Comp. Time	0.2 sec
Plunger Speed (Injection)	High
Syringe Insertion Speed	High
Injection Mode	Normal
Pumping Tim	5
Inj. Port Dwell Time	0.3 sec
Terminal Air Gap	No
Plunger Washing Speed	High
Washing Volume	8uL
Syringe Suction Position	0.0 mm
Syringe Injection Position	0.0 mm
Use 3 Solvent Via	1 vial

2.7.2. Gas Chromatogram [GC-2010] Column Conditions

The conditions in the GC column are given in Table 2 below.

Table 2: Applicable conditions in the GC Column Used

Analytical Parameter	Measurement
Column Oven Temp.	80.0 °C
Injection Temp.	250.00 °C
Injection Mode	Split
Flow Control Mode	Linear Velocity
Pressure	108.0 kPa
Total Flow	6.2 mL/min
Column Flow	1.58 mL/min
Linear Velocity	46.3 cm/sec
Purge Flow	3.0 mL/min
Split Ratio	1.0
High Pressure Injection	OFF
Carrier Gas Saver	OFF
Splitter Hold	OFF

Table 3 showing the programming of the oven temperature

Rate	Temperature (°C)	Hold Time(min)
-	80.0	1.00
10.00	200.0	4.00
10.00	280.0	5.00

Table 4 showing the programming conditions for the GC column

Parameter	Measurement
Ion Source Temp	230.00 °C
Interface Temp.	250.00 °C
Solvent Cut Time	2.50 min
Detector Gain Mode	Relative
Detector Gain	0.00 kV
Threshold	100

2.7.3. Conditions in the Mass-Spectrometer Column

Start Time: 3.00min
End Time: 28.00min
ACQ Mode: Scan
Event Time: 0.50sec
Scan Speed: 1250
Start m/z: 40.00
End m/z: 600.00
Sample Inlet Unit: GC

3. Results

3.1. Antimicrobial Test

The ethanolic crude extracts of *Tridax Procumbens* leaves were investigated for antibacterial activity *in vitro*. Results from the *in vitro* antibacterial study using the disc method are presented in Table 5. Results *E. coli, P. mirabilis*, and *Kleibsiella* spp were largely susceptible to the crude ethanolic extract tested. However, *Streptococcus* spp was resistant to the crude extract but susceptible to the standard drug, Ciprofloxacin at the respective test concentrations as shown in Table 5.

Table 5 showing the antibacterial activity of ethanolic leaf extract of *T. procumbens* against six clinical bacterial isolates (by disc diffusion method).

Microorganism	Inhibition Zone (mm) against respective extract conc. (mg/mL):										
	170	85	42.5	21.3	10.6	5.3	2.7	1.3	0.7	0.3	Ciprofloxacin (500 mg)
E. coli	21	18	16	15	14	12[b]	10[a]	R	R	R	30
P. mirabilis	24	21	20	19	18	17	16	14[b]	12[a]	R	27
Klebsiella sp.	20	19	18	17	15	14	12[b]	10[a]	R	R	27
S. aureus	15	13	12[b]	8[a]	R	R	R	R	R	R	23
β-haemolytic s.	9[b]	7[a]	R	R	R	R	R	R	R	R	25
Streptococcus sp.	8[a]	R	R	R	R	R	R	R	R	R	17

[a] = Minimum Inhibitory Concentration (MIC) [b] = Minimum Bactericidal Concentration (MBC)
R = Resistant

3.2 Phytochemical Screening

The phytochemical screening produced an array of compounds undergoing reactions typical of members of the following classes of compounds. Based on these results, identifications were made.

Table 6: Phytochemical Screening for *T. procumbens*

Phytochemical	Screening Result
Alkaloids	+
Tannin	+
Saponin	+
Steroid	-
Phlobatannin	-
Terpenoid	-
Flavonoid	+
Cardic glycoside	-
Carbohydrates	+
Proteins	+

3.3. GC-MS Chromatogram of T. procumbens Analysis

The chromatogram result is as shown in Figure 1.

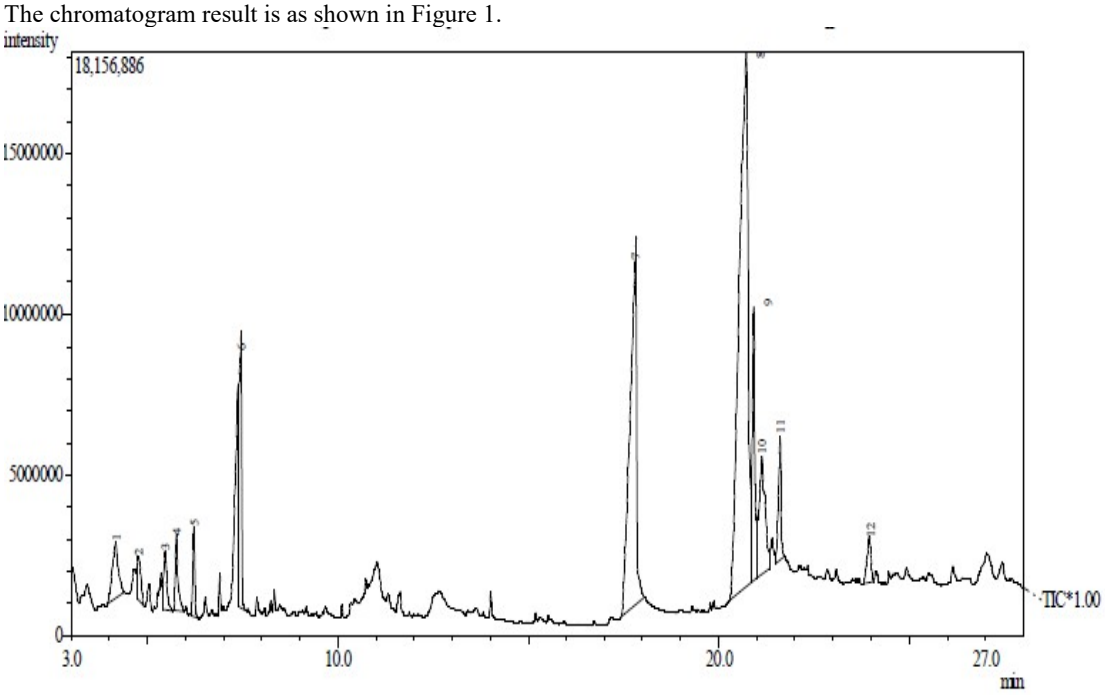
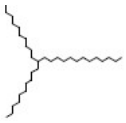


Fig. 1: Chromatogram for the Ethanolic Leaf Extract of *Tridax procumbens*

The peaks labelled 1 -12 in the diagram above were identified to be: 1. Propane-1,3-diamine
2. Propane-1,1-diol diacetate 3. Cyclopropylmethanol 4. 5-methyl-4,6-pyrimidinediol 5. 3,5-dihydroxymethyl-6-methyl-2,3-dihydro-4H-pyran-4-one 6. 5-(hydroxymethyl)-2-furaldehyde 7. Palmitic acid 8. Hexadecenoic acid 9. 2-(2-hydroxyethoxy)ethyl octadecanoate 10. 13-tetradece-11yn-1-ol, 11. Methyl trans, trans-9,12-octadecadienoic acid 12. 11-decyltetracosane.

The chemical compounds detected in the chromatogram were analysed, matching the observed m/z ratios against those in the mass spectral library. Also, considering the source of the material, best matches were arrived at, and the putative molecule structures are illustrated in Table 7 below.

Table 7: Chemical Compounds Detected in the Extract – Tentative molecular structures and presence

Compound Name	Peak Number	Formulae	Mol. Weight	Chemical Structure
Propane-1,3-diamine	1	$C_3H_{10}N_2$	74	
Propane-1,1-diol diacetate	2	$C_7H_{12}0_4$	160	
Cyclopropylmethanol	3	C_4H_8O	72	
5-methyl-4,6-pyrimedinediol	4	$C_5H_6N_20_2$	126	
3,5-dihydroxymethyl-6-methyl-2,3-dihydro-4H-pyran-4-one	5	$C_6H_8O_4$	144	
5-(hydroxymethyl)-2-furaldehyde	6	$C_6H_60_3$	126	
Palmitic acid	7	$C_{16}H_{32}0_2$	256	
Hexadecenoic acid	8	$C_{16}H_{30}O_2$	254	
2-(2-hydroxyethoxy)ethyl octadecanoate	9	$C_{22}H_{44}0_4$	372	
13-tetradece-11yn-1-ol,	10	$C_{14}H_{24}0$	208	
Methyl trans, trans-9,12-octadecadienoic acid	11	$C_{19}H_{34}0_2$	294	
11-decyltetracosane	12	$C_{34}H_70$	478	

4.0 Discussion

Six clinical isolates were used in this investigation. From the antibacterial assay, the Gram-negative and Gram-positive organisms showed a reduction in their growth on treatment with the ethanolic extract of *Tridax procumbens*. The observed antimicrobial activity against the tested organisms could be due to the presence of tannins and cyanogenic glycosides in the extract, as these have previously been reported to possess antimicrobial activities (Syed et al. 2020 Sharma and Sharma, 2010). These could explain the rationale for the use of the plant in the treatment of various ailments in traditional medical practice.

The degree of inhibition, measured by the disc diffusion method, shows Gram-negative bacteria are more susceptible to the active ingredients of the extract than the Gram-positive bacteria, in both the test ethanolic crude extract and the standard antibiotic positive control drug (ciprofloxacin 500 mg) (Table 5). Various researchers have reported similar findings (Seetharaman et al. 2025, Sharma and Sharma, 2010, and Mohale *et*

al., 2014). For instance, the highest inhibition zone in the Gram-negative group was 21 mm at 170 mg/mL for E. coli, while ciprofloxacin had an inhibition zone of 30 mm against the same organism. At its lower concentration, the extract is very effective, comparable to the higher concentration of the standard drug. Similarly, Seetharaman et al. (2025) reported that an MIC of 600 µg/mL was sufficient to elicit sensitive responses against *Mycobacterium tuberculosis* strains studied in vitro.

The extract at various concentrations had broad-spectrum antibacterial activity. Growth inhibition of the test organisms that are associated with several common infections pinpoints the use of the plant in traditional medical practice, with appreciable results.

The result also showed that the minimum inhibitory concentration (MIC) of the ethanol extract is 0.7 mg/mL. The MIC of *T. procumbens* extracts for different Gram-negative organisms was in the range of 0.7 – 2.7 mg/mL. For Gram-positive, the MIC was in the range of 21.3 – 170 mg/mL. MIC for the standard antibiotic ciprofloxacine was 17 mg/mL for both Gram-negative and Gram-positive bacteria. This suggests that ethanolic leaf extract of *T. procumbens* can be employed in the treatment of ailments caused by this range of bacteria, especially the Gram-negative bacteria: *E. coli*, *P. mirabilis*, and *Klebsiella sp*. The observed large MIC result against the Gram-positive bacteria could be due to the variation in the genetic makeup of the different classes of the test organisms.

The minimum bactericidal concentration (MBC) of the extract, in comparison to ciprofloxacin, a standard antibiotic, showed appreciable activity. MBC was observed within the range of 1.3 – 170 mg/mL for the Gram-negative bacteria. The Gram-positive bacteria showed a MIC range of 21.3 - 170 mg/mL and MBC of 42.5 – 170 mg/mL for *S. aureus* and *β-haemolytic streptococcus*. *Streptococcus* species did not show MBC with any concentrations of the extract. The ethanol extract showed moderate activity against *E. coli, P. mirabilis, Klebsiella species, S. aureus,* and *β-haemolytic streptococcus,* but the extract did not show any lethal activity against *Streptococcus* species, at the concentrations studied. This is in agreement with previous works (Mohamed *et al.,* 2010, Sharma and Sharma, 2010; Mohale *et al.,* 2014) on *T. procumbens* antimicrobial activity against pathogenic organisms.

The phytochemical screening of the ethanol extract showed the presence of alkaloids, tannin, saponin, flavonoid, carbohydrates and proteins (Table 6). This agrees with Seetharaman et al (2025) and Thalkari et al. (2020) who also reported on the rich presence of these secondary metabolites in the plant parts investigated. Ingole et al. (2022) attributed the myriad of observed medicinal effects of these herbal plants to the rich blend of these classes of compounds. The list of expected secondary metabolites, as indicated in the phytochemical analysis (Table 6) might not have been fully reflected in the GC-MS analysis results owing to the method of ionization adopted, as it was not primed primarily targeting a particular class of compounds. Hence, the analysis might have captured many molecules; however, we do not claim that this sufficiently represents all secondary metabolites present in the extracts investigated.

The GC-MS shows a spectrum of organic molecules. This result is similar to that of Jangid et al. (2025) whom reported the presence of alkaloids, flavonoids, carotenoids, β-sitisterol, n-hexane, fumaric acid, luteolin, quercitin, oxoester, lauric acid, myristic, palmitic, arachidic, linoleic acid and tannin, lauric acid, myristic, palmitic, Eicosane, Stearic acid, Octadecanoic acid, among others from *T. procumbens.* Other researchers also reported similar results (Ingole et al. 2022, Seetharaman et al. 2025, Baile and Parmar, 2025).

There are reports that plants rich in tannins have antibacterial potential due to their basic character that allows them to react with proteins to form stable water-soluble compounds, thereby eliciting lethal effect against the bacteria by directly damaging their cell membrane. This view was also expressed by Seetharaman *et al.* (2025). Probably, this could be one of the mechanisms of action of the ethanolic extract, which also showed the presence of tannins. It could also be due to the presence of alkaloids, which are found to have antimicrobial properties (Ingole et al. 2022).

5.0 Conclusion

The qualitative analysis of *T. procumbens* Linn (Compositae) from Benue Valley in Nigeria has revealed the presence of alkaloids, flavonoids, tannins, saponins, etc. The GC-MS analysis shows the presence of an array of organic molecules. The ethanolic extract has antibiotic properties with a minimum inhibitory concentration of 0.7 mg/mL. The MIC for different Gram-negative and Gram-positive bacteria was found to range between 0.7 – 2.7 mg/mL and 21.3 – 170 mg/mL, respectively. The Ethanolic extract of *T. procumbens* was found to have a lethal effect on some of the tested organisms, with MBC ranging from 1.3 – 170 mg/mL for the Gram-negative bacteria, while an MBC range of 42.5 – 170 mg/mL for *Staphylococcus aureus* and *β-haemolytic streptococcus* was observed. However, *Streptococcus species* did not show MBC with any concentrations of the extract.

Microorganisms are reportedly developing resistance to many antibiotics, and this has resulted in morbidity and mortality from treatment failure and increased health care costs. Thus, to stem the effect of multidrug resistance and obtain new, safe, cheap, easily accessible, and effective bioactive agents of herbal origin, it is hereby recommended that further research should be done on the crude extracts from the plant. This should include the

extraction and purification of the active organic molecules and *in vivo* studies. Therefore, a new raw material is hereby presented to the pharmaceutical, cosmetic, and food industries for further research towards obtaining new broad-spectrum antimicrobial agent(s), nutraceuticals, and other products of commercial value.

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