J. Chem. Soc. Nigeria, Vol. 49, No. 3, pp 301- 315 [2024]

GC-MS PROFILE AND SPECTRAL CHARACTERIZATION OF ETHANOLIC EXTRACTS OF *Tetrapleura tetraptera* PLANTS

[1]E.G. Adeyeni*,[2]E.T. Ayodele and [1]M. A. Onatolu.

[1]Department of Chemistry, Hallmark University, P.M.B. 2016, Ijebu-Itele, Ogun State, Nigeria
[2]Department of Pure and Applied Chemistry, Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Oyo State, Nigeria
egadeyeni@hallmarkuniversity.edu.ng, etayodele@lautech.edu.ng, and jamesadebayo43@gmail.com
* Corresponding Author:**egadeyeni@hallmarkuniversity.edu.ng**

ABSTRACT

Health challenges like arthritis, asthma, diabetes mellitus, hypertension, epilepsy, and similar conditions pose significant concerns for humanity. These issues contribute to various health complications, fatalities, and economic losses. Addressing these difficulties requires investigating the capabilities of plants like Tetrapleura tetraptera, renowned for its medicinal attributes. Although its advantages are acknowledged, there is a lack of thorough investigation. This study focuses on analysing the isolation, characterisation, and antibacterial properties of ethanol extracts from Tetrapleura Tetraptera. It provides valuable information for developing drugs to treat infectious diseases and related conditions. *Tetrapleura Tetraptera* was collected from Ijebu Itele, Ogun State. About 400 g of the samples were soaked in 4000 mL of ethanol. Subsequently, ultrasonic sonicator was applied for agitation, followed by decantation of the extracts. The acquisition of Fourier transform infrared (FT-IR) spectra was carried out using a Perkin Elmer Spectrophotometer and Gas Chromatography-Mass Spectrometry (GC-MS) was employed for analysis. The *TetrapleuraTetraptera's*analysis involved the use of FT-IR and GC/MS spectroscopic data to ascertain potential bioactive compounds in the plant extractsPhytochemical analysis indicated the existence of diverse phytoconstituents, likely linked to the occurrence of secondary metabolites in the plant. The FT-IR spectra exhibited the existence of hydroxyl, ester, and ketones, featuring significant peaks at 3387.11 cm^1, 1867.16 cm^1, and 1635.69 cm^1, correspondingly. The antimicrobial assessment demonstrated notable efficacy against examined fungi and bacteria, surpassing the performance of antibiotics outlined by the Clinical Laboratory Standard Institute (CLSI).The research findings suggest that *TetrapleuraTetraptera's* ethanolic extracts possess valuable bioactive compounds with significant medicinal properties. Consequently, these extracts could be considered as promising candidates for addressing infections induced by the fungi and bacteria investigated in the study.

Keywords: Phytochemical Constituents, Antimicrobial Activity, *Tetrapleura Tetraptera*, Ethanol extract, FTIR and GC-MS.

INTRODUCTION

Tetrapleura tetraptera, a robust perennial tree native to West, Central, and East Africa, is recognized for its yellow or pink flowers, shiny dark brown fruit, and various names across Nigerian ethnic groups. Appreciated for both nutritional and medicinal properties, it serves culinary purposes in Nigeria and is traditionally used to address health issues such as convulsions, leprosy, inflammation, and diabetes [1]. Notably, it contains essential phytochemicals and nutrients, offering therapeutic potential due to its richness in potassium, iron, calcium, zinc,

ISSN 0795 - 22066

flavonoids, tannins, alkaloids, and more [2].Extensive studies highlight *Tetrapleura tetraptera's* diverse health benefits, including hypolipidemic and hypokalemic effects [3]. Recognized by the World Health Organization, medicinal plants contribute significantly to global healthcare [4]. *Tetrapleura tetraptera's* bioactive compounds, crucial for its therapeutic potential, make it indispensable in managing various health conditions [2].

Despite reports on the antioxidant properties of *Tetrapleura tetraptera*, there's a gap in understanding its comparative antioxidant properties across leaf fractions and volatile oil constituents [5].Phytochemicals are known for their protective properties and are involved in disease prevention. Tetrapleura tetraptera is recognized for its cytoprotective, pesticidal, and antibacterial abilities. [6].The plant's application extends to soap production, benefiting from its antimicrobial and antibacterial properties. Notably, the ethanolic and water extracts of Aridan, the fruit of *Tetrapleura tetraptera*, exhibit molluscidal properties, serving as a pesticide against gastropod pests in agriculture [7]. Research aims to isolate and characterize bioactive compounds, shedding light on *Tetrapleuratetraptera*'s antimicrobial activities for potential drug design (Current research focus).In conclusion, *Tetrapleura tetraptera* stands as a valuable resource in traditional medicine, offering a range of health benefits attributed to its rich phytochemical composition. Ongoing research aims to deepen our understanding of its bioactive compounds, potentially opening avenues for novel drug development.



Fig 1: T. *Tetraptera* Fruitand Seed

ISSN 0795 - 22066

MATERIALS AND METHODS

Plant Collection and Authentication

The gathering of *Tetrapleuratetraptera* plants *occurred* on November 11, 2022, in Ijebu Itele, Ogun State, South-West Nigeria. The plant samples obtained were later identified and authenticated atthe Forestry Research Institute of Nigeria's (FRIN) medicinal plant section which is located in Jericho, Ibadan, Oyo State.

Plant Sample Preparation

Tetrapleura tetraptera underwent air-drying, followed by pulverization into a fine powder using an electric Kinelco blender. The resulting powder was then stored in a container devoid of moisture.

Reagents Used

The reagents of analytical grade utilized were obtained from the Bristol Scientific Company, an authorized distributor of Sigma-Aldrich in Nigeria.

Plant Sample Extraction

A quantity of 500g fromsamples underwent immersion in 4000 mL of ethanol. Agitation took place for a duration of 1 hour at room temperature (27^oC) using an ultrasonic sonicator.

Qualitative Phytochemical Screening of Plant extracts

Conducting a chemical examination of *Tetrapleura tetraptera* involved phytochemical analysis using established methods outlined by [8, 9]. The objective was to categorise various types of secondary metabolites in plants and examine their phytochemical components.

Alkaloids

4mL test extracts were acidified in a steam bath using a 1% hydrochloric acid (HCl) solution in water. Next, each test tube was given 1 mL of the acidified solution, followed by the addition of Meyer's reagent in drops. The confirmation of alkaloid presence was indicated by the formation of a creamy white precipitate.

Tannins

In each extract solution, 2 mL received the addition of five drops of ferric chloride ($FeCl_3$). Subsequently, the appearance of a murky green precipitate was noted, indicating tannins' presence.

Anthraquinones

Separately, five (5) mL of this extracts underwent boiling in a water bath at 100°C with a solution containing 10% hydrochloric acid (HCl) for duration of 10 minutes. After cooling, the filtrate was mixed with an equal amount of trichloromethane ($CHCl_3$), and the addition of 10% ammonia (NH_3) solution to the mixture was followed by heating. The confirmation of authraquinones' presence was indicated through the development of a solution with a colour resembling rose-pink.

Glycosides

Each individual test tube included a test extract mixed with 5 mL of 50% sulfuric

ISSN 0795 - 22066

acid. The mixture was heated in boiling water for 15 minutes. Subsequently, Fehling's reagent was added, and the mixture was heated until it boiled. A brick-red precipitate was seen, indicating the presence of glycosides.

Reducing Sugars

The extracts in the test tube were individually mixed with distilled water and vigorously shaken before undergoing filtration. Subsequently, the filtrate was subjected to a 10-minute boiling period with Fehling's solutions A and B. The appearance of an orange-red precipitate affirmed the existence of reducing sugars.

Saponins

Two (2) mL of the extracts were combined with five (5) mL of distilled water, vigorously shaken, and then heated to boiling. The indication of frothing, resembling creamy milk with small bubbles, confirmed the existence of saponins.

Flavonoids

In distinct test tubes, four (4) mL of sodium hydroxide solution (NaOH) in water was introduced to individual extracts of about 2 mL. The confirmation of flavonoid presence was indicated by a yellow solution, which became colorless upon the addition of hydrochloric acid (HCl).

Phlobatanins

The extracts of about 5 mL were mixed with distilled water and then filtered. The filtrate obtained was subjected to boiling in the company of a 2% hydrochloric acid (HCl) solution. The confirmation of phlobatanin presence was established by observing a red precipitate in the solution.

Steroids

Adding concentrated sulfuric acid (H_2SO_4) of 5 drops toevery milliliter of individual test extract solutions resulted in the observation of a brownish-to-red color, indicating the presence of steroids.

Terpenoids (Salkowski test)

To create a layered solution, chloroform ($CHCl_3$) of 2mL in quantity and concentrated sulfuric acid (H_2S0_4) of 3mL in quantity were mixed with each 2 mL extract. The development of a reddish-brown color at the interface indicated the presence of terpenoids.

Phenolic

Adding precisely 4 drops of ferric chloride to 5 mL of extracts resulted in the emergence of phenols through the development of bluish-black.

Antimicrobial assays

Collection and maintenance of test microbes

This study utilised a combination of Gram-negative bacteria (Klebsiella Oxytoca, Escherichia coli, Proteus Mirabilis) and a Gram-positive bacterium (Bacillus Subtilis), together with three fungi (Aspergillus

ISSN 0795 - 22066

fumigatus, Aspergillus niger, Aspergillus flavus). The microorganisms were obtained from the Department of Microbiology at LAUTECH Teaching Hospital in Ogbomoso, Oyo State, Nigeria, derived from well-established stock cultures. Maintenance required storing agar slants in Mc-Cartrey bottles in a refrigerator.

Antimicrobial Activity of Extracts against Selected Microorganisms

The receptiveness investigations were carried out using a modified agar-well diffusion method to investigate the impact of antimicrobial substances on the extract. The agar served as the substrate for diagnostic sensitivity testing. Cultures were prepared in triplicate and incubated at 37 °C for 24 hours. A mixture of 0.2 mL of the broth culture containing the test bacteria and fungus was combined with 18 mL of sterile molten agar in sterile Petri dishes for diagnostic sensitivity. Using a sterile cork borer, holes were made and 50 L of each extract (n-hexane, ethyl acetate, and ethanol) was added after being dissolved in the corresponding extraction solvent. Streptomycin was used as the standard agent at a dosage of 1 mg/ml. The plates were kept at 37 °C for 18-24 hours before measuring the sizes of microbial growth inhibition zones in millimetres. The Minimal Inhibitory Concentration (MIC) for each extract was then established.

Fourier Transform Infrared analysis

The acquisition of Infrared (IR) spectra was conducted utilizing a Fourier transform infrared spectrophotometer (FT-IR) manufactured by Perkin Elmer Spectrum 100, featuring a universal attenuated total reflector (ATR) sampling accessory. Fourier transform infrared spectroscopy (FTIR) was applied for the identification of functional groups in each fraction of isolated samples, utilizing the Spectra 100 instrument from Perkin Elmer in the United States.

Gas Chromatography-Mass Spectrometry analysis

The examination utilized gas chromatography-mass spectrometry (GC-MS) employing a distinctive device (QP-2010 Ultra Shimadzu, Japan) and a DB-5MS capillary column (30 m length, 0.25 m internal diameter, and 0.25 m film thickness) functioning in SCAN mode. Helium was employed as the carrier gas with a flow rate of 0.72 mL/min and a total flow of 31.8 mL/sec, characterized by a specific linear velocity, along with a purge flow of 3.0 mL/min.The injection port and detector were maintained at temperatures of 250 °C and 300 °C, respectively. The oven temperature program commenced with an initial setting of 60 °C for 0 minutes, followed by a gradual increase to 300 °C at a rate of 10 °C/min, and a subsequent 16-minute stabilization

ISSN 0795 - 22066

period. A splitless injection mode with a 1 L injection volume was utilized.

RESULTS AND DISCUSSION

Results

Qualitative Phytochemical Analysis of Phyto Constituents in Alkaloids, terpenoid, Saponin,Glycoside, Phenol, flavonoid, Steroids, Tannin, Anthraquinones, Reducing Sugar

The phytoconstituents present in *Tetrapleura tetraptera*a represented in Tables 1

Table 2 showed that among the plants secondary metabolites tested, in Alkaloids, terpenoids, Saponins,Glycosides, Phenols, flavonoids, Steroids, Tannins, Anthraquinones, Reducing Sugar

This result showed *Tetrapleura tetraptera* to be very rich in phyto-constituents and the best solvent for extraction according to this research work is ethanol because of its potency and medicinal values, which could be attributed to the presence of plant secondary metabolites which were found to be polar in nature.

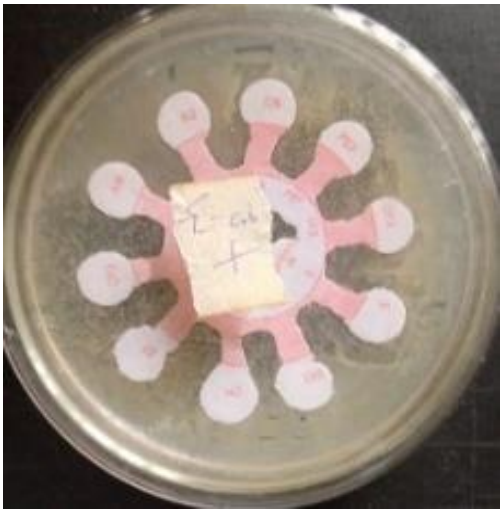
Table 1 Results of Phytochemical screening of the crude extracts of ***Tetra-pleura Tetraptera***

Phytoconstituents	(EtoH)
Alkaloids	++
Glycosides	++
Flavonoids	++
Tannins	++
Saponins	++
Terpenoids	++
Phenols	++
Steroids	++
Anthraquinones	++
Reducing Sugar	++
Phlobatanins	++

++ = Sufficient

ISSN 0795 - 22066

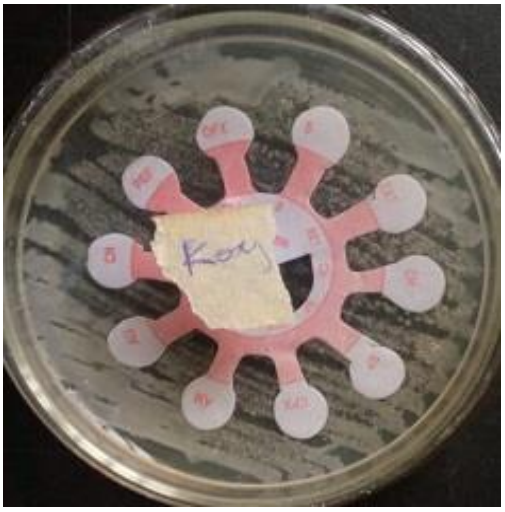
ANTIMICROBIAL ANALYSIS OF CRUDE EXTRACTS OF Tetra-pleura Tetraptera



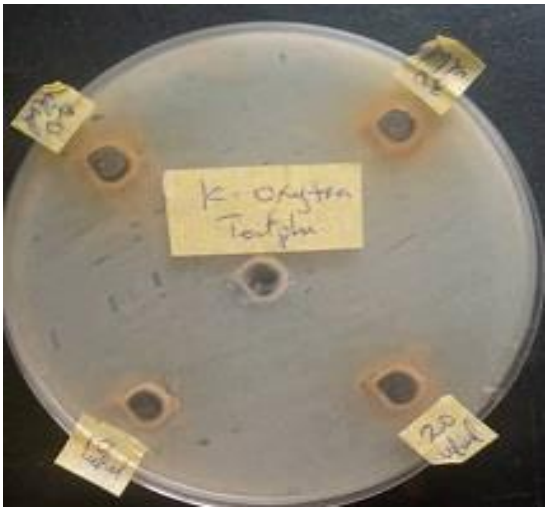
Escherichia coli (Gram Negative)



Escherichia coli (Gram Negative)



Klebsiella Oxytoca(Gram Negative)

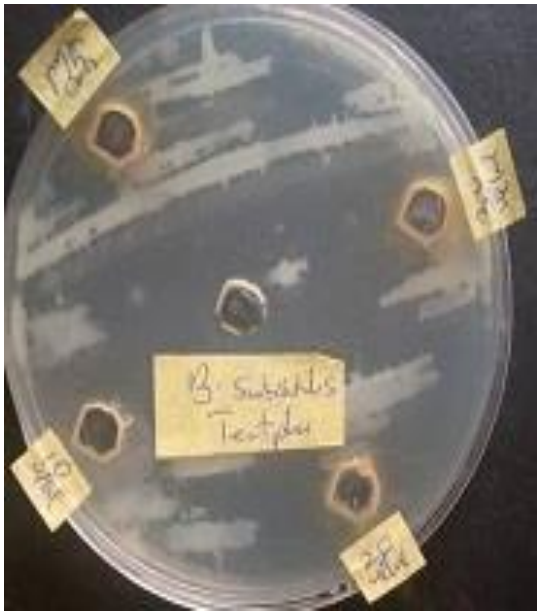


Klebsiella Oxytoca(Gram Negative)

ISSN 0795 - 22066



Bacillus Subtilis(Gram Positive)



Bacillus Subtilis (Gram Positive)



Proteus Mirabilis (Gram Negative)



Proteus Mirabilis(Gram Negative)

Fig. 2*Antibacterial activities of Tetrapleura Tetraptera*

ISSN 0795 - 22066

Table 2: Antifungal Activity of Tetrapleura tetraptera Extract

Test Organism	Control ($D_{control}$) (mm)	Plant Extract mm	($D_{control}$)	Plant inhibition
A. fumigates	67.3	24.6		63.45
A. niger	72.8	18.4		74.73
A. flavus	73.5	9.5		87.07

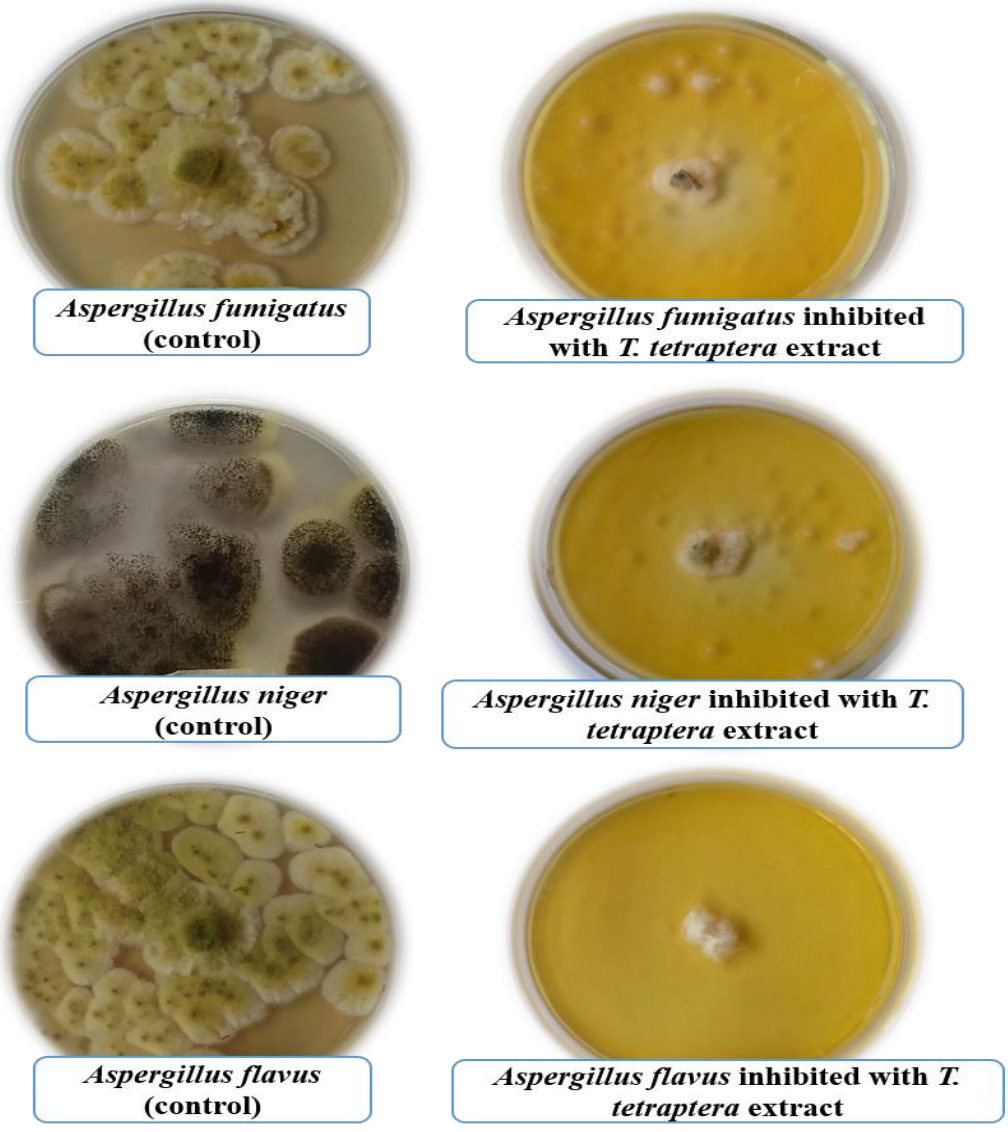
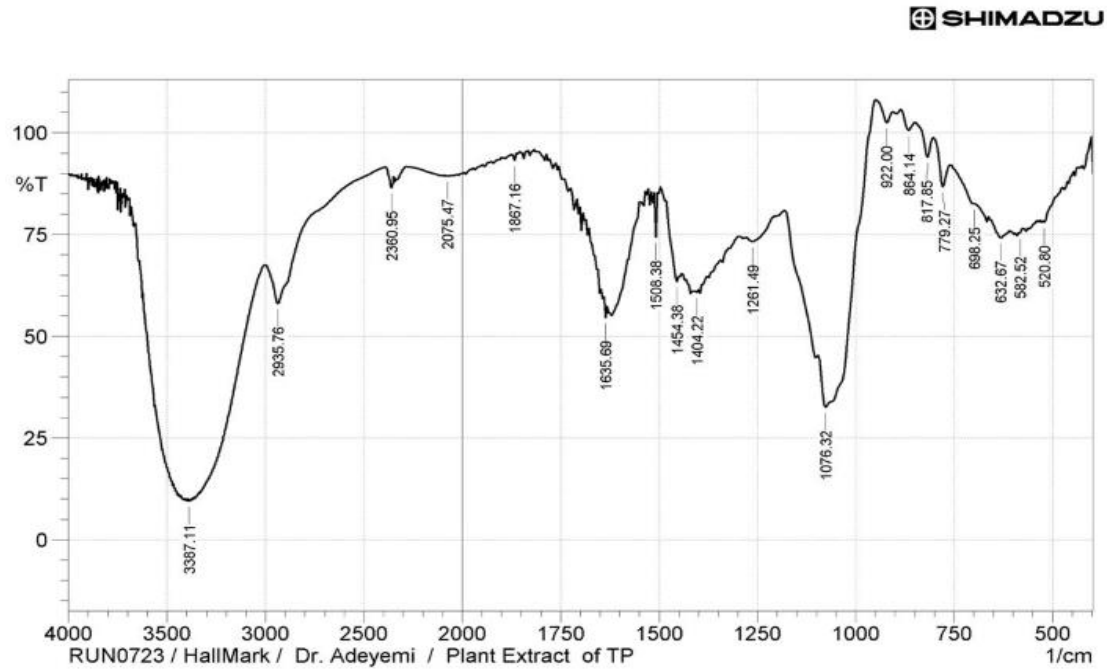


Fig. 3. Antifungal Activity of Tetrapleura tetraptera Extract.

ISSN 0795 - 22066



	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	520.8	77.963	1.117	524.66	474.5	4.2	-0.006
2	582.52	75.311	0.453	586.38	574.81	1.388	0.005
3	632.67	74.207	3.268	663.53	609.53	6.455	0.538
4	698.25	82.502	0.594	759.98	694.4	3.932	0.029
5	779.27	86.748	8.418	802.41	759.98	1.547	0.682
6	817.85	93.947	6.122	848.71	802.41	0.302	0.437
7	864.14	100.595	3.354	883.43	848.71	-0.34	0.267
8	922	102.506	3.757	949.01	906.57	-0.916	0.271
9	1076.32	32.545	21.04	1095.6	949.01	37.582	15.823
10	1261.49	73.26	2.217	1276.92	1207.48	8.546	0.628
11	1404.22	60.786	0.502	1408.08	1400.37	1.654	0.014
12	1454.38	63.446	6.533	1496.81	1442.8	7.257	0.603
13	1508.38	74.37	10.881	1512.24	1504.53	0.763	0.229
14	1635.69	54.549	3.949	1639.55	1631.83	1.914	0.117
15	1867.16	93.228	1.676	1874.87	1863.3	0.304	0.038
16	2075.47	89.381	0.07	2079.33	2071.62	0.375	0.001
17	2360.95	86.486	3.464	2387.95	2349.38	2.001	0.313
18	2935.76	57.972	11.98	2997.48	2391.81	62.622	6.516
19	3387.11	9.51	0.332	3390.97	3383.26	7.827	0.057

Comment;
RUN0723 / HallMark / Dr. Adeyemi / Plant Extract of TP

Date/Time; 7/18/2023 6:57:49 PM
No. of Scans;
Resolution;
Apodization;

Fig. 4: FTIR analysis of crude extract of Tetrapleura Tetraptera

ISSN 0795 - 22066

Table 3.Assignments of fundamental peaks or bands

Absorption Bands	Type of Vibrations	Frequency of Vibration
OH (Hydrogen bonded)	Stretching	3387.11 cm^{-1}
=C-H Alkenes	Stretching	2935.76cm^{-1}
C-H Aliphatic	Stretching	2360.95 cm^{-1}
C=C-C Alkenes	Stretching	1867.16 cm^{-1}
C= O of Ester	Stretching	1635.69 cm^{-1}
CH_3 of methylene.	Stretching	1076.32cm-1

Stretching

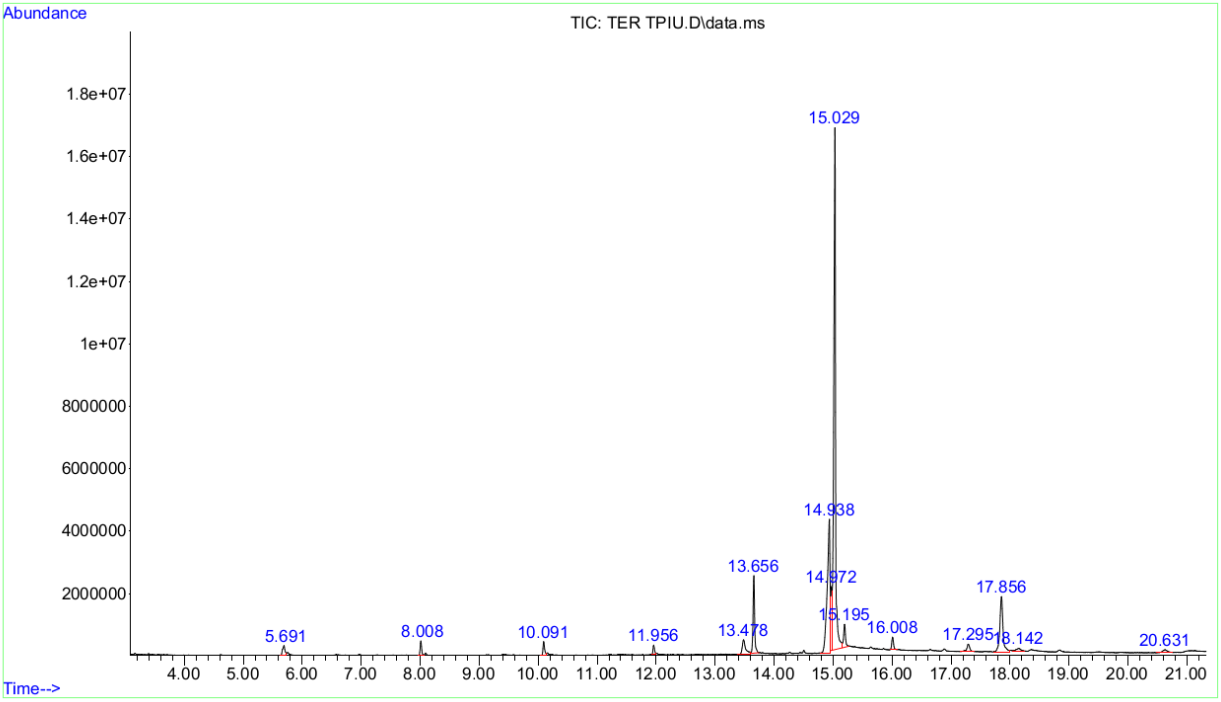


Fig. 5 GC/MS spectral of crude extract of Tetra-pleuraTetraptera

Discussion

An analysis of the phytochemical components responsible for the properties of Tetrapleura Tetraptera was conducted using ethanol as the solvent. Alkaloids, glycosides, terpenoids, saponins, phenols, steroids, anthraquinones, reducing sugars, and phlobatanins were detected in the plant secondary metabolites analysed. The analysis revealed that the plant under examination contains a high concentration of phytochemicals. Table 3 displayed the absorption bands of crude extracts of Tetra-pleura Tetraptera, including peaks at 3387.11 cm-1 (O-H of hydrogen bonding str.), 2935.76 cm-1 (C-H aliphatic str.), 1867.16 cm-1 (C=O of esters str.),

ISSN 0795 - 22066

1635.69 cm-1 (C=O of ketones str.), and 1076.32 cm-1.

FT-IR absorption spectra were used to identify the functional groups in pure compounds, aiding in the structural elucidation and identification of bioactive chemicals. This can help determine the molecules responsible for the therapeutic characteristics of the plant being studied. The FT-IR analysis in Table 3 showed the existence of hydroxyl, ester, olefin, and ketones. The absorption peaks observed were at 3387.11 cm-1 (O-H of hydrogen bonding str.), 2935.76 cm-1 (C-H aliphatic str.), 1867.16 cm-1 (C=O of esters str.), 1635.69 cm-1 (C=O of ketones str.), and 1076.32 cm-1. These peaks suggest the presence of various medicinal plant secondary metabolites like alkaloids, glycosides, terpenoids, saponins, phenols, steroids, anthraquinones, reducing sugars, and phlobatanins in the studied plants. The antimicrobial test showed the effects of various doses of Tetrapleura tetraptera crude extracts dissolved in ethanol on the examined bacteria. The results demonstrated stronger inhibitory effects against all tested microorganisms at a dosage of 50 mg/ml. The results clearly showed that only ethanol extracts had significant action against the examined bacteria. The results indicate that ethanol was more effective than other solvents in extracting the active compounds from these plant components. [12, 13].The ethanol extracts contain alkaloids, terpenoids, saponins, glycosides, phenols, flavonoids, steroids, tannins, anthraquinones, and reducing sugar. This validates the antibacterial and antifungal characteristics. Research by [14, 15] demonstrated that ethanol was the most efficient and effective solvent for extracting phytochemical components from plant materials. Ethanol is the most suited solvent for extracting phytoconstituents from plant materials due to its polar character.

The antifungal activity of *Tetrapleura tetraptera* extract showed significant mycelial inhibitory properties against the growth of *Aspergillus fumigatus, Aspergillus niger,* and *Aspergillus flavus*. The *Tetrapleura tetraptera* extract showed inhibitions of 63.45, 74.73, and 87.07% against *Aspergillus flavus, Aspergillus fumigatus,* and *Aspergillus niger,* respectively.

Tetrapleura tetraptera has been traditionally used for various medicinal purposes due to its numerous bioactive compounds. One of its potential medicinal properties is its antibacterial effect [16], but there is a dearth of information on its antifungal effect on molds. Antifungal properties are essential for combating fungal infections and preventing the growth of mold in various settings. Molds are a type of fungus that can grow on surfaces, food items, and even within the human body under certain conditions [17, 18]. *Tetrapleura tetraptera* contains several bioactive compounds that could contribute to its antimicrobial activities; some of the primary compounds responsible for this effect include alkaloids, tannins, flavonoids, saponins, and phenolics [19, 20]. These compounds possess

ISSN 0795 - 22066

various mechanisms of action that can inhibit the growth and development of mold.

There is still a dearth of information on the antifungal effect of *Tetrapleura tetraptera*. On the evidence of bioactive compounds present in the extracts from the plant, mold inhibitory activity against a range of mold species is possible, as is evident in this study, where the *Tetrapleura tetraptera* extract inhibited the mycelial growth of *Aspergillus fumigatus*, *Aspergillus niger*, and *Aspergillus flavus* by 63.45, 74.73, and 87.07%, respectively.

A GC-MS was carried out to screen and identify the probable bioactive compounds present in the metabolite (Fig. 3.4). The GC-MS examination identified the bioactive compounds present in the samples and their peak areas. The identified compounds were confirmed based on their peak area and retention time. There were three (3) compounds present, and the first and third peaks' compounds occur in a fragment that bears a resemblance to the same compound. 6-Tetradecene, 1-Tridecene, and 7-Tetradecene were the most prominent compounds in the analyzed sample. Because it has the highest percentage area of 73.73% at 69.10 min, followed by 1-Tridecene with a percentage peak area of 67.86% at 83.10 min, and 7-Tetradecene with 61.66% at 56.10 min.

CONCLUSIONS

Phytochemical results from the ethanolic extracts of Tetra-pleura Tetraptera have shown that the medicinal (antibacterial and antifungal) properties of this plant depend on the presence of certain active ingredients such as Alkaloids, Glycosides, flavonoids, terpenoids, Tannins, Saponins, Phenols, Steroids, Anthraquinones, Reducing sugar, and phenolatanins, which have been known to be responsible for their medicinal, antimicrobial, and antioxidant properties, which account for their uses in traditional medicine for the treatment of different infections.

The Tetra-pleura Tetraptera shown a wide range of antibacterial and antifungal activity, leading to the identification of novel antibiotic compounds that could be used as selective medicines for infectious illnesses, chemotherapy, and control. The effectiveness of these plants against specific pathogens indicates their potential as an alternative treatment option in light of antibiotic resistance.

An alleged bioactive component from the plants being researched was identified using GC-MS spectroscopic analysis and compared with existing published data. The research confirmed that Tetra-pleura Tetraptera plants contain bioactive chemicals with medical and pharmacological significance. Hence, they are suggested as promising options for treating infectious disorders and for medication design and development.

ISSN 0795 - 22066

REFERENCES

1. Abubakar Bello, Fatima Batul Mukhtar and Alexandra Nora Muellner-Riehl (2021): Diversityand Distribution of Nigerian Legumes (Fabaceae). The Open JournalSystems Vol. 480 No. 2. DOI: https://doi.org/10.11646/phytotaxa.480.2.1

2. Thank God Anyamele, Promise Nnaemeka Onwuegbuchu, EziucheAmadikeUgbogu, Chibuike Ibe (2023): Phytochemical composition, bioactive properties, and toxicological profile of Tetrapleura tetraptera. Epub. Feb: 131:106288. doi: 10.1016/j.bioorg.2022.106288.

3. Abayomi M Ajayi, Olubunmi O Diya, Aduragbenro Deborah A Adedapo (2020): Hypolipidemic Effect of *Chrysophyllum albidum* Peel Extract and Its Underlying Antioxidant Mechanisms in Normal and Triton-X-100-Induced Hyperlipidemic Rats. Epub.17 (4):365-383. doi: 10.1080/19390211.2019.1591563

4. World Health Organization, 2019. ISBN**:** 9789241565707.

5. Beatriz Vieira da Silva, João C.M. Barreira and M. Beatriz P.P. Oliveira (2016): Natural phytochemicals and probiotics as bioactive ingredients for functional foods: Extraction, biochemistry and protected-deliverytechnologiesTrends in Food Science & Technology, 50 (2016), pp. 144-158, 10.1016/j.tifs.2015.12.007

6. Esther BenafeghaEnaregha, Sylvester Chibueze Izah and Queen Okiriya(2021): Antibacterial Properties of Tetrapleura tetraptera pod against some pathogens. Res R ev Insights, Volume 5: 3-4. doi: 10.15761/RRI.1000165

7. Fokunang, C.N., Ndikum.V., Tabi. O.Y., Jiofack, R.B., Ngameni, B., Guedie, N.M., Tembe-Fokunang, E.A., Tomkins, P., Barkwan,S., Kechia F., Asongalem, E., Ngoupayou, J., Torimiro,Torimiro, III.A., Abena, O.M., Ngogang, J., Asonganyi, T., Colizzi, V., Lohoue, J., and Kamsu (2011): *Traditional Medicine*: Past, Present and Future Research and Development Prospects and Integration in the National Health System of Cameroon; 8(3): 284–295. doi: 10.4314/ajtcam. v8i3.65276

8. Sofowora, A (1983): Medicinal Plants and Traditional Medicine in Africa. John Wiley and son Limited. 150 -153. doi: 10.4314/ajtcam. v8i3.65276.

9. Trease, G.E., and Evans, W.C (1989): Pharmacognosy.11th Edn. BrailliarTiridel and Macmillian *Publishers, London.*38(6)**:**542-552. DOI: 10.4236/jcpt.2019.93003

10. Ezekiel Gbadebo Adeyeni, Ezekiel Temidayo Ayodele, Taofik Adewale Adedosu, Olusola Nathaniel Majolagbe and Ruth Adeola Adeyeni (2020): Phytochemical Constituents and Anti-inflammatory Activities of *Momordicaaugustisepala* Seed and Stem Species Grown in Nigeria, *Modern Chemistry*. Volume 8, Issue 4, pp. 54-63. doi: 10.11648/j.mc.20200804.12

11. Garrod, L.P., Lambert, H.P., Grady, F.O., and Waterworth, P.M (1981): Antibioresistance of Escherichia coli strains isolated in morocco from chicken with colibacillosis. *Journal of Ethnopharmacology* 4(43): 325-330 doi: 10.11648/j.mc.20200804.12

12. Okemo, P.O (1996): Antimicrobial efficacy of selected medicinal plants used by Kenyan Herbal doctors. Ph.D. thesis, Kenyatta University of Nairobi. 173-90.doi: 10.4314/ajtcam.v5i1.31256

ISSN 0795 - 22066

13. Hedberg I, Hedberg O, Madati P, Mshigeni KE, Mshiu EN, and SamuelssonG (1983): Inventory of plants used in traditional medicine in Tanzania.II. Plants of the family Dilleniaceae to Opiliaceae*Journal of Ethnopharmology*9:105-128. doi: 10.1016/0378-8741(83)90030-2.

14. Eloff, J.N (1998): Which extractan should be used for screening andisolation of antimicrobial Components from plants *Journal of Ethnopharmacology*60:1-8.doi: 10.1016/s0378-8741(97)00123-2

15. Cowan, M.M (1999): Plant products as antimicrobial agents. *Clinical Microbiolgy.12*: 564-582.doi: 10.1128/CMR.12.4.564.

16. Enaregha, E. B., Izah, S. C., andOkiriya, Q (2021): Antibacterial Properties of Tetrapleura tetraptera pod against some pathogens. Research and Review Insights, 5(1). https://doi.org/10.15761/rri.1000165

17. Robbins, C. A., Swenson, L. J., Nealley, M. L., Gots, R. E., and Kelman, B. J (2000): Health effects of mycotoxins in indoor air: A critical review. Applied Occupational and Environmental Hygiene, 15(10), 773–784. https://doi.org/10.1080/1047322005012 9419

18. Alshannaq, A., and Yu, J. H (2017): Occurrence, toxicity, and analysis of major mycotoxins in food. International Journal of Environmental Research and Public Health, 14(6), 632. https://doi.org/10.3390/ijerph14060632

19. Enema, U. U. O (2019): Phytochemical and Antioxidant Studies of Leaf of Tetrapleura Tetraptera (Schum and Thon) Taubert (Mimosaceae). Zenodo (CERN European Organization for Nuclear Research). https://doi.org/10.24942/bjpmr.2019.049 0

20. Adusei, S., Otchere, J. K., Oteng, P., Mensah, R. Q., and Tei-Mensah, E (2019): Phytochemical analysis, antioxidant and metal chelating capacity of Tetrapleura tetraptera. Heliyon, 5(11), e02762. https://doi.org/10.1016/j.heliyon.2019.e 02762

ISSN 0795 - 22066