British Journal of Pharmaceutical and Medical Research Vol.04, Issue 03, Pg.1865-1875, May-June 2019

Available Online at http://www.bjpmr.org

BRITISH JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

Cross Ref DOI : https://doi.org/10.24942/bjpmr.2019.490 Volume 04, Issue 03 May-June 2019

ISSN:2456-9836
ICV: 60.37

Research Article

Phytochemical And Antioxidant Studies Of Leaf Of *Tetrapleura Tetraptera* (Schum and Thon) Taubert (Mimosaceae)

OJ Enema[1], UF Umoh[1], PS Thomas[1], SK Adesina[1], and OA Eseyin[2]

[1]Department of Pharmacognosy and Natural Medicine, Faculty of Pharmacy, University of Uyo, Uyo, Nigeria.
[2]Department of Pharmaceutical and Medicinal Chemistry, Faculty of Pharmacy, University of Uyo, Uyo, Nigeria.

ARTICLE INFO

Article History:
Received on 11th May, 2019
Peer Reviewed on 24th May, 2019
Revised on 14th June, 2019
Published on 29th June, 2019

Keywords:
Phytochemical, Antioxidants, Concentration, Oxidation, Ethnopharmacology

ABSTRACT

Tetrapleura tetraptera (Schum and Thon) Taubert (Mimosaceae) has numerous ethnopharmacological relevance, the plant has played significant roles in the management of numerous health conditions including ulcer, inflammations, arthritis, malaria and even as molluscicidal agent. This research was aimed at evaluating the phytochemical and antioxidant properties of both fractions and volatile oil of leaf of T. tetraptera. Soxhlet apparatus was used in extraction of the leaves into fractions of n-hexane, dichloromethane, ethyl acetate, and methanol, respectively. Determination of total phenolic content, ferric reducing powers (FRAP) assay, and 2,2- diphenyl-1- picrylhydrazyl (DPPH) radical scavenging assay, were used to determine the antioxidant power. Isolation and purification of volatile oils of n-hexane fraction involved chromatographic techniques. Results of total phenolic content showed that methanol fraction had highest phenolic content of 16.66±0.0012 mg, and 4.165 mg GAE/g, and this is statistically significance at $p<0.001$. DPPH radical scavenging activity assay also showed an increase in percentage inhibition with a corresponding increase in concentration, sample NH1 (volatile oil) showed greater percentage inhibition of 80 %, and was statistically significant at $p<0.001$. The FRAP assay also showed an increase in percentage inhibition with a corresponding increase in concentration, this is also significant at $p<0.001$. The GC-MS of the volatile oil showed the presence of 25 compounds which are basically esters, terpenoids, alkenes, alkanes and fatty acids. From the results of this study, it can be inferred that various fractions and volatile oil of leaf of T. tetraptera may be used as antioxidant agents.

Corresponding Author: *OJ Enema, Department of Pharmacognosy and Natural Medicine, Faculty of Pharmacy, University of Uyo, Uyo, Nigeria*

INTRODUCTION:

T. tetraptera is an indispensible medicinal plant, it has proven efficacy in the management of numerous health conditions. It is valuable because it contains high amount of essential phytochemicals and nutrients that are significant for the normal functioning of the body, the plant is an excellent source of potassium, iron, calcium, zinc, phosphorus, flavonoids, tannins, alkaloids, saponins, steroids and phenolic compounds [1].

Studies have shown that T. tetraptera has potent molluscicidal properties [2] [3] [4] [5] [6]. The anticonvulsant and hypotensive properties of T. tetraptera have been reported by many researchers [7] [8] [9] [10] [11]. The extract of this plant is also known for its anti-inflammatory properties and its use in the management of leprosy has also been reported 12] [13] [14] .The potential activity of extracts of T. tetraptera fruit as an antioxidant, hypoglycaemic and hepatoprotective and antipathogenic agent have been reported [15] [16] [17] [18] [19] [20] [21] [22] [23]. The economic and medicinal importance of T. tetraptera are many; the fruits have been widely used in Nigeria for the manufacturing of seasoning spices, pomades and soaps due to its pleasant aroma characteristics and used in Ghana as additive to soups and as a source of vitamin and to prevent postpartum contractions [24] [25].

Oxygen as a major requirement for the continuous existence of life produces free radicals in the mitochondria in the process of oxidative phosphorylation and the production of Adenosine triphosphate (ATP). These free radicals cause oxidative stress which plays a significant role in the development of human diseases. Numerous diseases including cancer, diabetes, cardiovascular diseases, rheumatic arthritis etc can result from the over-production of free radicals in the body. Although reports has been made on the antioxidant properties of aqueous and ethanol fractions of the leaf of T. tetraptera there are no such reports the comparative antioxidant properties of gradiently extracted fractions of the leaf of T. tetraptera and the constituents of a column obtained volatile oil[27].

MATERIALS AND METHODS

Plant collection and Identification

The leaves of T. Tetraptera were collected from the front of Post Graduate Laboratory, Department of Pharmacognosy and natural medicine, University of Uyo. The plant was identified by a taxonomist in the Department of Botany and Ecological Studies with the herbarium number UUPHA32(f) and voucher specimen deposited in the herbarium of the Department of Pharmacognosy and natural medicine, University of Uyo, Uyo, Nigeria.

Preparation of Extract

T. tetraptera leaves were air dried and coarsely powdered. About 650 g of the powdered plant material was extracted continuously using soxhlet apparatus and successively with n-hexane, dichloromethane, ethyl acetate and methanol, respectively, and dried to obtain different fractions.

Phytochemical Screening

The various soxhlet extracts of T. tetraptera were screened for secondary metabolites using standard methods [28]

Open Column Chromatography

The column chromatography was carried out the n-hexane fraction (30 g) using Rotaflo glass column. Silica gel – G mesh 60 – 200 (Burgoyne, India) was used as adsorbent and a wad of glass wool was inserted into the constriction just above the stopcock prior to the packing of the column. Slurry of the silica gel was prepared in a beaker and transferred into the column to about ¾ of its length. The gel was allowed to settle uniformly by gentle tapping of the column to prevent channelling due to air bubbles. Filter paper was cut to fit the inner diameter of the column before loading the sample. A layer of sand was also introduced at the top of the sample to avoid disturbances when introducing the elution solvent systems. The flow rate of the column was kept constant at about 1ml/min and the fractions were collected in 20 mL using beakers. The eluates in beakers (3-11) were bulked and coded NH1 (volatile oil).

Gas chromatography – Mass Spectroscopy (GC-MS) Analysis of NH1 (volatile oil)

The analysis was done on Agilent 7890 A GC/ MS equipped with a Quadrupole Mass Spectra Detector and an Autosampler. GC-MS system settings were as follows; 200°C, interfaced temperature, 250°C,

solvent cut time; 2.50 min; relative detector mode, ACQ mode; Scan; start time – end time; 3.00 min – 56.00 min, event time, 0.50 sec; scan speed, 1428.

Ferric Reducing Antioxidant Power (FRAP) Assay

The FRAP activity of the plant extract and isolates were determined by the method described by [29]. Various concentrations (20, 40, 60, 80, 100 µg/mL) of volatile oil (NH1), and ascorbic acid (2.5 mL) were mixed individually with the mixture containing 2.5 ml of 0.2 m sodium phosphate buffer (pH 6.6) and 2.5 mL of Potassium Ferricyanide (K2Fe(CN)6) (1% w/v). The resulting mixture was incubated at 50oC for 20 min., 2.5 mL of trichloroacetic acid (10% w/v) was added. The resulting mixture was centrifuged at 650 rpm for 10 minutes. The upper layer of the solution (2.5 mL) was mixed with 2.5 mL of distilled water and 0.5 mL of ferric chloride (0.1% w/v. The absorbance was measured at wavelength 700 nm against a blank sample.

Determination of 2,2 – Diphenly – 1 – Picrylhydrazyl (DPPH) radical scavenging Activity)

The DPPH free radical scavenging activity of volatile oil and ascorbic acid prepared in methanol at various concentrations (20, 40, 60, 80, 100 µg/mL) was evaluated according to the method of [30]. 2,2 – Diphenyl – 1 – Picrylhydrazyl (0.1 mm, 1 ml) was added to 3ml of the solutions prepared with compounds volatile oil, and ascorbic acid and stirred for 1 minute. Each mixture was incubated in the dark for 30 minutes and absorbance (As) was measured at 517 nm. The assays were carried out in triplicates and the results expressed as mean values vs standard error of mean. The percentage DPPH scavenging effect was calculated using the following equation:

DPPH Scabenging effect (%) or percentage exhibition = [(A0 – As)/A0] x 100

Where Ao is the absorbance of control reaction and As is the absorbance of the test samples or standard sample (ascorbic acid).

Determination of Total Phenolic Content

The total phenolic content of the fractions was determined spectrophotometrically with folin – ciocalteu reagent 0.5 ml (1 mg/ml) of the fractions was mixed with 2.5 mL of 10% folin ciocalteu reagent and 2mL of Na2CO3 (7%). The resulting mixture was vortexed for 15 seconds and incubated at 40oc for 30 minutes for colour development. The absorbance of the samples was measured at 765 nm wavelength. 2.5 mL of water was added to different concentrations for the calibration curve of gallic acid. The total phenolic content was calculated from the calibration curve and the results were expressed as mg of gallic acid equivalent per gram dry weight. These were performed in triplicates [31].

Statistical Analysis.

Data was analyzed statistically using one way analysis of variance (ANOVA).

RESULTS

Table 1: Yield of Fractions

Fraction	Yield (g)
n-hexane	18.8
Dichloromethane	11.4
Ethyl acetate	7.2
Methanol	24.7

Table 2: Phytochemical Screening of Fractions of T. tetraptera

Test	n-hexane fraction	Dichloromethane Fraction	Ethyl acetate Fraction	Methanol Fraction
Phenols	+	+	+	+
Cardiac glycosides	-	-	-	-
Alkaloids	-	+	-	-
Terpenoids	+	+	+	+
Tannins	+	+	-	+
Flavonoids	+	-	+	+
Saponins	-	+	-	+
Anthraquinone	-	-	-	-

+ present

- absent

Figure 1: Gallic acid calibration curve

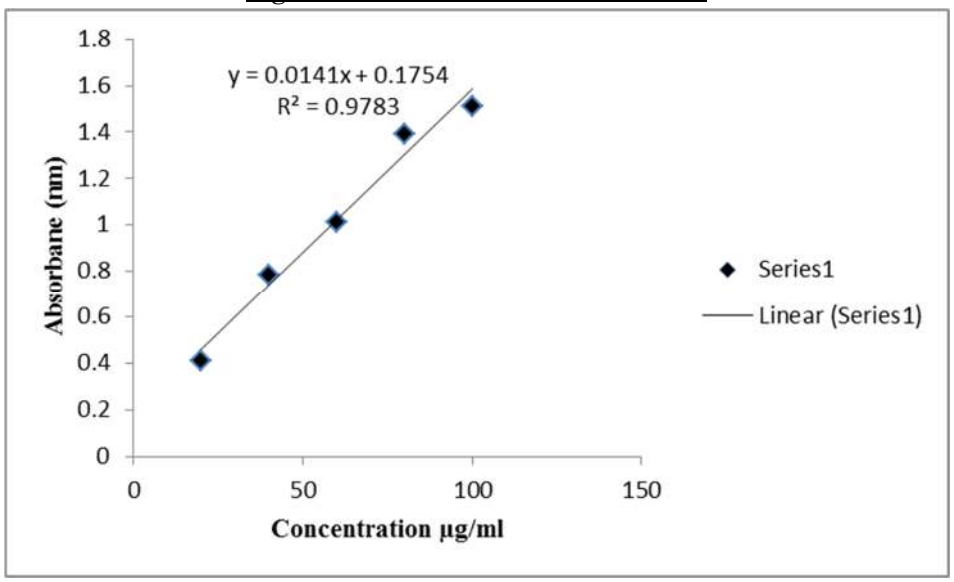

Table 3: Total phenolic content of fractions and gallic acid equivalent

Fractions	Total Phenolic (mg)±SEM	Gallic acid equivalent (mg GAE/g)
n-hexane	2.03±0.00152	0.507
Dichloromethane	5.72±0.00038	1.429
Ethyl acetate	13.16±0.0043	3.291
Methanol	16.66±0.0012	4.165

Table 4: 2,2 – Diphenly – 1 – picrylhydrazyl (DPPH) radical scavenging activity

CONC (µg/mL)	Ascorbic acid	n-hexane fraction	Dichloromethane fraction	Ethyl acetate fraction	Methanol fraction	Volatile oil
20	0.0550±0.0010	0.2813±0.0008*	0.3200±0.0012*	0.3267±0.0008*	0.2843±0.0008*	0.1773±0.0007*
	+93%	+64%	+59%	+58%	+64%	+79%
40	0.0537±0.0008	0.2703±0.0007*	0.3173±0.0007*	0.2210±0.0006*	0.2570±0.0006*	0.1763±0.0008*
	+93%	+67%	+60%	+72%	+67%	+79%
60	0.0553±0.0003	0.2603±0.0007*	0.2830±0.0006*	0.0973±0.0008*	0.2230±0.0012*	0.1743±0.0009*
	+93%	+67%	+64%	+87%	+72%	+80%
80	0.0533±0.0007	0.2217±0.0003*	0.2243±0.0009*	0.0950±0.0006*	0.2000±0.0006*	0.1737±0.0009*
	+93%	+72%	+72%	+88%	+74%	+81%
100	0.0533±0.0003	0.1987±0.0003*	0.2223±0.0009*	0.0833±0.0009*	0.1977±0.0009*	0.1713±0.0007*
	+93%	+75%	+72%	+89%	+76%	+80%

Values represent Mean±S.E.M
*Significance related to control: ᶜp<0.01; *p<0.001*
(n=3); ns=not significant

Table 5: FRAP for ascorbic acid and fractions and isolates from T. tetraptera Taub

CONC µg/Ml	Ascorbic acid	n-hexane fraction	Dichloromethane fraction	Ethyl acetate fraction	Methanol fraction	Volatile oil
20	0.3447±0.0003	0.2910±0.0006*	0.3010±0.0006*	0.3550±0.0006ᶜ	0.3177±0.0007*	0.3270±0.0006ᶜ
40	0.3617±0.0003	0.3233±0.0007*	0.3287±0.0003*	0.3673±0.0007ᶜ	0.3403±0.0007*	0.3493±0.0003*
60	0.4103±0.0003	0.3587±0.0007*	0.3163±0.0009*	0.3797±0.0007*	0.4667±0.0007*	0.3943±0.0003ᶜ
80	0.4523±0.0003	0.3913±0.0003*	0.3647±0.0013*	0.3837±0.0003*	0.4987±0.0003*	0.4097±0.0007*
100	0.4753±0.0003	0.4073±0.0003*	0.3723±0.0003*	0.4013±0.0003*	0.5657±0.0007*	0.4553±0.0003*

Values represent Mean±S.E.M
*Significance related to control: ᶜp<0.01; *p<0.001*
(n=3); ns=not significant

Figure 5: Gc-Ms spectra of volatile oil (NH1) of leaf of T. tetraptera

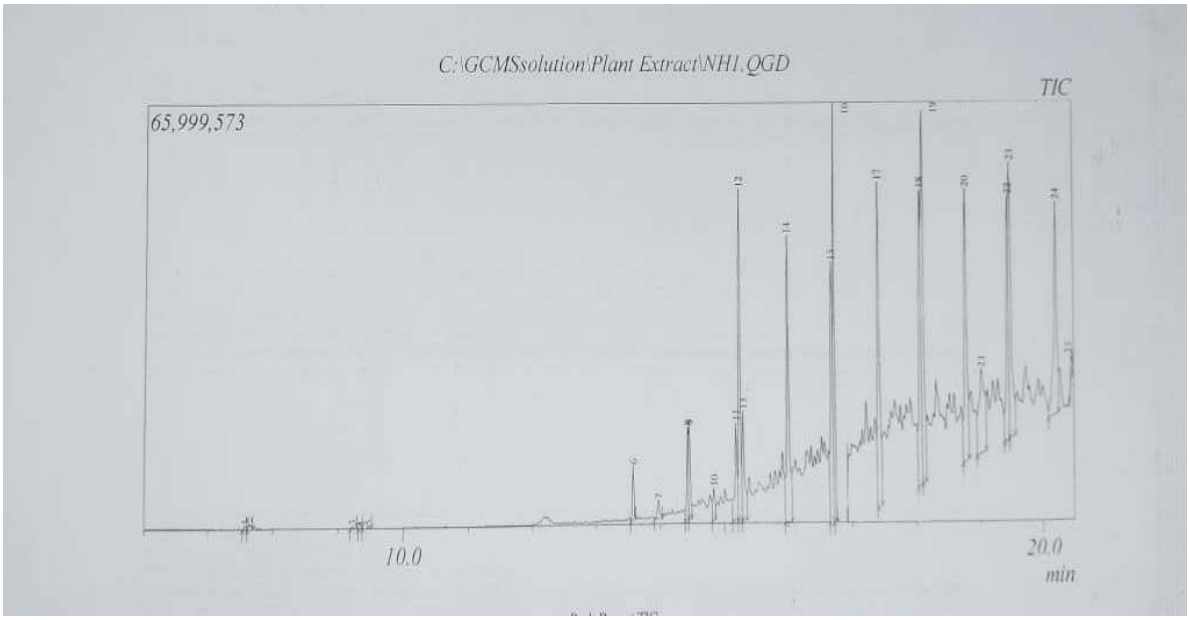

Table 6: Report peaks of gas chromatography-mass spectroscopy of volatile oil (NH1)

Peak	R.Time	Area	Area (%)	Height Molecular	Name(%)	Formula
1	7.57	1180683	0.08	0.08	$C_{10}H_{14}$	Benzene,1-methyl-3-
2	7.634	2633630	0.18	0.14	$C_{10}H_{16}$	Limonene
3	9.217	711221	0.05	0.05	$C_{10}H_{18}$	l-Menthone
4	9.34	188085	0.01	0.02	$C_{10}H_{18}$	Cyclohexanone, 5-methyl-2-(1-methylethyl)
5	9.459	620051	0.04	0.05	$C_{10}H_{20}$	Levomenthol
6	13.569	13115807	0.88	1.37	$C_{16}H_{34}$	Hexadecane
7	13.967	7179999	0.48	0.47	$C_{44}H_{90}$	Tetratetracontane
8	14.431	25305593	1.71	2.33	$C_{19}H_{40}$	Nonadecane
9	14.453	24312582	1.64	2.36	$C_{19}H_{40}$	Pentadecane,2,6,10,14- tetramethyl
10	14.836	11487502	0.77	0.81	$C_{25}H_{52}$	2-methyltetracosane
11	15.19	39366890	2.65	2.47	$C_{18}H_{36}$	1-Octadecene
12	15.253	108596434	7.32	8.48	$C_{20}H_{42}$	Eicosane
13	15.302	40416266	2.72	2.78	$C_{20}H_{42}$	Eicosane
14	16.013	112838101	7.6	7.32	$C_{20}H_{42}$	Eicosane
15	16.701	104307842	7.03	6.66	$C_{23}H_{46}$	9-Tricosene, (Z)-
16	16.748	88935007	5.99	10.8	$C_{20}H_{42}$	Eicosane
17	17.435	122639326	8.27	8.31	$C_{28}H_{58}$	Octacosane
18	18.089	126107100	8.5	7.54	$C_{21}H_{44}$	1-Heneicosanol
19	18.129	132138201	8.91	9.59	$C_{24}H_{50}$	Tetracosane
20	18.797	112418152	7.58	6.99	$C_{27}H_{56}$	2-methylhexacosane
21	19.035	84854245	5.72	2.15	$C_{54}H_{108}$	Tetrapentacontane, 1,54-dibromo
22	19.466	101078834	6.81	6.24	$C_{35}H_{70}$	17-Pentatriacontene
23	19.494	109489582	7.38	7.09	$C_{24}H_{50}$	Tetracosane
24	20.219	108867266	7.34	5.45	$C_{27}H_{56}$	2-methylhexacosane
25	20.464	5048092	0.34	0.43	$C_{54}H_{108}$	Tetrapentacontane,1,54-dibro

Table 7: NH1 Gas Chromatography-Mass Spectroscopy (GC-MS) Spectral Pharmacological Information

S/N	Volatile oil	Biological activity	Reference
1	Benzene,1-methyl-3-(1-methylethyl)-	Nothing reported	
2	Limonene	Promotes weight loss, anticancer, antioxidant	[32]
3	l-Menthone	Antibacterial, antifungal	[33]
4	Cyclohexanone,5-methyl-2-(1-methylethyl)	Nothing reported	
5	Levomenthol	Analgesic	[34]
6	Hexadecane	Nothing reported	
7	Tetratetracontane	Antioxidant, antibacterial	[35]
8	Nonadecane	Antioxidant, antifungal, antibacterial	[36]
9	Pentadecane,2,6,10,14-tetramethyl-	Antibacterial, antioxidant	[37]
10	2-methyltetracosane	Antioxidant	[38]
11	1-Octadecene	Nothing reported	
12	Eicosane	Antibacterial	[39]
13	Eicosane	Antibacterial	
14	Eicosane	Antibacterial	
15	9-Tricosene, (Z)-	Antifungal, antioxidant	[40]
16	Eicosane	Antibacterial	
17	Octacosane	Antibacterial	[41]
18	1-Heneicosanol	Antibacterial, antifungal	[42]
19	Tetracosane	Antioxidant, allelopathic, antibacterial	[43]
20	2-methylhexacosane	Antioxidant, antibacterial	[44]
21	Tetrapentacontane, 1,54-dibromo-17-Pentatriacontene	Antioxidant, antitumour, antiviral, hypolipidemic	[45]
22	Tetracosane	Antioxidant, allelopathic, antibacterial	
23	2-methylhexacosane	Antioxidant, antibacterial	[46]
24	Tetrapentacontane, 1,54-dibromo-	Nothing reported	

DISCUSSION

T. tetraptera Taub has played significant roles in the management of numerous health conditions. Antidiabetic, antipyretic, anticancer, antioxidant, analgesic, anti-inflammatory, anticonvulsive and antitussive properties have been reported with different parts of the plant [47]. The antioxidant activity of the leaf was evaluated in this study.

In Table 1, the methanol fraction gave the highest yield of 24.7 g and this is followed by n-hexane fraction which yielded 18.8 g. The yield of the ethyl acetate fraction showed 7.2 g while dichloromethane fraction gave 11.4 g, respectively. The phytochemical screening of various fractions of T. tetraptera showed the presence of secondary metabolites such as terpenoids, tannins, flavonoids, saponins, phenols, and alkaloids, respectively, others such as glycosides, cardiac glycosides and anthraquinones were reported absent.

The result of the total phenolic content differed from each fraction (Table 3). Data from table 3 revealed that n-hexane fraction had the least phenolic content of 2.03 mg while methanol fraction with 16.66±0.0012 mg had the highest phenolic content among the fractions. The total phenolic content of ethyl acetate fraction and dichloromethane fraction were 13.16±0.0043 mg and 5.72±0.00038 mg, respectively. The gallic acid equivalent of n-hexane fraction was the least and was recorded as 0.507 mg GAE/g. The methanol extract, ethyl acetate fraction, and dichloromethane fraction showed gallic acid equivalent of 4.165 mg GAE/g, 3.30 mg GAE/g, and 1.429 mg GAE/g, respectively. These

figures are in harmony with the reported total phenolic contents.

Determination of the 2, 2-diphenyl-1-picryhydrazyl (DPPH) radical scavenging activity showed gradual increase with in a dose-related manner for the various fractions and volatile oil as shown in Table 4. Ascorbic acid recorded consistent percentage inhibition of 93% at all concentration different from both fractions and volatile oil which showed increasing percentage inhibition with increase in concentration. The average percentage inhibition recorded were; 69% for n-hexane fraction, dichloromethane fraction (65.4%), ethyl acetate fraction (78.8%), methanol fraction (70%) and volatile oil (NH1) (80%) with the ethyl acetate with 78.8% percentage inhibition as the highest and dichloromethane fraction with 65.4% as the lowest. The volatile oil showed 80% which is 13% less active when compared with the standard (Ascorbic acid 93%), this result was statistically significant at $p<0.001$. This is consistent with the findings of an earlier report [48].

The ferric reducing power (FRAP) assay demonstrated a similar activity with the result of the 2, 2-diphenyl-1-picryhydrazyl (DPPH) radical scavenging activity with increasing percentage inhibition based on increasing concentration. The methanol fraction recorded the highest absorbance of 0.5657±0.0007 nm at 100 µg/mL comparable to ascorbic acid which recorded 0.4753±0.003 nm at 100µg/mL and these were statistically significant at $p<0.001$. This result supports an earlier report [49]. This evaluation supports the use of T. tetraptera Taub leaf as an antioxidant and is consistent with other findings in [50] [51].

The gas chromatography-mass spectroscopy spectra of sample NH1(volatile oil) as shown in Figure 2 shows the presence of 25 peaks and twenty volatile oils which are mainly terpenoids, esters, fatty acids, alkanes, phenols, alcohols and benzene derivatives. The identified volatile oils include; Benzene, 1-methyl-3-(1-methylethyl)-, Limonene, 1-Methone, Cyclohexanone, 5-methyl-2-(1-methylethyl)-, Levomenthol, Hexadecane, Tetratetracontane, Nonadecane, Pentadecane, 2,6,10,14-tetramethyl, 2-Methyltetracosane, 1-Octadecene, Eicosane, 9-Tricosene, Octacosane, 1-Heineicosanol, Tetrapentacontane, 1,54-dibromo-, 17-Pentatriacontene, Tetracosane, 2-Methylhexacosane, and Tetrapentacontane, 1,54-dibromo.

Volatile oils have played significant roles as antioxidant agents. Over 50% of these volatile oils have been reported as antioxidant agents as shown in Table 7. Phytochemical constituents of the volatile oil have shown valid applications as antibacterial, antioxidant, and anticancer, antifungal, antimicrobial and anti-inflammatory agents [57]. Tetracosane (C24H50) and 1-heneicosanol (C21H44) have the highest area (8.91 and 8.50%) respectively. 1-menthone and Cyclohexanone, 5-methyl-2-(1-methyl)- -(2 have same molecular formula (C10H18) as does nonadecane and pentadecane, 2,6,10,14-tetramethyl-.

CONCLUSION

Total phenolic content assay of various fractions indicated ethyl acetate fraction had highest amount of phenolic components, determination of the 2,2-diphenyl-1-picryhydrazyl (DPPH) radical scavenging activity showed 69%, 65.4%, 78.8%, 90%, 93%, 80%, 77.4% and 71.2% percentage inhibition for n-hexane fraction, dichloromethane fraction, ethylacetate fraction, methanol fraction, ascorbic acid, and the volatile oil, respectively. The ferric reducing power assay (FRAP) also showed a minimum of 557% percentage inhibition, the nitric oxide assay showed an average of 57.85% percentage inhibition. The gas chromatography-mass spectral the volatile oil showed the presence of 31 and 25 volatile oils respectively. 0ver 40% of these volatile oil content have been reported to possess antioxidant properties. These results support the use of various fractions and volatile oil (NH1) of T. tetraptera Taub as an antioxidant agent.

ACKNOWLEDGEMENT

All authors are grateful to the department of Pharmacognosy and natural medicine, faculty of pharmacy, university of Uyo, Nigeria for providing laboratory facilities.

REFERENCES

1. Akin-Idowu, P. E., Ibitoye, D. O., Ademoyegum, O. T., Adeniyi, O. T., (2011). Chemical composition of the dry fruit of T. tetraptera and its impact on human health. Journal of Herbs, Spices and Medicinal Plants. 17(2): 52-61
2. Adesina, S. K., Ojowole, J. O. and Marquis, V. O. (1980). Isolation and Identification of an Anti-convulsant agent from the fruit of Tetrapleura tetraptera (Aridan/Aidan). The Nigerian Journal of Pharmacy. 11(6):260-262.
3. Adewunmi, C. O., Adesina, S. K., and Marquis, V. O., (1982). On the laboratory and field evaluation of the molluscicidal properties of Tetrapleura

tetraptera fruit. Bulletin of Animal Health and Production. 30(4): 89-94.

4. Millard, M., Adewunmi, C. O., and Hostettman, K., (1989). New triterpenoid N-acetylglycosides with molluscicidal activity from Tetrapleura tetraptera Taub. Helvetica Chimica Acta. 72(8): 668-674.
5. Adewunmi, C. O. (1991). Plant Molluscicides: Potentials of Aridan, Tetrapleura tetraptera, for Schistosomiasis Control in Nigeria. Science of the Total Environment. 102 (2): 21-33.
6. Aladesanmi, J. A. (2007). Tetrapleura tetraptera: Molluscicidal Activity and Chemical Constituents. African Journal of Traditional, Complementary, and Alternative Medicine. 4(1): 23-36.
7. Adesina, S. K., (1978). Anticonvulsant Properties of Extracts of some Nigerian Medicinal Plants. The Nigerian Journal of Pharmacy. 9(5): 211-224.
8. Essien, E. E., Adesina, S. K. and Reish, J. (1983). Quantitative Analysis of Scopoletin in the Fruit of Tetrapleura tetraptera Fruit (Mimosoidae). Sci. Pharm. 51: 397-402.
9. Adesina, S. K. and Reisch, J. (1985). A Triterpenoid Glycoside from Tetrapleura tetraptera Fruit. Phytochemistry. 24(12): 3003-3006.
10. Ojewole, J. A. O., and Adesina, S. K., (1983). Cardiovascular and neuromuscular actions of scopoletin from the fruit of Tetrapleura tetraptera. Planta Med. 49(4): 46-50.
11. Akintola, O. O., Bodede, A. I., and Ogunbanjo, O. R., (2015). Nutritional and Medicinal Importance of Tetrapleura tetraptera Fruits (Aridan). African Journal of Science and Research. 6(4): 33-38
12. Adesina, S. K., and Reisch, J., (1985). A triterpenoid glycoside from Tetrapleura tetraptera fruit. Phytochemistry. 24(12): 3003-3006.
13. Ojowole, J. A. O. (2005). Analgesic and Anticonvulsant Properties of Tetrapleura tetraptera Taub. (Fabaceae) Fruit Aqueous Extract in Mice. Phytotherapy Research. 19(12): 1023-1029.
14. Aderibigbe, A. O., Iwalewa, E. O., Adesina, S. K., Adebanjo, A. O., and Ukponmwan, O. E., (2007). Anti-convulsant, analgesic, and hypothermic effects of aridanin, isolated from Tetrapleura tetraptera fruit in mice. Journal of Biological Science. 7(11): 1520-1524.
15. Ojowole, J. A. O., Adewunmi, C. O. (2004). Anti-inflammatory and Hypoglycaemic Effects of Tetrapleura tetraptera Taub. Fruit Aqueous Extract in Rats. Journal of Ethnopharmacology. 95(3): 177-1546.
16. Panda, S., and Kar, A. (2006). Evaluation of the Anti-thyroid, Anti-oxidative and anti-hypoglycaemic of Scopoletin from Aegle marmelos leaves in Hyperthyroid Rats. Phytotherapy Research. 20(12): 1103-1105.
17. Aderibigbe, A. O., Iwalewa, E. O., Adesina, S. K. and Agboola, O. I. (2010). Studies of Behavioural and Neural Mechanism of Aridanin Isolated From Tetrapleura tetraptera Fruit in Mice. International Journal of Pharmacology. 6(4): 480-486.
18. Nwozo, S. O. and Orojobi, B. F. (2010). Hypolipidemic and Antioxidant Effects of Tetrapleura tetraptera Fruit including Seeds in Hypercholesterolaemic Rats. Seed Science and Biotechnology. 4(1): 73-78.
19. Manaharan, T., Palanisamy, U. D. and Ming, C. H. (2012). Tropical Plant Extracts as Potential Hypoglycemic agents. Molecules. 17(34): 5915-5923.
20. Okoli, T. N. J., Agbo, M. O. and Ukekwe, I. (2014). Antioxidant andHepatoprotective Activity of Fruit Extracts of Tetrapleura tetraptera (Schum and Thonn) Taubert. Jordan Journal of Biological Sciences. 7(4): 251-255.
21. Achi, O. K. (2006). Composition and Antibacterial Activity of Tetrapleura tetraptera Taub Pod Extracts. Research Journal of Microbiology. 1(5): 416-422.
22. Ekwenye, U. N. and Okorie, C. F. (2010). Antibacterial Activity of Tetrapleura tetraptera Taub Pod Extracts. International Journal of Pharmacy and Biological Sciences. 1(4): 734-741.
23. Awofisayo, S. O., Udoh, I. E. and Mbagwu, H. O.C. (2010). Antibacterial Effects of the Aqueous and Ethanolic Extracts of Tetrapleura tetraptera Pods on the Pathogens in Nosocomial Wound Infections. Journal of Pharmacognosy and Herbal Formulations. 1(2): 18-23.
24. Okwu, D.O. (2001). Evaluation of the Chemical composition of Indiginenous Spices and Flavouring Agents. Global Journal of Pure and Applied Science. 7(8):445-459.
25. Okwu, D. E. (2003). The Potentials of Ocimum gratissimum, Pergularia extensa and Tetrapleura tetraptera as Spice and Flavouring agents. Nigerian Agricultural Journal. 35: 143-148.

26. Famobuwa, O. E., Lajide L., Owolabi B. J., Osho I. B., Amuho U. E., (2016). Antioxidant Activity of the Fruit and Stem bark of T. tetraptera Taub (Mimosaceae). British Journal of Pharmaceutical Research. 9(3): 56-71.
27. Soforowa, A., (1993). Medicinal Plants and Traditional Medicine in Africa, 2nd Ed. Ibadan: Spectrum Books Limited, pp 42-48, 99-108.
28. Soforowa, A., (1993). Medicinal Plants and Traditional Medicine in Africa, 2nd Ed. Ibadan: Spectrum Books Limited, pp 42-48, 99-108.
29. Yen, G. C., and Chen, H. Y., (1995). Comparison of antimutagenic effect of various tea extract (green, oolong, pouching and black tea). Journal of Clinical Investigation. 120(11): 3742-3744
30. Shekhar, T. C., and Anju, G., (2014). Antioxidant activity by DPPH radical scavenging method of Ageratum conyzoides Linn leaves. American Journal of Ethnomedicine. 1(4): 244-249.
31. Kaur, C., Kapoor, H. C., (2002). Antioxidant Activity and total phenolic content of some Asian vegetables. International Journal of Food Science and Technology. 37(2): 9-26.
32. Casano, S., Grassi G., Martini V., Michelozzi M., (2011). Variations in Terpene Profiles of Different Strains of Cannabis sativa L. Acta Horticulture. 25(7) : 115-121.
33. Mohamed, H. M., Amani M. D., El-Mesallamy, Safaan S., Hussein S., Mohamed M., (2014). Chemical Composition and Antimicrobial Activities of the Volatile oils of Mentha pulegium (Labiatae). Natural Products. 10(5): 131-135.
34. Sundstrup, E., Jackobsen, M. D., Brandf, M., Jay K., Colado J. C., Wang, Y., Anderson, L. L., (2014). Acute effect of topical menthol on chronic pain in slaughterhouse workers with corporal tunnel syndrome: Triple-blind, randomised placebo-contolled. Rehabilitation and Reproductive Practice. 9(8): 9-17.
35. De silva, K. L., Jadhav D. Y., Rathnaya R. M., and Sahoo A. K., (2014). Investigation into the Nutrient content, Phytochemical content, Antioxidant Activity and Antibacterial Activity of inedible portion of Pomegranate (Punica granatum L). Europian Journal of Medicinal Plants. 4(5): 610-622.
36. Al-youssef, H. M., and Hassan W. H. B., (2015). Antimicrobial, and Antioxidant Activity of Parkinsonia aculeate and Chemical Composition of their essential oils. Merit Research Journals. 3(4): 147-157.
37. Huan-Feng, Y., and Yan-Ndi Z., (2017). Phytopchemical Composition and Antibacterial Activity of the Eseential oils from Different Parts of Sea Buckthorn (Hippophae rhamnoides L). Journal of Food and Drug Analysis. 25(2): 327-332.
38. Steven, S., Munzel T., Daiber A., (2015). Exploiting the Pleiotropic Antioxidant Effects of Established Drugs in Cardiovascular Disease. International Journal of Molecular Science. 16(8): 185-203
39. Golebiowski M., Cerkowniak M., Urbanck A., Dawgul M., Kamysz W., Bogus M. I., Stepnowski P., (2015). Identification and Antifungal Activity of novel Organic Compounds found in Cuticular and Internal Lipids of Medically Important Flies. Microbial Research. 13(17): 213- 222.
40. He, L., (2009). Th Studies on the Bacteriostatic Effect of Loquat Flowers extracts and its Relative Active Composition. Ms D Thesis. Schuan. Schuan Normal University. 35-79.
41. Mulugeta, T., Legesse A., Tariku Y., Diriba M., Shiferaw D., (2013). Isolation of Compounds from Acetone Extract of Wood of Moringa Stenopetala and Evaluation of their Antibacterial Activities. Research Journal of Medicinal Plants. 7(1): 32-47.
42. Neera, D., (2017). Biological Activity of 1-heneicosanol Isolated from Senecio coluhuapiensis, an endemic Species from Patagonia, Argentina. The Pharmaceutical and Chemical Journal. 8(4): 349-57
43. Kalegani, M,M Migeul M,. D., Andressa F. P., Dias J. F. G. D., Zamin S. M W., Lima C. P., Miguel O., G., (2012). Antibacterial, allelopathic and Antioxidant Activity of Extracts and Compounds from Rourea induta Planch (Connaraceae). Journal of Applied Pharmaceutical Science. 2(9): 061-066.
44. Khatua, S., Akhil, P., Biswas, S. J., (2016). Phytochemical Evaluation and Antimicrobial properties of Trichosanthes dioicica root extract. Journal of Pharmacognosy and Phytochemistry. 5 (5): 410-413.
45. Abdelhamid, M. S., Kondratenko E. L., Lomteva N. NA., (2015). GC-MS Analysis of Phytocomponents in Ethanolic Extract of Nelumbo nucifera Seeds from Russia. Journal of Applied Pharmaceutical Science. 5(4): 115-118.

46. Adesina, S. K., Ezekiel, O. I., and Imoh, I. J., (2016). Tetrapleura tetraptera Taub-Ethnopharmacology, Chemistry and Nutritional Values- A Review. British Journal of Pharmaceutical Research. 12(3): 1-22.
47. Badu, M., Mensah J. K., Boadi N. O., (2012). Antioxidant Activity of Methanol and Ethanol/Water extracts of T. tetraptera and Parkia biglobosa. International Journal of Pharma and Biosciences. 3(3): 312-321.
48. Peramaiyan, R., Nandakumar, N., Themaraiselvan, R., and Nishigaki, I., Ragendran, P., Gnanadhas, E. N., Uppalapati, L., and Gopas, J. (2014). Antioxidants and Human Diseases. Clinica Chimica Acta. 435(2014):332-347.
49. Josiah S. J., Omoregie E. S., Obuofor E. M., Nwangwu S., Chukwumaobim O., and Adeyemi A. E., (2017). Comparative Antioxidant Capacity of Aqueous and Ethanol Fruit Extracts of T. tetraptera. Journal of Biological Sciences. 17(4): 185-195.
50. Koma, O. S., Olawumi O. O., Etuk-Udo G., Orishdipe A. A., (2018). Phytochemical Screening, in vitro Antimicrobial Activity and Antioxidant Characteristics of T. tetraptera Extracts. European Journal of Medicinal Plants. 17(2): 8-12.
51. Atawodi, S. E., Yakubu, O. E., Mubarak, L. L., and Iliemene, D. U., (2014). Effect of Methanolic Extract of Tetrapleura tetraptera (Schum and Thonn) Taub Leaves on hyperglycemia and Indices of Diabetic Complications in Alloxan-induced Diabetic rats. Asian Pacific Journal of Tropical Biomedicine. 4(4): 272-278.
52. Moukette, B. M., Anatole, C. P., Biapa, P. C. N., Njimou, J. R., Marco, S., Marco, B., Ngogang, J. Y. (2015). In Vitro Ion Chelating, Antioxidant Mechanism of Extracts of Fruits and Braks of Tetrapleura tetraptera and their Prospective Effects against Fenton Mediated Toxicity of Metal Ions on Liver Homogenates. Evidence-Based Complementary and Alternative Medicine. 2015(2015): 231-245.

How To Cite This Article:
OJ Enema, UF Umoh, PS Thomas, SK Adesina, and OA Eseyin. ***Phytochemical and antioxidant studies of leaf of Tetrapleura tetraptera (Schum and Thon) Taubert (Mimosaceae)*** **Br J Pharm Med Res , Vol.04, Issue 03, Pg.1865-1875, May - June 2019. ISSN:2456-9836 Cross Ref DOI : https://doi.org/10.24942/bjpmr.2019.490**

Source of Support: Nil **Conflict of Interest:** None declared