

GC-MS Analysis, Quantitative Phytochemical Profile and *in vitro* Antioxidant Studies of the Stem Bark of *Dennettia tripetala*

Abstract

Plants have played a significant role in preventing degenerative diseases and maintaining good health. *Dennettia tripetala* is used for the treatment of pains and inflammations, as an antimicrobial agent, relief of respiratory disorders and for the treatment of fever. This study aims to evaluate the chemical profile and antioxidant properties of the methanol extract of the stem bark of *Dennettia tripetala*. The stem bark was collected, air-dried, and extracted with 70% methanol. Quantitative phytochemical screening of the methanol extract was performed to determine the concentrations of tannins, phenolics, alkaloids, flavonoids, saponins, and terpenoids using *in vitro* techniques and gas chromatography-mass spectrometry. Antioxidant activity of the extract and fractions was evaluated using ferric-reducing antioxidant power (FRAP), 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging, and nitric oxide (NO) scavenging assays and determination of total phenolic content. The IC_{50} values were determined using GraphPad Prism 9. The GC-MS analysis revealed the presence of bioactive compounds including phenol, eugenol, caryophyllene, naphthalene, trimethyl arsenate, and other phenolic and flavonoid compounds. The methanol extract and its fractions demonstrated significant antioxidant activity, with high concentrations of phenolics and flavonoids contributing to their potency. The FRAP, DPPH, and NO scavenging assays confirmed the extract's ability to neutralize free radicals. The study concludes that the stem bark of *D. tripetala* possesses substantial antioxidant properties, which supports its traditional use in managing oxidative stress-related ailments.

Keywords: *Dennettia tripetala*, antioxidant properties, GC-MS analysis, quantitative phytochemical profile.

Introduction

Plants have played a significant role in the treatment and prevention of degenerative diseases and maintenance of good health [1]. The rich biological activities of plants and their various parts are often due to their chemical constituents. Different parts of plants may possess different biochemical agents; this may also be affected by season and time of collection [2].

Traditional and Complementary Medicine (T&CM) is an important and often underestimated health resource with many applications in meeting the health needs of aging populations. *Dennettia tripetala* also known as pepper fruit, widely consumed in West Africa, has been used in traditional medicine for the management of inflammations, diabetes, cough, fever, nausea, and even as an antioxidant agent. The plant possesses phytochemicals that have been shown to elicit antimicrobial, insecticidal, analgesic, and anti-inflammatory properties [3].

Cancer is another main cause of death globally, in Nigeria; over 100000 new cases are recorded annually. Nigeria represented 15% of the estimated 681000 cancer cases in Africa in

2008; this is due to increasing life expectancy, reduced risk of death from infectious diseases, increasing prevalence of smoking, physical inactivity, obesity and poor dietary habits [4]. Reactive oxygen species (ROS) such as hydrogen peroxide, hypochlorous acid, triperoxy anion, single oxygen, lipid peroxides, hypochlorite and hydroxyl radicals play significant roles in growth, differentiation, progression and subsequently death of cells. Free radicals have special affinity for lipids, proteins, carbohydrates, and nucleic acids [5,27,28,29,30].

The fruit and leaf of *D. tripetala* have been shown to have medicinal properties ranging from anti-inflammatory, antioxidant, and antibacterial effects [6][7]. López-Martínez *al.* [8] reported three alkaloids from the crude methanol extract of the root (uvaropsine, argentinine, stephenanthine) and a chromene, called Dennetine. However, no research has been reported on the quantitative phytochemical study, GCMS profiling, and antioxidant properties of the stem bark hence, the novelty of this research. This study aimed to evaluate the chemical profile of the methanol extract of the stem bark of *Dennettia tripetala* and the antioxidant properties of the methanol extract of the stem bark and various partitioned fractions of *D. tripetala*.

Materials and Methods

Plant collection and identification

The stem bark of *D. tripetala* was collected from Itak Ikot Akap village in Ikono Local Government, Akwa Ibom State, Nigeria. The plant was identified by Dr. Imeh Imoh Johnny of the Department of Pharmacognosy and Natural Medicine, Faculty of Pharmacy, University of Uyo, Uyo and authenticated (UUPH A₂(i)) at the Department of Botany and Ecological Studies, Faculty of Science, University of Uyo, Uyo.

Preparation of extract

Dennettia tripetala stem bark was air-dried and coarsely powdered with hammer mill. 1 kg of the powdered plant material was extracted in 70% methanol. The extract was concentrated in a rotatory evaporator, dried in a water bath and weighed (80 g) and 40 g was then partitioned into n-hexane, dichloromethane, ethyl acetate, n-butanol and aqueous fractions, respectively.

Quantitative Phytochemical Screening of Extract

Determination of tannin content

Tannin content in each sample was determined using insoluble polyvinyl-pyrrolidone (PVPP). Briefly, 1.0 mL of extract dissolved in methanol (1%), was mixed with 100 mg PVPP, vortexed, left for 15 min at 4°C and then centrifuged for 10 min at 3,000 rpm. In the clear supernatant, the non-tannin phenolics were determined in the way similar to the total phenolics content. Tannin content was calculated as a difference between total phenolic and non-tannin phenolic content in the extract [9].

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 were mixed with 2.5 mL of 10% Folin-Ciocalteu reagent and 2 mL of Na₂CO₃ (7%). The resulting mixture was vortexed for 15 seconds and incubated at 40°C 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 gallic calibration curve and the results were expressed as mg of gallic acid equivalent per gram dry weight. These were performed in triplicates [10].

Determination of alkaloid

The stem bark extract (1mg) was dissolved in dimethyl sulphoxide (DMSO), added 1mL of 2N HCl and filtered. This solution was transferred to a separating funnel, 5 mL of bromocresol green solution and 5 mL of phosphate buffer were added. The mixture was vigorously shaken with 1, 2, 3 and 4 mL chloroform and collected in a 10-mL volumetric flask and diluted to the volume with chloroform. A set of reference standard solutions of atropine (20, 40, 60, 80 and 100 µg/mL) were prepared in the same manner as described earlier. The absorbance for test and standard solutions was determined against the reagent blank at 470 nm with an UV/Visible spectrophotometer. The total alkaloid content was expressed as mg of AE/g of extract where AE is atropine equivalence [11].

Determination of total flavonoid content

The total flavonoid content was determined by the method described by Lee and Intan [12]. Total flavonoid content was measured by the aluminium chloride colorimetric assay. The reaction mixture consists of 1 mL of extract and 4 mL of distilled water in a 10 mL volumetric flask. To the flask, 0.30 mL of 5 % sodium nitrite was treated and after 5 minutes, 0.3 mL of 10 % aluminium chloride was mixed. After 5 minutes, 2 mL of 1M sodium hydroxide was treated and diluted to 10 mL with distilled water. A set of reference standard solutions of quercetin (20, 40, 60, 80 and 100 µg/mL) were prepared in the same manner as described earlier. The absorbance for test and standard solutions was determined against the reagent blank at 510 nm with an UV/Visible spectrophotometer. The total flavonoid content was expressed as mg of QE/g of extract where QE is quercetin equivalence.

Determination of saponins

The total saponin of the stem bark extract was determined by the method described by Ameen *et al.* [13]. 1g of the dried sample of the stem bark extract of *D. tripetala* that had passed through 125 mm sieve was transferred into a 250 mL beaker, and 100 mL of isobutyl alcohol was added. The mixture was swirled for 5 minutes and filtered. The filtrate was transferred into a 100 mL beaker containing 20 mL of 40% saturated solution of MgCO₃. 1 mL of the colourless filtrate was pipette into a 50 mL volumetric flask and 2 mL of 5% FeCl₃ solution was added and made up to the marked level with distilled water. This was then allowed to stand for 30 minutes for a blood red colour to develop. Percentage saponin was calculated using the formula:

$$\% \text{ Saponin} = \text{AS} \times \text{AG} \times \text{DF} / \text{Wt of sample} \times 10,000$$

Where AS =Absorbance of sample; AG = Average gradient; DF = Dilution factor; Wt of sample = Weight of sample

Total terpenoid determination

The total terpenoid was determined by the method described by [14]. Stock standard solution of each terpene [α -pinene, (-)- β -pinene, myrcene, (R)- (+)-limonene, terpinolene, linalool, α -terpineol, β -caryophyllene, α -humulene, caryophyllene oxide] was prepared in ethyl acetate. The standard terpenes were mixed and the concentration of each terpene was adjusted to be 1.0 mg/mL from which serial dilutions were made to prepare the individual points of the calibration curves. Internal standard preparation: n-Tridecane (C13 hydrocarbon) was selected as the IS, and its concentration was kept at 100 µg/ mL, which was added to all of the calibration and sample solutions.

Sample solution preparation:

The stem bark extracts of *D. tripetala* were dried for 24 h at 40 °C in a ventilated oven and then ground in a stainless steel coffee grinder. Triplicates (1.0 g each) of the powdered samples were weighed in a 15 mL centrifuge tube and each was extracted with 10 mL of the extraction solution (100 µg/mL of the IS in ethyl acetate) by sonication for 15 min. The mixture was centrifuged for 5 min at 1252 × g and the supernatants (without filtration) were used for the GC/MS analysis.

Antioxidant evaluation of extracts and fractions

The antioxidant evaluation of the extract and fractions was carried out using ferric reducing antioxidant power (FRAP) assay, 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging activity models, nitric oxide (NO) scavenging assay, and determination of total phenolic content.

Ferric reducing antioxidant power (FRAP) assay

The FRAP activity of the methanol stem bark extract and fractions were determined by the method described by [15]. Various concentrations (20, 40, 60, 80, 100 µg/mL) of the methanol extract and fractions of stem bark of *D. tripetala* (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 ($K_2Fe(CN)_6$) (1% w/v). The resulting mixture was incubated at 50°C 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. Ascorbic acid was used as the reference compound.

Determination of 2,2-Diphenyl-1-picrylhydrazyl (DPPH) radical scavenging activity

The DPPH free radical scavenging activity of methanol extract and fractions of stem bark of *D. tripetala* and ascorbic acid prepared in methanol at various concentrations (20, 40, 60, 80, 100 µg/mL) was evaluated according to the method of [16]. 2,2-Diphenyl-1-picrylhydrazyl (0.1 mm, 1 mL) was added to 3mL of the solutions prepared with the extracts, fractions and ascorbic acid and stirred for 1 minute. Each mixture was incubated in the dark for 30 minutes and absorbance (A_s) was measured at 517 nm. The assays were carried out in triplicates and the results expressed as mean values versus standard error of mean. The percentage DPPH scavenging effect was calculated using the following equation:

DPPH scavenging effect (%) or percentage exhibition

= $[(A_0 - A_s)/A_0] \times 100$, Where A_0 is the absorbance of control reaction and A_s is the absorbance of the test samples or standard sample (ascorbic acid).

Nitric oxide (NO) scavenging assay

Nitric oxide generated from sodium nitroprusside (SNP) was measured according to the modified method of [17]. 3.0 mL of 10 µM of SNP in phosphate buffered saline (PH 7.4) was added to 2mL of different concentrations of methanol extract and fractions of stem bark of *D. tripetala* and ascorbic acid (20, 40, 60, 80, 100 µg/mL). The resulting solutions were incubated at 25°C for 60 minutes. A similar procedure was repeated with methanol as blank which served as control to 30 mL of Griess reagent (1% sulfanilamide in 2% phosphoric diamene dihydrochloride). The absorbance formed during the diazotization of nitric ions with sulphamylamide and subsequent coupling with ethylenediamine dihydrochloride was

measured at 540 nm. The assays were carried out in triplicate and the results expressed as mean values \pm standard deviation.

Determination of IC₅₀

The IC₅₀ of the fractions was determined using GraphPad Prism 9.

Gas Chromatography Mass Spectrum (GC-MS) analysis

GC-MS analysis was carried out using 7890A GC system, 5675C Inert MSD with triple-Axis detector. The column has a length of 30m with an internal diameter of 0.2 μ m and a thickness of 250 μ m, treated with phenyl methyl silox. Other GC-MS conditions are ion source temperature (EI), 250°C, interface temperature; 300°C, pressure; 16.2 psi out time, 1.8mm, 1 μ l injector in split mode with split ratio 1:50 with injection temperature of 300°C, the column temperature started at 35°C for 5minutes and changed to 150°C at the rate of 4°C/min, the temperature was raised to 250°C at the rate of 20°C/min and held for 5minutes. The total elution was 47.5 minutes. Ms Solution software provided by supplier was used to control the system and to acquire the data; identification of the compounds was carried out by comparing the mass spectra obtained with those of the standard mass spectra from National Institute of Standard and Technology (NIST) database. The identity of the spectra above 95% was used to ascertain the name, molecular weight and structure of the components in the stem bark of *D. tripetala*.

Results and Discussion

Quantitative phytochemical screening

Table 1: Quantitative phytochemical screening

Sample	Alkaloids	Flavonoids	Saponins	Tannin	Terpenoids	Phenol
EPFS(% w/w)	19.5	241.4	1.75	53.7	0.9	1.0

EPFS = Methanol extract of stem bark of *D. tripetala*

Quantitative phytochemical screening of the stem bark of *D. tripetala* was carried out to determine the concentration of various bioactive compounds such as phenolics, flavonoids, saponins, tannins, terpenoids, and alkaloids which are responsible for the various medicinal applications of the plant's part in the treatment of ailments traditionally. The total phenolic content was evaluated using a calibration curve based on gallic acid. The absorbance values for gallic acid ranged from 0.046 \pm 0.000 (at 32 μ g/mL) to 2.075 \pm 0.001 (at 1000 μ g/mL), with the calibration curve described by the equation $y = 0.0024x - 0.0878$ ($R^2 = 0.9795$). The Total phenolic content in the stem bark extract was calculated from the calibration curve as 180 mg GAE/g. The linear relationship of the gallic acid calibration curve, with a correlation coefficient (R^2) of 0.9795 also suggests a highly reliable measurement.

Table 1 shows the result of the total flavonoid in the stem bark extract of *D. tripetala*. The total flavonoid content showed a progressive increase with higher concentrations. The concentration-dependent increase, especially noted at 1000 μ g/mL with totals reaching 313 mg GAE/g for the stem bark extract, suggesting strong anti-inflammatory and antioxidative potential. The total saponin component was also quantified, with the stem extract presenting a yield of (1.75 % w/w). Tannin compounds which are known for their astringent properties and potential health benefits ranging from antioxidative to anticancer effects were also quantified through a quercetin calibration curve that demonstrated an exceptionally high correlation coefficient ($R^2 = 0.9926$), signifying the accuracy of the measurement. The total

tannins in the stem bark extract (EPFS) showed a maximum of 60.2 mg GAE/g. Alkaloids, which have diverse pharmacological activities, were found to be concentrated in the stem bark (19.5 % w/w). This is similar to the quantitative determination of the leaves of *D. tripetala*, reported by Osuagwu *et al.*, [18].

Antioxidant analysis

Table 2: DPPH absorbance (nm) and percentage inhibition (%) of EPFS and fractions of EPFS

Absorbance (nm) and percentage inhibition (%)							
Concentration ($\mu\text{g/mL}$)	AS	EPFS	NH	DCM	ETH	nBT	AQ
20	$0.119 \pm 0.001^*$ (85)	$0.737 \pm 0.000^*$ (10)	$0.604 \pm 0.000^*$ (26)	$0.475 \pm 0.000^*$ (42)	$0.65 \pm 0.000^*$ (21)	$0.672 \pm 0.000^*$ (18)	$0.649 \pm 0.000^*$ (21)
40	$0.116 \pm 0.000^*$ (86)	$0.576 \pm 0.000^*$ (30)	$0.461 \pm 0.000^*$ (44)	$0.452 \pm 0.000^*$ (45)	$0.545 \pm 0.000^*$ (34)	$0.568 \pm 0.000^*$ (31)	$0.619 \pm 0.000^*$ (25)
60	$0.114 \pm 0.000^*$ (86)	$0.573 \pm 0.000^*$ (30)	$0.398 \pm 0.000^*$ (52)	$0.344 \pm 0.333^*$ (58)	$0.542 \pm 0.000^*$ (34)	$0.478 \pm 0.000^*$ (42)	$0.605 \pm 0.000^*$ (26)
80	$0.110 \pm 0.001^*$ (87)	$0.509 \pm 0.000^*$ (38)	$0.362 \pm 0.000^*$ (56)	$0.314 \pm 0.333^*$ (61)	$0.509 \pm 0.000^*$ (38)	$0.453 \pm 0.001^*$ (45)	$0.571 \pm 0.000^*$ (30)
100	$0.09 \pm 0.001^*$ (89)	$0.444 \pm 0.000^*$ (46)	$0.251 \pm 0.000^*$ (69)	$0.197 \pm 0.000^*$ (76)	$0.418 \pm 0.000^*$ (49)	$0.396 \pm 0.000^*$ (52)	$0.264 \pm 0.000^*$ (68)

($p < 0.05$)

Where:

AS = Ascorbic acid
 EPFS = Methanol stem bark extract
 NH = n-hexane fraction
 DCM = Dichloromethane fraction
 ETH = Ethyl acetate fraction
 nBT = n-butanol fraction
 AQ = Aqueous fraction

DPPH assay is considered a valid, accurate, easy and economical method to evaluate antioxidants' activity, since the radical compound is stable and need not be generated [19]. The technique of DPPH testing is associated with eliminating DPPH, which would be a stabilized free radical [20]. The result of the DPPH assay of the stem bark extract of *D. tripetala* showed a significant increase with an increase in concentration of the sample when compared to the standard compound (ascorbic acid), this is shown in Table 2. The methanol stem bark extract had an average percentage inhibition of 30.8% when compared to ascorbic acid which had an average percentage inhibition of 87%. The statistical analysis of the absorbance (nm) of the samples was conducted using two-way ANOVA. The result showed that the measurements were statistically significant at ($p < 0.05$).

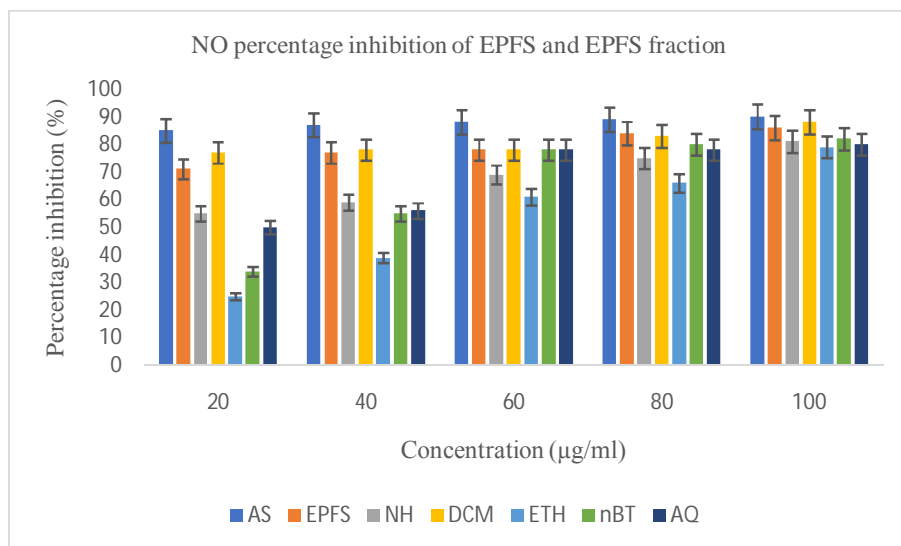


Figure 1: NO percentage inhibition of EPFS and EPFS fraction

The result of the nitric oxide assay illustrated in Figure 1 also showed an increase in percentage inhibition of NO with increase in concentration of the sample. Like the DPPH scavenging activity assay, the results are statistically significant at all concentrations at ($p < 0.05$). Among the fractions, the dichloromethane fraction of the stem showed the highest nitric oxide scavenging potential of 80.8. At 20 µg/mL, the ethyl acetate fraction showed the least percentage inhibition when compared to other fractions of the stem bark extract. This assay measures the ability to scavenge nitric oxide radicals, which may involve different mechanisms or compounds than those effective in the DPPH assay. The high activity in the n-butanol fraction of the root and the dichloromethane fraction of the stem indicates the presence of effective nitric oxide scavengers in these fractions.

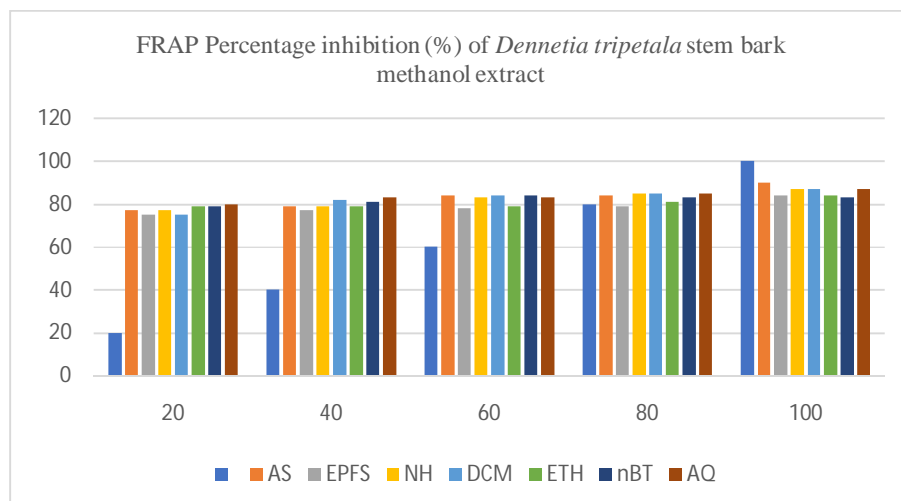


Figure 2: FRAP percentage inhibition of *D. tripetala* stem bark extract and its fractions

Figure 2 shows the ferric reducing antioxidant power assay of the stem bark extract and fractions of *D. tripetala*. The ferric reducing antioxidant power measurement of the stem bark was also statistically significant at ($p < 0.05$). Unlike the DPPH and nitric oxide assays where the measurements were significant across all concentrations, the ferric reducing power assay of the stem showed that at 20 $\mu\text{g/mL}$, the absorbance of the n-hexane fraction was not significant ($p < 0.05$). At 80 $\mu\text{g/mL}$, the dichloromethane fraction was also reported as not significant ($p < 0.05$). This was also noted in the aqueous fraction at 40 $\mu\text{g/mL}$ ($p < 0.05$).

IC₅₀ determination

Table 3: IC₅₀ and LogIC₅₀ of methanol stem bark extract of *Dennettia tripetala* and its fractions

	IC ₅₀ (μM)						
	AS	EPFS	NH	DCM	ETH	nBT	AQ
IC ₅₀	0.006218	0.03187	0.02364	0.02021	0.02971	0.02888	0.03039
LogIC ₅₀	-2.206	-1.497	-1.626	-1.695	-1.527	-1.539	-1.517

IC₅₀= Half-maximal inhibitory concentration

The IC₅₀ of the stem bark extract of *Dennettia tripetala* (EPFS) is presented in Table 3. The IC₅₀ values for the fractions n-hexane (NH), dichloromethane (DCM), ethyl acetate (ETH), n-butanol (nBT), and aqueous (AQ) are 0.02364, 0.02021, 0.02971, 0.02888, 0.03039 μM, respectively. In this case, the dichloromethane fraction also shows the lowest IC₅₀ value, indicating the highest inhibitory potency among these fractions against the target. The LogIC₅₀ values are -1.626, -1.695, -1.527, -1.539, and -1.517, respectively for the various fractions of n-hexane, dichloromethane, ethyl acetate, n-butanol and aqueous.

From these observations, it is clear that the dichloromethane fraction exhibits a particularly high potency as an antioxidant agent, with relatively low IC₅₀ and LogIC₅₀ values, indicating that it might be the most effective inhibitory fraction among the tested fractions, excluding the standard ascorbic acid (AS) which is the standard compound. The differences in IC₅₀ and LogIC₅₀ values among the fractions indicate varying levels of inhibitory activity, which could be due to differences in their chemical composition and mechanism of action of the bioactive compounds.

The total phenolic content of the fractions was estimated from the gallic acid calibration curve equation $y = 0.0024x - 0.00878$. The n-hexane fraction of the stem had the lowest phenolic content recorded (41.2 mg GAE/g). The ethyl acetate fraction of the stem had 139.1 mg GAE/g phenolic content and was noted as the second most active fraction when compared to all others. These effects were statistically significant ($p < 0.05$).

GC-MS analysis

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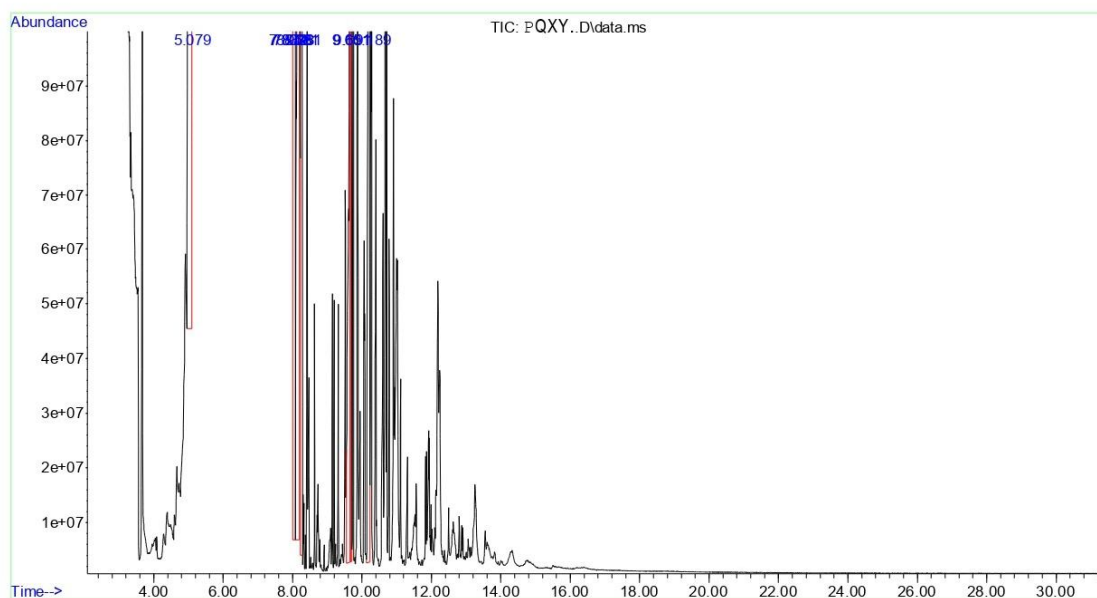


Figure 3: GC-MS spectra of methanol extract of the stem bark of *Dennettia tripetala*

Table 4: Identified compounds from GC-MS analysis of methanol extract of the stem bark of *Dennettia tripetala*.

S/N	Retention time	Compound name	Molecular formula	Molecular weight	Area %
1	5.079	Phenol, 2-methoxy-3-(2-propenyl)-	C ₁₀ H ₁₂ O ₂	164	17.232
2	7.832	Eugenol	C ₁₀ H ₁₂ O ₂	164	7.666
3	7.872	Caryophellene	C ₁₅ H ₂₄	204	8.894
4	7.958	Naphthalene	C ₁₀ H ₈	128	10.853
5	8.038	Ethyl α-d-glucopyranoside	C ₈ H ₁₆ O ₆	208	15.426
6	8.181	Clionasterol acetate	C ₃₁ H ₅₂ O ₂	456	14.835
7	8.261	α-Farnesene	C ₁₅ H ₂₄	204	8.264
8	9.651	Cycloundecene, 1-methyl	C ₁₂ H ₂₂	166	3.602
9	9.691	1,2-Benzenedicarboxylic acid	C ₈ H ₆ O ₄	166	5.423
10	10.189	Trimethyl arsenate	C ₃ H ₉ AsO ₄	184	7.806

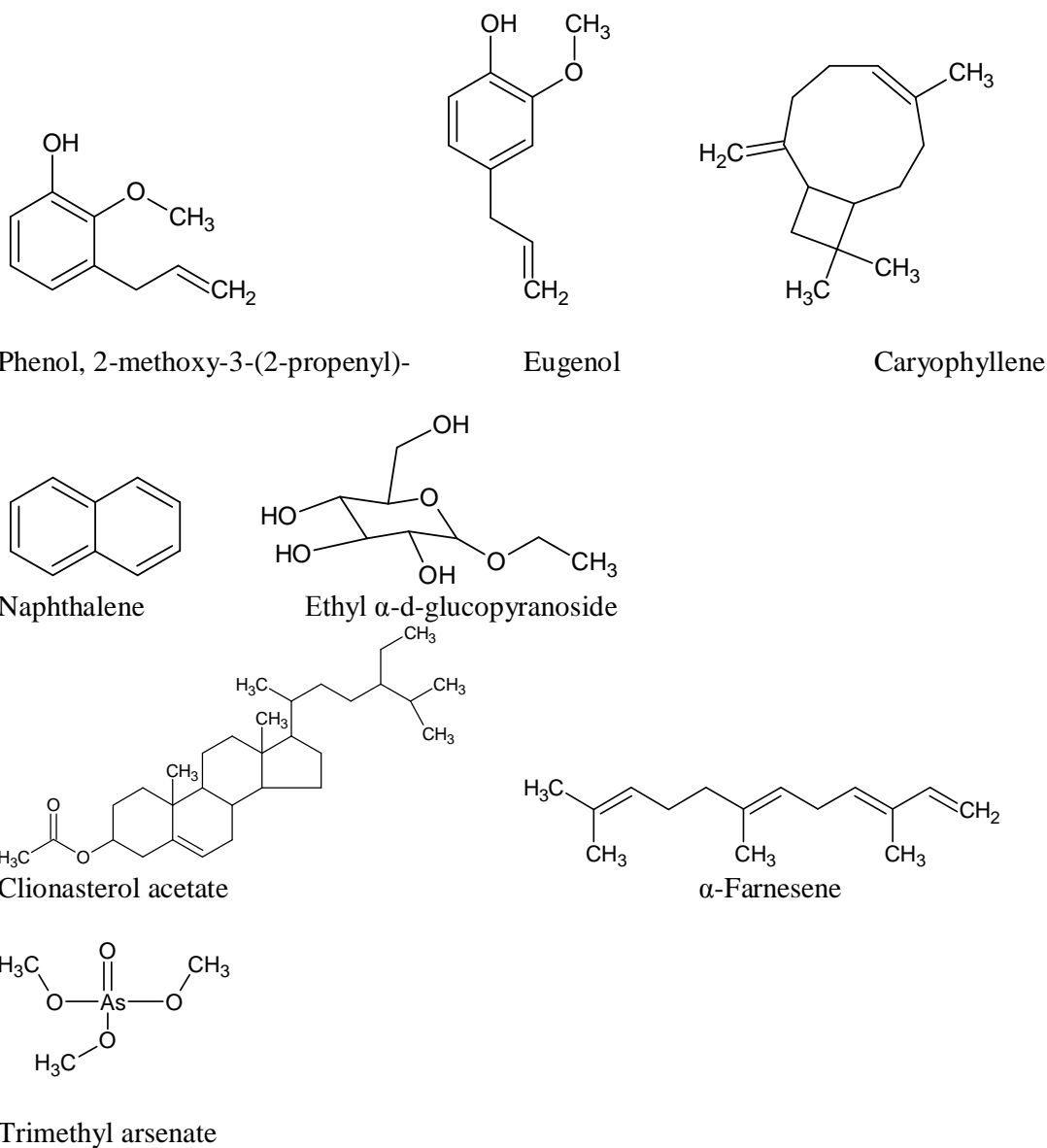


Figure 4: Chemical structures of compounds from the stem bark extract of *Dennettia tripetala*

The GC-MS analysis of the methanol extract of the stem bark of *D. tripetala* revealed the presence of 10 compounds. Phenol, 2-methoxy-3-(2-propenyl)- (also known as 3-Allylguaiacol or 3-Allyl-2-methoxyphenol) has been studied for its various applications. Researchers have identified it as a potential flavouring agent, food additive, and component in food contact materials. It has also been reported to possess analgesic, antibacterial and anticancer properties. Additionally, phenol finds use in dental products (such as disinfectants and impression pastes), pet cleaners, and as a fungicide, insecticide, and pesticide. While these findings are promising, further research and clinical trials are necessary to fully validate its efficacy and safety across various contexts [21].

Eugenol has been reported to exhibit a wide range of pharmacological properties, including antibacterial, anticancer, antiviral, antifungal, anti-inflammatory, and antioxidant effects. It is also used as a flavouring agent, food additive, and in dental products [22].

Caryophellene, which is found in various plants, has anti-inflammatory, antioxidant, analgesic, and immunomodulatory properties. It has also been reported as a potential candidate for treating various conditions, including pain and inflammation [23].

Naphthalene is historically known for its use in mothballs, naphthalene repels moths and insects. It has been used widely in dermatology, gastroenterology, ophthalmology, and veterinary medicine. Ethyl α -D-glucopyranoside has antioxidant, anti-inflammatory, and skin-whitening effects. It is used in cosmeceuticals. Clionasterol acetate, a plant-originated sterol, exhibits antiviral, antioxidant, and antitumor activities. It holds promise for various therapeutic applications [24].

1,2-Benzenedicarboxylic acid has been isolated from *Salvadora persica* and shows antidiabetic activity [25]. Trimethyl arsenate has been studied for its clinical applications, particularly in treating diseases such as leukemia and tumors. It has a long history of use in traditional Chinese medicine [26]. Researchers have explored its pharmacological effects, including anti-tumor properties, while being mindful of its dose-dependent toxicity.

Conclusion

The chemical profile analysis of the stem bark methanol extract of *D. tripetala*, GC-MS and *in vitro* antioxidant assays revealed its rich phytochemical profile and significant antioxidant properties. The high concentrations of flavonoids and alkaloids identified in the stem bark indicate its potent bioactivity. These findings support the traditional use of *D. tripetala* in herbal medicine and suggest its potential for development as a natural antioxidant agent. Further studies are warranted to isolate specific bioactive compounds and explore their mechanisms of action, which could lead to the development of novel therapeutic agents for oxidative stress-related diseases

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