

Original Research Article

Phytochemical Profile of *Cola pachycarpa* K. Schum. (Malvaceae) Leaf and Stem Ethanol Extracts

ABSTRACT

Aim: The present study ~~is was~~ carried out to explore the phytoconstituents present in the ethanolic extract of the leaf and stem of *Cola pachycarpa* by GC-MS analysis. **Methods:** The ethanolic extract of the extracts was used for the GC-MS analysis. QP2010SE Shimadzu, Japan System GC-MS was used for the analysis. The compounds were identified by the gas chromatography coupled with the mass spectrometry. The molecular weight and structure of the compounds of test materials are ascertained by interpretation of the mass spectrum of GC-MS using the database of National Institute Standard and Technology (NIST). **Results:** GC-MS analysis of the leaf and stem ethanol extracts of *C. pachycarpa* revealed the presence of 64 and 47 chemical constituents respectively which includes 1-propanol, 2-amino-2-methyl (31.34%), undecanal, 2-methyl (4.00%), phenol, 2,6-dimethoxy (4.18%), n-Hexadecanoic acid (3.35%) and vitamin E (5.15%) and the most abundant in the stem extract were: 1,4-Benzodioxin-6-sulfonamide, N-[2-(dimethylamino)ethyl]- (30.10%), .alpha.D-Galactopyranoside, methyl (12.56%), Phenethylamine, .alpha.-ethyl- (10.96%), 4-Methylpiperazine-2-carboxylic acid (5.78%) and Guanosine (3.86%). **Conclusion:** The presence of various bioactive compounds confirms the application [\(how do you confirm the application just by looking at the content of chemical compounds?\)](#) of *Cola pachycarpa* for various ailments. However, isolation of individual phytoconstituents may proceed to find a novel drug or lead compound. [\(put full stop here\)](#)

Keywords: GC-MS analysis, Phytochemical constituents and *Cola pachycarpa*.

Introduction

Colapachycarpa K. Schum. Family: Malvaceae. Is a Monkey Kola in the genus *Cola* with about 140 species (Burkill, 2000). It possesses non-edible seeds which are enclosed in an edible mesocarp. It is considered as valuable medicinal herb in folklore medicine. The white fleshy mesocarp is chewed for the management of cancer and the seeds are used in the eastern part of Nigeria as stimulants (Keay and Onochie, 1964).

Plants produce several chemical compounds that play significant roles in inducing biological activities including development of defense against insects, fungi and herbivorous mammals (Tapsell et al., 2006). The mechanisms of action of herbal medicines do not vary greatly from those of the orthodox drugs because the chemical compounds present in plants causes their effect on human body via processes that are similar to those that are already understood for the chemical compounds in orthodox drugs (Lai Roy, 2004; Tapsell et al., 2006). These chemical compounds are a product of the plant's secondary metabolism (secondary metabolites) that can only be obtained from plants and are found in a range of plants that are employed as essential components of both human and animal diets including fruits, seeds, herbs and vegetables (Okwu, 2005). The study of these phytochemicals is important to understanding their essential roles in the human system such as protection and treatment of diseases and their possible adverse effects.

Johnny and Bassey (2020) reported on the standardization of the taxa by evaluating the pharmacognostic and taxonomic parameters. No work has been analysed on the chemical constituents by gas

chromatography-mass spectrometry (GC-MS). This work is the first-time report on the phytochemicals on the ethanolic leaf and stem extract of *C. pachycarpa*

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Method

Collection and Identification

The fresh samples of *C. pachycarpa* was collected from Osomba Hills in Osomba, Akankpa Local Government Area, Cross River State with the GPS reading as $\pm 61^{\circ} 5' 27.28''$ N, $008^{\circ} 39' 39.4''$ E and preserved in Formalin Acetic Acid. The collected sample was authenticated by Prof. Margaret E. Bassey of the department of Botany and Ecological Studies, Faculty of Science, University of Uyo and the herbarium number UUH4083 was allocated to the sample and the voucher specimen was deposited in the herbarium for reference purpose.

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Preparation of Plant Material

The leaf and stem of the sample were washed under running tap water to remove soil particles and adhered debris and finally washed with sterile distilled water. The samples were chopped into pieces, dried under shade at room temperature. The dried samples were ground into powder. The powdered materials were stored in airtight containers until use. The leaf and stem powders of *C. pachycarpa* were extracted with 70% ethanol for 72 hours. It was filtered and the filtrate concentrated using the rotary evaporator.

GC-MS Analysis

GC-MS analysis of ethanol extract of the leaf and stem of *C. pachycarpa* was performed using QP2010SE Shimadzu, Japan System and GCMS employed a fused silica capillary column packed with Elite-1(100% dimethyl polysiloxane, $30\text{m} \times 0.25\text{mm ID} \times 1\mu\text{m df}$). For GC/MS detection, an electron ionization system with ionizing energy of 70 eV was used. Helium gas (99.999%) was used as the carrier gas at constant flow rate 1mL/minute and an injection volume of 2 μL was employed [split ratio of 10:1] injector temperature was set at 250°C; ion-sourced temperature was set at 230°C. The oven temperature was programmed from 60°C (isothermal for 2 minutes) with an increase at 10°C/minutes to 240°C, then 5°C/minutes to 290°C. Mass spectra were taken at 70 eV; a scan interval of 0.5seconds and fragments from 45 to 450Da. Total GC detection time was completed in 23 minutes. The relative percentage amount of each component was calculated by comparing its average peak area to the total areas.

Identification of Components

The interpretation of mass spectra of GC-MS was conducted using the database of National Institute of Standard and Technology (NIST) having more than 62, 000 patterns. The spectrum of the unknown component was compared with the spectrum of the known components stored in the NIST library. The name, molecular weight, molecular formula, % area and retention time were ascertained.

Result and discussion ([lacking points and suggestions for improvement:Analyze your results in relation to previously published studies. Discuss how your findings align with or diverge from the existing body of knowledge. Identify any similarities or differences in terms of the identified compounds, their concentrations, or their reported bioactivities. Highlight any novel or unique aspects of your results.](#))

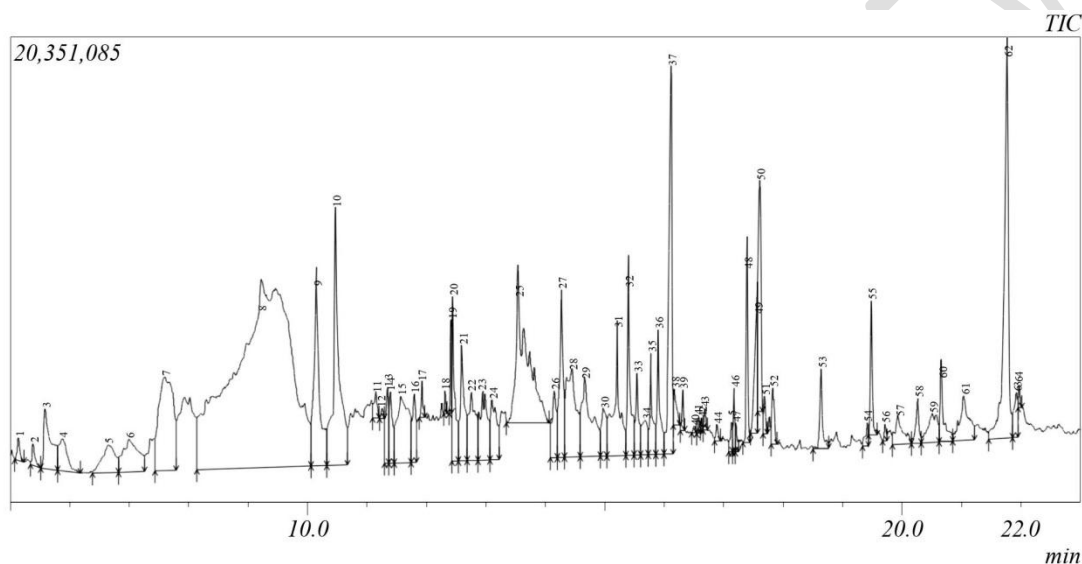


Figure 1: Gas chromatography-mass spectrometry chromatogram of ethanol leaf extract of *C. pachycarpa*

Table 1: Phytochemical composition of ethanolic leaf extract of *Cola pachycarpa* by GC-MS analysis

| S/N | Retention time | Compound name | Molecular formula | Molecular weight | Area % |
|-----|----------------|-------------------------------------|---|------------------|--------|
| 1 | 5.140 | 1,1-Dimethylamino-1-butene | C ₆ H ₁₃ N | 99 | 0.17 |
| 2 | 5.387 | 4-Oxopentyl formate | C ₆ H ₁₀ O ₃ | 130 | 0.18 |
| 3 | 5.589 | 2-Propenamide, N-methyl- | C ₄ H ₇ NO | 85 | 1.26 |
| 4 | 5.876 | 2-Methylcyclopropanecarboxylic acid | C ₅ H ₈ O ₂ | 100 | 0.78 |
| 5 | 6.651 | exo-Norborneol, methyl ether | C ₈ H ₁₄ O | 126 | 1.07 |
| 6 | 7.001 | Cycloheptanol, 2-chloro-, trans- | C ₇ H ₁₃ ClO | 148 | 1.49 |
| 7 | 7.601 | Undecanal, 2-methyl- | C ₁₂ H ₂₄ O | 184 | 4.00 |
| 8 | 9.225 | 1-Propanol, 2-amino-2-methyl- | C ₄ H ₁₁ NO | 89 | 31.34 |
| 9 | 10.155 | 2-Methoxy-4-vinylphenol | C ₉ H ₁₀ O ₂ | 150 | 3.10 |
| 10 | 10.478 | Phenol, 2,6-dimethoxy- | C ₈ H ₁₀ O ₃ | 154 | 4.18 |
| 11 | 11.150 | 5-Octen-2-ol, 5-methyl- | C ₉ H ₁₈ O | 142 | 0.22 |
| 12 | 11.256 | 5-Octen-2-ol, 5-methyl- | C ₉ H ₁₈ O | 142 | 0.06 |
| 13 | 11.347 | 5-Octen-2-ol, 5-methyl- | C ₉ H ₁₈ O | 142 | 0.66 |

| | | | | | |
|----|--------|---|---------------------|-----|------|
| 14 | 11.398 | cis-1,2-Cyclododecanediol | $C_{12}H_{24}O_2$ | 200 | 0.64 |
| 15 | 11.575 | 1H-Azepin-1-amine, hexahydro- | $C_6H_{14}N_2$ | 114 | 2.30 |
| 16 | 11.798 | Bicyclo[2.2.1]heptane-2,3-diol,1,7,7-trimethyl-,(2-endo, 3-exo) | $C_{10}H_{18}O_2$ | 170 | 0.71 |
| 17 | 11.927 | 1-Naphthalenecarboxylic acid, decahydro-1,4a-dimethyl-6-methylene | $C_{21}H_{32}O_2$ | 316 | 0.19 |
| 18 | 12.319 | 2-Undecanone, 6,10-dimethyl- | $C_{13}H_{26}O$ | 198 | 0.09 |
| 19 | 12.419 | 12-Oxabicyclo[9.1.0]dodeca-3,7-diene,1,5,5,8-tetramethyl- | $C_{13}H_{22}O_3$ | 226 | 0.47 |
| 20 | 12.443 | 12-Oxabicyclo[9.1.0]dodeca-3,7-diene,1,5,5,8-tetramethyl- | $C_{15}H_{24}O$ | 220 | 1.15 |
| 21 | 12.602 | 3-tert-Butyl-4-hydroxyanisole | $C_{11}H_{16}O_2$ | 180 | 1.47 |
| 22 | 12.761 | 2,4,7,9-Tetramethyl-5-decyn-4,7-diol | $C_{14}H_{26}O_2$ | 226 | 1.39 |
| 23 | 12.953 | 5-Octen-2-ol, 5-methyl- | $C_9H_{18}O$ | 142 | 1.49 |
| 24 | 13.110 | 5-Octen-2-ol, 5-methyl- | $C_9H_{18}O$ | 142 | 1.05 |
| 25 | 13.544 | Methyl-(2-hydroxy-3-ethoxy-benzyl)ether | $C_{10}H_{14}O_3$ | 182 | 4.79 |
| 26 | 14.151 | Cyclohexanone, 2-(2-nitro-2-propenyl)- | $C_9H_{13}NO_3$ | 183 | 0.91 |
| 27 | 14.274 | Phenol, 4-(3-hydroxy-1-propenyl)-2-methoxy- | $C_{10}H_{12}O_3$ | 180 | 1.72 |
| 28 | 14.458 | 5-Caranol, (1S,3R,5S,6R)-(-)- | $C_{10}H_{18}O$ | 154 | 2.63 |
| 29 | 14.674 | 1-Heptadec-1-ynyl-cyclopentanol | $C_{22}H_{40}O$ | 320 | 2.23 |
| 30 | 14.987 | 10-Undecen-1-al, 2-methyl- | $C_{12}H_{22}O$ | 182 | 0.69 |
| 31 | 15.214 | 3,7,11,15-Tetramethyl-2-hexadecen-1-ol | $C_{20}H_{40}O$ | 296 | 2.21 |
| 32 | 15.399 | 3,5-Dimethoxy-4-hydroxyphenethylamine | $C_{10}H_{15}NO_3$ | 197 | 1.63 |
| 33 | 15.544 | 3,7,11,15-Tetramethyl-2-hexadecen-1-ol | $C_{20}H_{40}O$ | 296 | 0.71 |
| 34 | 15.686 | Cyclopentadecanone | $C_{15}H_{28}O$ | 224 | 0.59 |
| 35 | 15.776 | Cyclopentanetridecanoic acid, methyl ester | $C_{19}H_{36}O_2$ | 296 | 0.82 |
| 36 | 15.901 | 1,2-Benzenedicarboxylic acid, butyl octyl ester | $C_{20}H_{30}O_4$ | 334 | 0.96 |
| 37 | 16.119 | n-Hexadecanoic acid | $C_{16}H_{32}O_2$ | 256 | 3.35 |
| 38 | 16.175 | [1,1'-Bicyclopropyl]-2-octanoic acid, 2'-hexyl-, methyl ester | $C_{21}H_{38}O_2$ | 322 | 0.30 |
| 39 | 16.314 | Hexadecanoic acid, ethyl ester | $C_{18}H_{36}O_2$ | 284 | 0.17 |
| 40 | 16.503 | 5-Octen-2-ol, 5-methyl- | $C_9H_{18}O$ | 142 | 0.04 |
| 41 | 16.582 | Tricyclo[4.3.1.1(2,5)]undec-3-en-10-ol, stereoisomer | $C_{11}H_{16}O$ | 164 | 0.07 |
| 42 | 16.630 | 4a,8a-Naphthalenediol, octahydro-, cis- | $C_{10}H_{18}O_2$ | 170 | 0.05 |
| 43 | 16.685 | 17-Octadecynoic acid | $C_{18}H_{32}O_2$ | 280 | 0.11 |
| 44 | 16.886 | [1,1'-Bicyclopropyl]-2-octanoic acid, 2'-hexyl-, methyl ester | $C_{21}H_{38}O_2$ | 322 | 0.11 |
| 45 | 17.137 | (R)-(-)-14-Methyl-8-hexadecyn-1-ol | $C_{17}H_{32}O$ | 252 | 0.18 |
| 46 | 17.176 | 9,12,15-Octadecatrienoic acid, methyl ester, (Z,Z,Z)- | $C_{19}H_{32}O_2$ | 292 | 0.31 |
| 47 | 17.208 | Cyclopentadecanone | $C_{15}H_{28}O$ | 224 | 0.13 |
| 48 | 17.398 | Phytol | $C_{20}H_{40}O$ | 296 | 0.98 |
| 49 | 17.575 | 9,12-Octadecadienoic acid (Z,Z)- | $C_{18}H_{32}O_2$ | 280 | 1.25 |
| 50 | 17.609 | 8,11,14-Eicosatrienoic acid, (Z,Z,Z)- | $C_{20}H_{34}O_2$ | 306 | 1.71 |
| 51 | 17.693 | 1,2-15,16-Diepoxyhexadecane | $C_{16}H_{30}O_2$ | 254 | 0.19 |
| 52 | 17.824 | Dichloroacetic acid, tridec-2-ynyl ester | $C_{15}H_{24}Cl_2O$ | 306 | 0.44 |
| 53 | 18.642 | cis-Vaccenic acid | $C_{18}H_{34}O_2$ | 282 | 0.62 |
| 54 | 19.419 | Cyclohexanol,2-methyl-5-(1-methylethenyl)-, (1.alpha.,2.beta.,5.) | $C_{10}H_{18}O$ | 154 | 0.19 |
| 55 | 19.485 | 9-Octadecenamide, (Z)- | $C_{18}H_{35}NO$ | 281 | 0.73 |
| 56 | 19.717 | cis-Verbenol | $C_{10}H_{16}O$ | 152 | 0.10 |
| 57 | 19.939 | 1-Heptatriacotanol | $C_{37}H_{76}O$ | 536 | 0.62 |
| 58 | 20.270 | .beta.-Tocopherol | $C_{28}H_{48}O_2$ | 416 | 0.42 |
| 59 | 20.516 | Pseudosmilagenin | $C_{27}H_{44}O_3$ | 416 | 0.81 |
| 60 | 20.675 | Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester | $C_{19}H_{38}O_4$ | 330 | 0.81 |

| | | | | | |
|----|--------|--|--|-----|------|
| 61 | 21.045 | cis-Z-.alpha.-Bisabolene epoxide | C ₁₅ H ₂₄ O | 220 | 1.17 |
| 62 | 21.772 | Vitamin E | C ₂₉ H ₅₀ O ₂ | 430 | 5.16 |
| 63 | 21.925 | 4-Isopropenyl-4,7-dimethyl-1-oxaspiro[2.5]octane | C ₁₂ H ₂₀ O | 180 | 0.48 |
| 64 | 21.973 | 1H-3a,7-Methanoazulen-5-ol,octahydro-3,8,8-trimethyl-6-methylene | C ₁₅ H ₂₄ O | 220 | 0.11 |

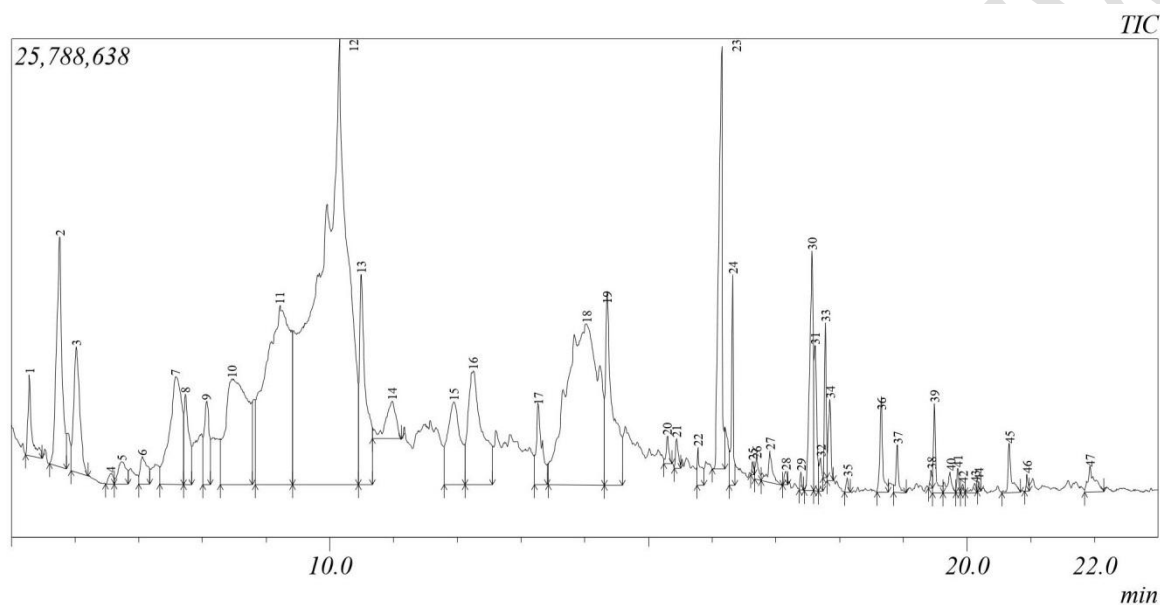


Figure 2: Gas chromatography-mass spectrometry chromatogram of ethanol leaf extract of *C. pachycarpa*

Table: 2 Phytochemical composition of ethanolic stem extract of *Cola pachycarpa* by GC-MS analysis

| S/N | Retention time | Compound name | Molecular formula | Molecular weight | Area % |
|-----|----------------|--|---|------------------|--------|
| 1 | 5.285 | N-[Dimethylaminomethyl]aziridine | C ₅ H ₁₂ N ₂ | 100 | 0.75 |
| 2 | 5.762 | 2(5H)-Furanone | C ₄ H ₄ O ₂ | 84 | 3.07 |
| 3 | 6.016 | 6-Oxa-bicyclo[3.1.0]hexan-3-one | C ₅ H ₆ O ₂ | 98 | 1.84 |
| 4 | 6.559 | Cycloheptanol, 2-chloro-, trans- | C ₇ H ₁₃ ClO | 148 | 0.13 |
| 5 | 6.734 | Cycloheptanol, 2-chloro-, trans- | C ₇ H ₁₃ ClO | 148 | 0.46 |
| 6 | 7.057 | Cycloheptanol, 2-chloro-, trans- | C ₇ H ₁₃ ClO | 148 | 0.48 |
| 7 | 7.577 | 3-Cyclohexen-1-carboxaldehyde, 3-methyl- | C ₈ H ₁₂ O | 124 | 3.23 |
| 8 | 7.735 | 3-Cyclohexen-1-carboxaldehyde, 3-methyl- | C ₈ H ₁₂ O | 124 | 1.10 |
| 9 | 8.063 | 10-Undecen-1-al, 2-methyl- | C ₁₂ H ₂₂ O | 182 | 1.00 |
| 10 | 8.465 | 4-Methylpiperazine-2-carboxylic acid | C ₆ H ₁₂ N ₂ O ₂ | 144 | 5.78 |
| 11 | 9.214 | Phenethylamine, .alpha.-ethyl- | C ₁₀ H ₁₅ N | 149 | 10.96 |
| 12 | 10.148 | 1,4-Benzodioxin-6-sulfonamide, N-[2-(dimethylamino)ethyl]- | C ₁₂ H ₁₈ N ₂ O ₄ S | 286 | 30.10 |
| 13 | 10.488 | Phenol, 2,6-dimethoxy- | C ₈ H ₁₀ O ₃ | 154 | 3.19 |
| 14 | 10.974 | 2,2-Dimethyl-1-aza-spiro[2.4]heptane | C ₈ H ₁₅ N | 125 | 0.95 |
| 15 | 11.952 | Guanosine | C ₁₀ H ₁₃ N ₅ O ₅ | 283 | 2.60 |
| 16 | 12.253 | Guanosine | C ₁₀ H ₁₃ N ₅ O ₅ | 283 | 3.86 |
| 17 | 13.274 | Phenol, 3,4,5-trimethoxy- | C ₉ H ₁₂ O ₄ | 184 | 1.13 |

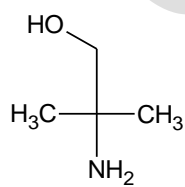
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|----|--------|---|-------------------|-----|-------|
| 18 | 14.030 | .alpha.-D-Galactopyranoside, methyl | $C_7H_{14}O_6$ | 194 | 12.56 |
| 19 | 14.355 | Phenol, 4-(3-hydroxy-1-propenyl)-2-methoxy- | $C_{10}H_{12}O_3$ | 180 | 3.36 |
| 20 | 15.296 | Octadecanoic acid | $C_{18}H_{36}O_2$ | 284 | 0.19 |
| 21 | 15.440 | 4,4-Dimethyl-cyclohex-1-enecarboxylic acid, methyl ester | $C_{10}H_{16}O_2$ | 168 | 0.18 |
| 22 | 15.775 | Cyclopentaneundecanoic acid, methyl ester | $C_{17}H_{32}O_2$ | 268 | 0.33 |
| 23 | 16.146 | n-Hexadecanoic acid | $C_{16}H_{32}O_2$ | 256 | 3.69 |
| 24 | 16.317 | Hexadecanoic acid, ethyl ester | $C_{18}H_{36}O_2$ | 284 | 0.91 |
| 25 | 16.633 | 4-Cyclooctene-1-carboxaldehyde | $C_9H_{14}O$ | 138 | 0.06 |
| 26 | 16.692 | 10-Undecen-1-al, 2-methyl- | $C_{12}H_{22}O$ | 182 | 0.16 |
| 27 | 16.901 | Octadecanoic acid | $C_{18}H_{36}O_2$ | 284 | 0.37 |
| 28 | 17.151 | 1-Tetradecyne | $C_{14}H_{26}$ | 194 | 0.08 |
| 29 | 17.392 | Cyclopentadecanone | $C_{15}H_{28}O$ | 224 | 0.07 |
| 30 | 17.568 | 9,12-Octadecadienoic acid (Z,Z)- | $C_{18}H_{32}O_2$ | 280 | 2.11 |
| 31 | 17.613 | 9,12-Octadecadienoic acid (Z,Z)- | $C_{18}H_{32}O_2$ | 280 | 0.89 |
| 32 | 17.697 | 13-Tetradecenal | $C_{14}H_{26}O$ | 210 | 0.22 |
| 33 | 17.777 | 9,12-Octadecadienoic acid (Z,Z)- | $C_{18}H_{32}O_2$ | 280 | 0.63 |
| 34 | 17.847 | [1,1'-Bicyclopropyl]-2-octanoic acid, 2'-hexyl-, methyl ester | $C_{21}H_{38}O_2$ | 322 | 0.54 |
| 35 | 18.120 | Nonanoic acid, 9-oxo-, ethyl ester | $C_{11}H_{20}O_3$ | 200 | 0.09 |
| 36 | 18.655 | cis-Vaccenic acid | $C_{18}H_{34}O_2$ | 282 | 0.62 |
| 37 | 18.908 | Ethyl 9-hexadecenoate | $C_{18}H_{34}O_2$ | 282 | 0.28 |
| 38 | 19.436 | 2-Pentyl-cyclohexane-1,4-diol | $C_{11}H_{22}O_2$ | 186 | 0.10 |
| 39 | 19.485 | 9-Octadecenamide, (Z)- | $C_{18}H_{35}NO$ | 281 | 0.50 |
| 40 | 19.736 | 17-Octadecynoic acid | $C_{18}H_{32}O_2$ | 280 | 0.23 |
| 41 | 19.854 | Oxiraneoctanoic acid, 3-octyl-, cis- | $C_{18}H_{34}O_3$ | 298 | 0.10 |
| 42 | 19.931 | Cyclopentadecanone | $C_{15}H_{28}O$ | 224 | 0.05 |
| 43 | 20.121 | Cyclopentadecanone | $C_{15}H_{28}O$ | 224 | 0.08 |
| 44 | 20.183 | Cyclopentadecanone | $C_{15}H_{28}O$ | 224 | 0.04 |
| 45 | 20.665 | Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester | $C_{19}H_{38}O_4$ | 330 | 0.42 |
| 46 | 20.939 | 9-t-Butyltricyclo[4.2.1.1(2,5)]decane-9,10-diol | $C_{14}H_{24}O_2$ | 224 | 0.08 |
| 47 | 21.930 | Propyleneglycol monooleate | $C_{21}H_{40}O_3$ | 340 | 0.43 |

Mass spectrometry becomes a vital tool in the hands of the organic chemists and biochemists because of its potential to supply the definitive, qualitative and quantitative information on molecules based on their structural compositions.

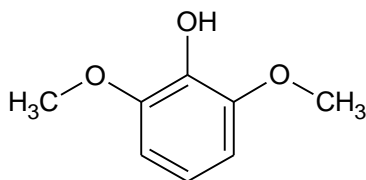
Table: 3 Activity of phytocomponents identified in the ethanol extract of leaf of *C. pachycarpa*

| S/N | Retention time | Compound name | Molecular formula | Molecular weight | Area % | Compound Nature | Activity | References |
|-----|----------------|--------------------------------|-------------------|------------------|--------|---------------------------|--|---------------------------------|
| 1 | 16.314 | Hexadecanoic acid, ethyl ester | $C_{18}H_{36}O_2$ | 284 | 0.17 | Palmitic acid ethyl ester | Antioxidant, Hypocholesterolemic, Nematicide, Pesticide, Lubricant, Antiandrogenic Flavor, Hemolytic | Balamurugan <i>etal.</i> , 2017 |
| | 20.270 | .beta.-Tocopherol | $C_{28}H_{48}O_2$ | 416 | 0.42 | Vitamin E | Antiageing, Analgesic, Antidiabetic, Anti-inflammatory, Antioxidant, Antidermatitic, Antileukemic, | Balamurugan <i>etal.</i> , 2017 |

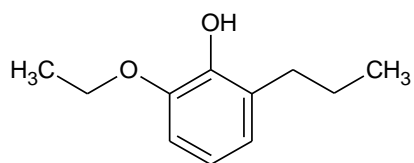
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|--------|---|-------------------|-----|------|---------------|---|--------------------------|
| 21.772 | Vitamin E | $C_{29}H_{50}O_2$ | 430 | 5.16 | Vitamin E | Antitumor, Anticancer, Hepatoprotective, Hypocholesterolemic, Antiulcerogenic, Vasodilator, Antispasmodic, Antibronchitic, Anticoronary, Antiageing, Analgesic, Antidiabetic, Anti-inflammatory, Antioxidant, Antidermatitic, Antileukemic, Antitumor, Anticancer, Hepatoprotective, Hypocholesterolemic, Antiulcerogenic, Vasodilator, Antispasmodic, Antibronchitic, Anticoronary | Devi and Muthu (2015) |
| 19.717 | cis-Verbenol | $C_{10}H_{16}O$ | 152 | 0.10 | | antioxidative and anti-inflammatory | |
| 17.398 | Phytol | $C_{20}H_{40}O$ | 296 | 0.98 | | Antioxidant | Balamurugan et al., 2017 |
| 17.609 | 8,11,14-Eicosatrienoic acid, (Z,Z,Z)- | $C_{20}H_{34}O_2$ | 306 | 1.71 | | Cardio protective | Balamurugan et al., 2017 |
| 16.119 | n-Hexadecanoic acid | $C_{16}H_{32}O_2$ | 256 | 3.35 | Palmitic acid | anti-inflammatory | Balamurugan et al., 2017 |
| 16.685 | 17-Octadecynoic acid | $C_{18}H_{32}O_2$ | 280 | 0.11 | | antioxidant, nematocide, pesticide and vasoconstrictor | Jarez et al., (2011). |
| 17.176 | 9,12,15-Octadecatrienoic acid, methyl ester, (Z,Z,Z)- | $C_{19}H_{32}O_2$ | 292 | 0.31 | Palmitic acid | antifungal, antibacterial, antioxidant, anti-inflammatory, hypocholesterolemic, anticancer, anticoronary, 5-alpha reductase inhibitor and antimicrobial | |



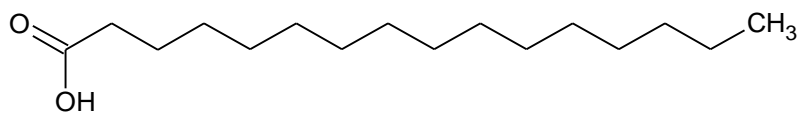
1-propanol,2-amino-2-methyl



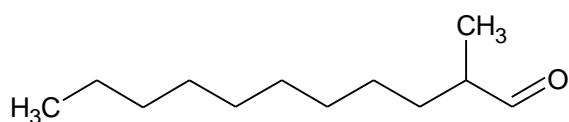
Phenol,2,6-dimethoxy



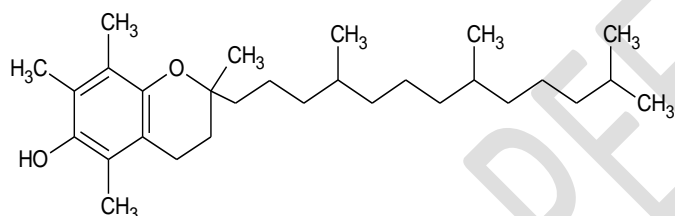
Methyl-(2-hydroxy-3-ethoxy-benzyl) ether



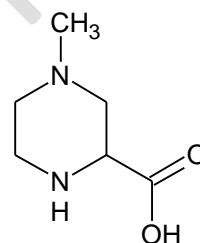
n-Hexadecanoic acid



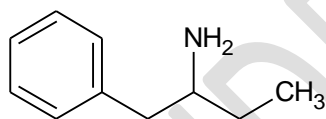
Undecanal,2-methyl



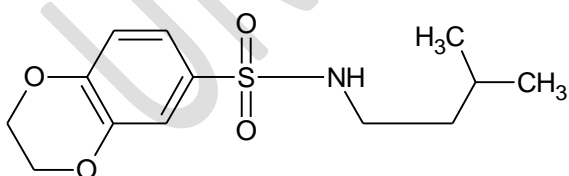
Vitamine E



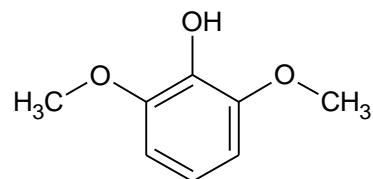
4-methylpiperazine-2-carboxylic acid



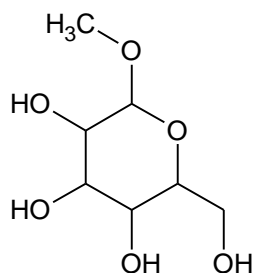
2-phenethylamine, .alpha-ethyl



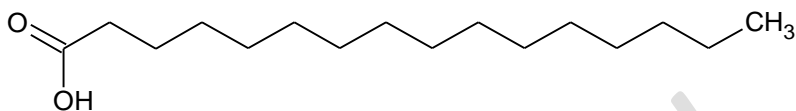
1,4-benzodioxin-6-sulphonamide, 2-N-[2-dimethylamino ethyl]



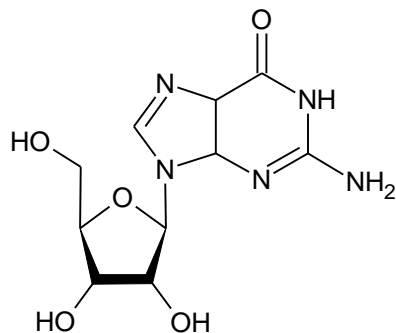
Phenol-2,6-dimethoxy



Alpha.-D-galactopyranoside, methyl



n-Hexadecanoic acid



Guanosine

Figure 3: Some chemical structures of compounds in the leaf and stem ethanol extract.

Spectrometer (GC-MS), enables mixture of small molecules mainly organic compounds of low molecular weight (<600) which can be analysed.

Johnny and Bassey (2020) reported the presence of alkaloid, flavonoid, saponins, tannins, cardiac glycosides for the leaf while alkaloid, cardiac glycosides and anthraquinones were absent in the stem. Taxonomic characters were also reported for its identification.

GC-MS chromatogram analysis of the ethanolic leaf and stem extracts of *C. pachycarpa* [Figure 1 and 2] predicted 64 and 47 peaks respectively, indicating the presence of 64 and 47 phytochemical constituents respectively. On comparison of the mass spectra of the constituents with the NIST library, the phytochemicals were characterized and identified [Table 1 and 2] for the leaf and stem extracts respectively. The various phytochemicals which contribute to the medicinal activities of the plant were shown in Table 3. The chemical structures of the most abundant phytochemicals were presented in Figure 3. Of the 64 compounds identified in the leaf extract, the most prevailing compounds were: 1-propanol, 2-amino-2-methyl (31.34%), undecanal, 2-methyl (4.00%), phenol, 2,6-dimethoxy (4.18%), n-Hexadecanoic acid (3.35%), 3,7,11,15-Tetramethyl-2-hexadecen-1-ol (2.21%), 9,12-Octadecadienoic acid (Z,Z) (1.25%), vitamin E (5.15%), methyl-(2-hydroxy-3-ethoxy-benzyl)ether (4.79%), 5-caranol, (1S,3R,5S,6R) (2.63%), 2-methoxy-4-vinylphenol (3.10%), 1H-Azepin-1-amine, hexahydro (2.30%), 1-Heptadec-1-ynyl-cyclopentanol (2.23%) and 5-Octen-2-ol, 5-methyl (1.49%), while the most abundant in the stem ethanol extracts were: 2(5H)-Furanone (3.07%), 3-Cyclohexen-1-carboxaldehyde, 3-methyl (3.23%), 4-Methylpiperazine-2-carboxylic acid (5.78%), Phenethylamine.alpha.-ethyl- (10.96%), 1,4-Benzodioxin-6-sulfonamide,N-[2-(dimethylamino)ethyl- (30.10%), Phenol,2,6-dimethoxy-(3.19%), Guanosine (3.86%), .alpha.D-Galactopyranoside, methyl (12.56%), Phenol,4-(3-hydroxy-1-propenyl)-2-

methoxy- (3.36%), n-Hexadecanoic acid (3.69%) and 9,12-Octadecadienoic acid (Z,Z)- (2.11%) amongst others.

The available literature supports [\(what were the literature? Pls cite those here\)](#) that the identified compounds of *C. pachycarpa*. has the biological activities like antioxidant, antibacterial, antifungal, antidiabetic and anticancer activities.

CONCLUSION

The results of the study clearly indicate the presence of active principles with the pharmacological activities in the ethanolic extract of *Cola pachycarpa* K. Schum. So, this can be effectively used to treat diseases like cancer, diabetes mellitus, arthritis and inflammation. [\(The conclusion provided here is a bit premature and lacks sufficient evidence to support the effectiveness of the ethanolic extract of Cola pachycarpa for treating specific diseases\)](#)

[Consider limitations and future research: Acknowledge any limitations of the study and mention areas for further research. It is important to recognize that the identification of bioactive compounds is just the initial step. Future studies should include in vitro and in vivo experiments, as well as clinical trials, to assess the efficacy and safety of the extract for specific diseases.](#)

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