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Research Article

Phytochemical Constituents of Ethanolic Extracts of Riped and Unriped Fruits of *Dennettia tripetala*

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ABSTRACT

Dennettia tripetala fruit is commonly used as spices and in traditional medicine,it is employed for the treatment of various ailments. The phytochemical composition of both riped and unriped fruits of *Dennettia tripetala* were evaluated in this study. Fresh matured fruit of *Dennettia tripetala* used in this study were purchased at Nsukka, Enugu State, Nigeria. The healthy fruits were selected, air-dried and pulverized. GC-MS was used for the phytochemical analysis. The GC-MS analysis of ethanolic extracts of riped and unriped fruits of *Dennettia tripetala* revealed some constituents that have been reported to possess medicinal, nutritional and other functions. Some of the constituents include (Z)-9,17-octadecadienal, octadecanoic acid, 9-octadecenoic acid ethyl ester, D-gluconic acid delta lactone, 2-Methyl-Z,Z-3,13-octadecadienol, 13-Bromotetradecanoic acid and pentadecanoic acid. The results showed that both riped and unriped ethanolic fruits extracts of *Dennettia tripetala* may possess nutritional and medicinal properties. However, some of the phytochemicals may confer liver and kidney toxicity.

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INTRODUCTION

Medicinal plants contain natural products that are important in pharmaceutical development and used to treat a variety of disorders in humans (Yakubu, 2013; Imo and Zaku, 2019; Yakubu, 2020). Some of the medicinal plants have been investigated in the laboratory for their medicinal uses (Imo and Uhegbu, 2015). Spices especially fruity spices possess vitamins, minerals, essential oil and other important compounds that are used in folk medicine for treatment of various ailments. *Dennettia tripetala* belong to such class of fruit spices that is on high demand due to its importance.

Dennettia tripetala, often known as Pepper fruit; is found throughout West African rain forest region. It is well known for its fiery and peppery flavour (Adebayo, 2010; Muhammed *et al.*, 2021). In Nigeria, it is known as Ako (Edo), Mmimi (Igbo), and Ata Igbere (Yoruba). The fruit have been used for centuries as a treatment for fevers, coughs, toothaches, as laxative and other diseases (Adebayo, 2010). The fruit of *Dennettia tripetala* is enormous in phytochemicals (Elekwa, 2011; Ihemeje, 2013; Muhammed *et al.*, 2021). In rodents, the essential oil of *D. tripetala* posses very significant analgesic and anti-inflammatory properties (Oyemitan, 2008).

MATERIALS AND METHODS

Plant material used: Fresh matured fruits of *Dennettia tripetala* used in this study were purchased at Nsukka, Enugu State, Nigeria. The healthy fruits were selected, air-dried and pulverized with a blender.

Preparation of plant extract: The powder was macerated in 70% ethanol for 48 hours while being periodically shaken, after which it was filtered and evaporated to produce a concentrate. The concentrated extract was utilized for the determination of phytochemicals.

Figure 1: Unriped fruits of *Dennettia tripetala*

Figure 2: Riped fruits of *Dennettia tripetala*

Determination of phytochemical constituents of ethanolic extracts of fruits of *Dennettia tripetala*

The ethanolic extracts of riped and unripe fruits of *Dennettia tripetala* were subjected to GC-MS analysis for their phytoconstituents. The GC-MS was equipped with column: Agilent HP 5MS ultra-Inert (350°C) 30 m × 250 µm × 0.25 µm. The gas used was Helium (He) with flow: 0.7 mL/minute, average velocity: 30.641 cm/seconds, and pressure: 4.4867 psi. Exactly 1 mL was used as the injection volume with inlet temperature 250°C, split ratio 20:1, and split flow 14 mL/minute. The oven temperature used was 60°C with equilibrating time of 1-minute, maximum oven temperature 350°C, and total run time of 35.857 minutes. Mass Hunter Library NIST14 was used in comparing and identifying the constituents.

RESULTS AND DISCUSSION

Table 1: GC-MS phytoconstituents of ethanolic extract of riped fruits of *D. tripetala*

S/N	Compound	Retention time (min)	Area %
1	2-[Hydroxyimino]methyl-1-[1-propyl-3-sulfonate]pyridinium, inner salt	5.26	0.13
2	Glutaric acid, di(phenethyl) ester	5.55	8.42
3	Formic acid, (2-methylphenyl) methyl ester	5.92	0.09
4	Methyl 2-O-methyl-.beta.-D-xylopyranoside	6.71	0.12
5	Alpha.-Farnesene	10.92	0.09
6	Dodecanoic acid, methyl ester	11.28	1.64
7	Nerolidol	12.12	5.96
8	Tridecanoic acid, 4,8,12-trimethyl-, methyl ester	12.36	0.04
9	1,3-Dioxan-4-one, 2-(1,1-dimethylethyl)-5-methyl-, (2s-cis)-	12.39	0.03
10	Z-2-Dodecenol	12.74	0.31
11	Dodecanoic acid, 1-methylethyl ester	12.90	0.06
12	Cyclohexanone, 4-hydroxy-	13.76	0.27
13	tert-Hexadecanethiol	13.79	0.07
14	Trisilane	13.81	0.06
15	5-Thio-d-glucopyranose	13.86	0.16
16	Carbonic acid, octadecyl prop-1-en-2-yl ester	13.89	0.13
17	Polygalitol	14.06	0.22
18	Beta.-D-Ribopyranoside, methyl	14.12	0.14
19	D-Fucose	14.16	0.19
20	L-Galactose, 6-deoxy-	14.22	0.28
21	Morpholine 4-methyl-, 4-oxide	14.26	0.22
22	Maltose	14.29	0.14
23	Trehalose	14.31	0.18
24	Pentadecanoic acid	14.52	0.80
25	Octadecane, 1-chloro-	14.62	0.35
26	Cyclopentaneacetic acid	14.70	0.33
27	Methyl-.beta.-D-	14.72	0.14

	arabinopyranoside		
28	Undecanoic acid	14.76	0.28
29	Lactose	14.87	0.92
30	Beta.-D-Glucopyranose, 4-O-.beta.-D-galactopyranosyl-	15.11	3.62
31	D-Talonic acid lactone	15.19	1.81
32	Gluconic acid	15.29	3.11
33	D-Galactitol-5-O-hexyl-	15.40	3.99
34	D-Gluconic acid, .delta.-lactone	15.44	6.77
35	Methyl tetradecanoate	15.76	2.23
36	Hexadecanoic acid, methyl ester	19.93	2.40
37	n-Hexadecanoic acid	21.03	2.24
38	Hexadecanoic acid, ethyl ester	21.27	0.79
39	9,12-Octadecadienoic acid (Z,Z)-, methyl ester	22.96	0.41
40	10-Octadecenoic acid, methyl ester	23.15	3.02
41	7-Hexadecenoic acid, methyl ester, (Z)-	23.27	0.51
42	Methyl stearate	23.75	1.34
43	9-Hexadecenoic acid, methyl ester	23.86	0.05
44	9,17-Octadecadienal, (Z)-	24.25	18.05
45	9-Octadecenoic acid (Z)-, methyl ester	24.38	9.99
46	Octadecanoic acid	24.70	10.32
47	Octadecanoic acid, ethyl ester	24.98	5.77
48	9-Octadecenoic acid	25.11	1.76
49	Nonadecanoic acid, 11-methyl-, methyl ester	27.26	0.13
50	9-Octadecenoic acid (Z)-, 2,3-dihydroxypropyl ester	32.63	0.01
51	Trans-13-Octadecenoic Acid	37.33	0.01
52	Oleic Acid	37.41	0.01
53	2-Methyl-Z,Z-3,13-octadecadienol	37.77	0.09

The GC-MS analysis results of ethanolic extract of riped fruits of *D. tripetala* showed 9,17-Octadecadienal (Z)-, Octadecanoic acid, Octadecanoic acid ethyl ester, 9-Octadecenoic acid (Z)- methyl ester, Nerolidol, D-Gluconic acid delta.-lactone and Glutaric acid, di(phenethyl) ester as some of the constituents with high area %.

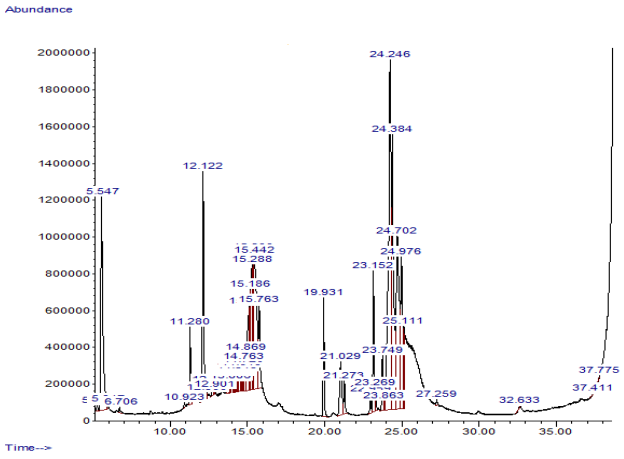

Figure 3: GC-MS chromatogram of ethanolic extract of riped fruits of *D. tripetala*

Table 2: GC-MS phytoconstituents of ethanolic extract of unriped fruits of *D. tripetala*

S/N	Compound	Retention time (min)	Area %
1	Benzoic acid, 2-phenylethyl ester	5.53	25.03
2	Oxalic acid, 2-phenylethyl propyl ester	6.05	0.30
3	3-Phenylthiopropionic acid, S-benzyl ester	6.49	0.52
4	Methyl 13-methyltetradecanoate	6.70	0.33
5	Dodecanoic acid, methyl ester	11.28	0.92
6	1,6,10-Dodecatrien-3-ol, 3,7,11-trimethyl-	12.12	1.95
7	1-Nitro-1-deoxy-d-glycero-l-mannoheptitol	15.17	1.14
8	D-Mannitol	15.41	1.51
9	3-Methyl-1-diisopropylsilyloxybutane	15.46	1.98
10	Methyl tetradecanoate	15.77	1.49
11	Beta.-D-Glucopyranose, 4-O-.beta.-D-galactopyranosyl-	17.08	0.13
12	trans-2,7-Dimethyl-3,6-octadien-2-ol	17.14	0.04
13	Hexadecenoic acid, Z-11-	19.38	0.31
14	Pentadecanoic acid-14-methyl-, methyl ester	19.93	11.10
15	trans-4-Aminocyclohexanol, N,O-diacetyl	20.63	0.33
16	n-Hexadecanoic acid	21.01	4.99
17	Hexadecanoic acid, ethyl ester	21.27	1.16

18	9,12-Octadecadienoic acid (Z,Z)-, methyl ester	22.96	0.42
19	9-Octadecenoic acid (Z)-, methyl ester	23.15	2.37
20	Methyl stearate	23.75	0.61
21	9,17-Octadecadienal, (Z)-	24.22	3.88
22	9-Octadecenoic acid (Z)-, 2,3-dihydroxypropyl ester	24.38	1.25
23	Octadecanoic acid	24.71	0.69
24	Octadecanoic acid, ethyl ester	24.97	0.32
25	Oxirane, tetradecyl-	29.96	0.15
26	9-Octadecenoic acid (Z)-, 2-hydroxy-1-(hydroxymethyl)ethyl ester	32.64	0.89
27	9-Octadecenoic acid (Z)-, 2,3-dihydroxypropyl ester	33.13	0.16
28	9,12-Octadecadien-1-ol, (Z,Z)-	33.35	0.05
29	Cycloeicosane	33.53	0.05
30	cis-7,cis-11-Hexadecadien-1-yl acetate	34.73	0.06
31	9-Eicosenoic Acid, (Z) -	34.94	0.20
32	2-Methyl-Z,Z-3,13-octadecadienol	36.35	13.75
33	Trans-13-Octadecenoic acid	36.57	5.69
34	Oleic Acid	36.61	2.49
35	13-Bromotetradecanoic acid	36.71	13.01

The GC-MS analysis of unriped ethanolic extract of fruits of *D. tripetala* showed Benzoic acid-2-phenylethyl ester, 13-Bromotetradecanoic acid, Trans-13-Octadecenoic acid, 2-Methyl-Z,Z-3,13-octadecadienol, n-Hexadecanoic acid, Pentadecanoic acid-14-methyl-, methyl ester and 9,17-Octadecadienal, (Z)- as some of the constituents with high area %.

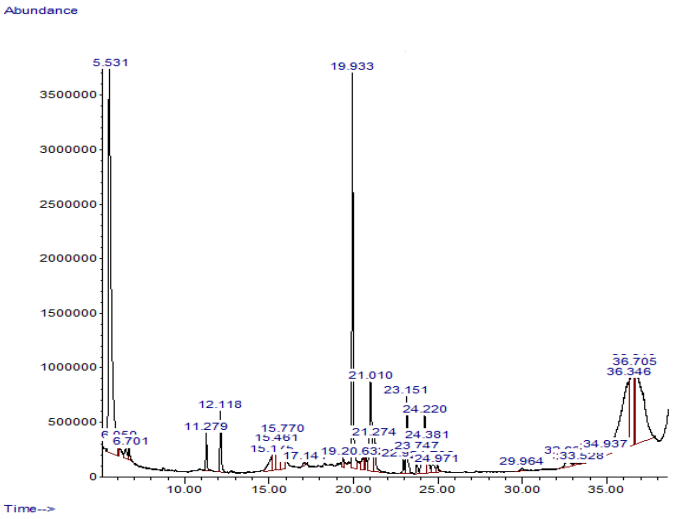

Figure 4: GC-MS Chromatogram of ethanolic extract of unriped fruits of *D. tripetala*

The results obtained from GC-MS analysis of the ethanolic extract of riped fruits of *D. tripetala* are presented in table 1. The constituent with highest area % (9,17-octadecadienal) in the riped fruit extract which is also found in the unriped fruit extract is an aldehyde also known as linolenic acid, it is a crucial omega-3 fatty acid with a clear therapeutic benefit in lowering blood cholesterol level. Increased intake of linolenic acid has been shown to have neuroprotective qualities, which reduces depression symptoms and maintains mental health (Hibbeln, 1998; Peet *et al.*, 1998; Peet and Stokes, 2005). Octadecanoic acid which is also known as stearic acid present in both fruit extracts of *D. tripetala* has been documented in epidemiologic and clinical studies to be linked with lowered LDL cholesterol in contrast with other saturated fatty acids (Rizzo *et al.*, 1986; Cho *et al.*, 2010; Imo *et al.*, 2018). This might be linked to the hypocholesterolemic effect of the fruit of *D. tripetala* on blood cholesterol levels of human (Cho *et al.*, 2010). Oleic acid present in both fruit extracts of *D. tripetala* is a widespread monounsaturated fat found in human diet. The oral intake of monounsaturated fat is linked with decreased low-density lipoprotein (LDL) cholesterol, and perhaps increased high-density lipoprotein (HDL) cholesterol (Rao *et al.*, 2012; Imo *et al.*, 2018). Oleic acid is a fundamental omega-9 monounsaturated fatty acid and is employed as an emulsifying agent, it has also been described as a hypotensive agent (Mahato and Sen, 1997) and known to inhibit the progression of adrenoleukodystrophy, a serious disease that affect the brain and adrenal glands (Nestel *et al.*, 1994).

n-Hexadecanoic acid present in both extracts is used in personal care products and cosmetics production and has also been reported to have antioxidant, hypocholesterolemic, anti-inflammatory property, 5-alpha reductase inhibitor activities (Apama *et al*.,2012; Bruce, 2021). 12-Octadecadienoic acid (Z,Z)-, methyl ester present in both extracts was reported to have anti-inflammatory, anti-arthritic, anti-acne, anti-histaminic, anti-eczemic, anti-androgenic, anti-coronary artery disease, anti-cancer, antihypercholesterolemic, 5-alpha reductase inhibitor activities (Kavitha and Nadu 2021; Olivia *et al.*,2021). Nerolidol is a dodeca-1,6,10-triene farnesane sesquiterpene that bears methyl groups at positions 3, 7, and 11, as well as a hydroxy group at position 3, it is a naturally occurring substance with a floral scent; it functions as a neuroprotective agent, a pheromone, an antifungal, an anti-inflammatory, an antihypertensive, and as antioxidant (Soliha *et al.*, 2021). It is also used as antiulcer (Klopell *et al.*, 2007). 9-Phytol was reported to exert antioxidant, neuroprotective, antimicrobial, anticancer, anti-inflammatory, and anti-diuretic activities (Olivia *et al.*, 2021). Methyl stearate present in both extracts is used as

a food additive and also used in the production of cosmetics and soaps. Benzene (2-nitroethyl) is a key component of flower fragrance (Yasumasa *et al.,* 2014). Tridecanoic acid is important in food industry as a flavouring agent or adjuvant. Pentadecanoic acid is an essential fatty acid that have clinically relevant benefits in stem chronic cardiometabolic, liver and inflammatory diseases (Venn-Watson and Butterworth, 2022).

9-Octadecenoic acid (Z)-, methyl ester has been shown to have anti-carcinogenic activity (Jeneciu*set al.,* 2012). Mannose, fucose, galactose are known to be important in human metabolism (Freeze and Sharma, 2010; Imo *et al.,* 2018). People that consume extracts of *D. tripetala* may have low risk of developing heart problem, cancer development and may be provided with constituents that can promote healthy life.

The results obtained from GC-MS analysis of ethanolic extract of unripe fruits of *D tripetala* as shown in table 2, showed that the extract has important constituents. Benzoic acid 2-phenylethyl ester is the compound with the highest peak area and is used as food additive (Yasumasa*et al.,* 2014; War *et al.,* 2020). 2-Methyl-Z,Z-3,13-octadecadienol present in both extracts is a tarpenoid that is used as pesticide, herbicide, insecticide and pheromone (Adeyemi *et al.*,2017). 13-Bromotetradecanoic acid, Pentadecanoic acid, 14-methyl-, methyl ester and trans-13-Octadecenoic acid has a good anti-inflammatory activity (Hameed *et al.,* 2016). Hexadecanoic acid ethyl ester present in both fruit extracts works as an antibacterial, antifungal, and antitumor agent (Tyagi and Agarwal, 2017). 1-Nitro-1-deoxy-d-glycero-l-mannoheptitol and dodecanoic acid, methyl ester possesses antibacterial activity (Chandrasekaran *et al.,* 2008). This may contribute to the reasons why some people use it for antimicrobial activity. 3-Methyl-1-diisopropylsilyloxybutane, 1,6,10-Dodecatrien-3-ol, 3,7,11-trimethyl-, D-Mannitol are widely used as an excipient in pharmaceutical products (Nunes *et al.,* 2004). Methyl tetradecanoate has been reported as a highly pure long-chain saturated fatty acid used in a wide variety of products in the market including flavourings, soaps, and cosmetics (National Center for Biotechnology Information, 2022). 9-Octadecenoic acid (Z)- and 2,3-dihydroxypropyl ester are used as surfactant and emulsifying agents (Powder-George and Mohammed, 2018).
Utilization of fruits of *D. tripetala* in nutrition and pharmacology will provide these constituents, which may help achieve their reported functions in humans and other animals.

CONCLUSION

This study evaluated the phytochemical constituents of ethanolic extracts of fruits of *Dennettia tripetala*. The fruits of *Dennettia tripetala* contains important phytochemicals with wide range of application in nutritional, medicinal and other various industries. The presence of these phytochemicals in ethanolic extracts of fruits of *Dennettia tripetala* support the use of fruits of *Dennettia tripetala* in cosmetics, nutrition, medicine and pharmacology.

CONFLICT OF INTEREST

All the contributing authors declare no conflict of interest.

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