Indonesian Journal of Pharmacy

VOL 33 (2) 2022: 193–199 | RESEARCH ARTICLE

Chemical composition of *Bryophyllum pinnatum* (Lam.) Oken

Mahmoud Dogara Abdulrahman

Department of Biology, Faculty of Education, Tishk International University-Erbil, Kurdistan Region, Iraq

Info Article

Submitted: 19-09-2021
Revised: 11-02-2022
Accepted: 13-04-2022

*Corresponding author
Mahmoud Dogara Abdulrahman

Email: abdulrahman.mahmud@tiu.edu.iq

ABSTRACT

Natural chemicals with medicinal qualities are an endless source of chemical molecules, making them a valuable source of pharmacologically active molecules. Humans have always looked for these plants, not only for food but also for medicinal purposes. *Bryophyllum pinnatum* is a succulent perennial herb native to Africa and Asia. The plant is traditionally used in northern Nigeria to treat and manage various ailments. To date, no studies have been carried out on the chemical composition of *B. pinnatum* in northern Nigeria. The study examined the chemical composition of *B. pinnatum* leaves in northern Nigeria. Soxhlet extraction was used to extract the essential oil using three different solvents (dichloromethane, hexane and hexane-acetone). The chemical composition of the essential was identified with Gas chromatography coupled with mass spectrometry. Thirty-five compounds were identified from the essential oil extracted with dichloromethane, twenty-five from the essential oil extracted with hexane, and twenty-three from the essential oil extracted with hexane-acetone. But the three solvents were found to be dominant by Bis(2-ethylhexyl) phthalate. The study provides the first chemical composition of *B. Pinnatum,* which can be fully utilised by industry and pharmaceutical companies. Further studies are needed to ascertain each identified compound's pharmacological and industrial usage.

Keywords: Bis(2-ethylhexyl) phthalate, Ethnobotany, Medicinal plants, Nigeria

INTRODUCTION

Plants have long been a vital part of life in many traditional cultures around the world, including those in Africa (Dike and Obembe, 2012). Plants are highly significant in traditional healing. From prehistoric times to the present, medicinal and aromatic plants have been an essential source of human health care (Mahmoud *et al*., 2020). An unlimited number of plants are utilised as medicine all over the world. In Nigeria, a wide range of plants have traditionally been used to cure a wide range of ailments and disorders (Dogara *et al*., 2021). These herbs, typically used in synergistic combinations, are as effective as commercially available drugs and are frequently preferred by a larger segment of society (Dogara *et al*., 2021).

Plant taxonomy is the study of allocating, naming, and describing plant species to a group or class. Beyond Morpho-anatomical traits, chemical and molecular identification are required to comprehend the evolutionary relationship among plants (Abdulrahman *et al*., 2018). The authenticity and safety of plant resources are crucial in developing herbal products or modern medicine (Abdulrahman *et al*., 2018). The Crassulaceae family includes plants from the Crassula tribe with mushy, succulent leaves. There are 25 genera and 450 species in the family. Herbs and shrubs make up this family. Branches and stems are succulent (Nagaratna and Hegde, 2015). Bryophyllum pinnatum is a succulent perennial herb native to Africa and Asia (Tatsimo *et al*., 2012). The plants are traditionally used in northern Nigeria to treat and manage various ailments. *B. pinnatum* was reported in Cameroon as the most utilised plant to treat infectious diseases (Tatsimo *et al*., 2012). The plant is also used traditionally in other parts of the world (Kamboj and Saluja, 2009). Quality control is required and critical in ethno-pharmacology to ensure the quality and authenticity of plants to create modern medication or herbal supplements (Abdulrahman *et al*., 2018).

One of the most significant setbacks in the development of herbal goods is the lack of quality assurance due to considerable variations in the chemical contents of the plants for product development (Abdulrahman *et al*., 2018). For quality control, each medicinal plant must be identified based on its chemical contents (Nafiu *et al*., 2017). The incredible chemical diversity of plants in Nigeria could be a source of novel lead compounds that are now relatively unknown. The study aimed to document the anatomical structure and chemical composition of *B. Pinnatum* from Kaduna State, northern Nigeria, to help serve as quality control for identifying the plant species for the possible development of herbal drugs, herbal supplements, or modern drugs.

MATERIALS AND METHODS

Sample collection and taxonomic identification

The samples were obtained from the wild in Kaduna state, northern Nigeria, with the assistance of traditional herbalists and confirmed by a certified taxonomist at ABU Zaria before being put in the institute's herbarium. The voucher number listed below was assigned (ABU01838).

Essential oil distillation

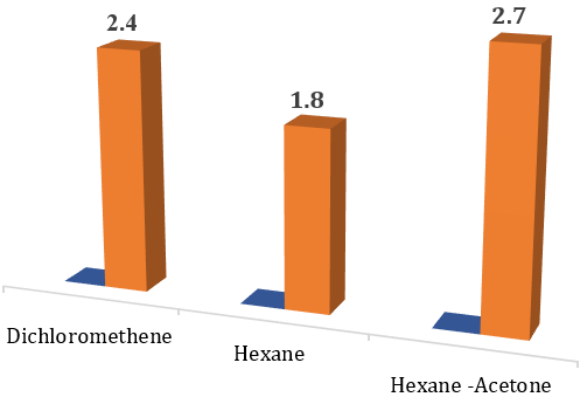
A fresh sample was taken from the wild. The powder form (100 g) was weighed separately for four different solvent concentrations, dichloromethane, hexane, hexane-acetone and aqueous, using Soxhlet extraction. The extraction product was filtered through Whatman filter no. 2, and the solvents were subsequently evaporated. The percentage yield was calculated concerning the dry mass of the starting sample trice (Mahmoud *et al*., 2019; Tesfaye and Tefera, 2017).

Essential oil identification

The components of the essential oil were detected using gas chromatography attached to mass spectrometry (QP2010) with the aid of a capillary column with a thickness of 30 m × 0.25 mm × 0.25 $\mu\mu$m. Helium was used as a carrier gas at a flow rate of 1 mL per minute, and the temperature of the injector and detector were 240 and 220 °C, respectively. The volume of the injection was 1.0 μL, and the split ratio at 1:20. The oven temperature was set from 60 °C to 240 °C at a ramping rate of 3 °C per minute. The impact energy of the electron was 70 eV, and fragments with sizes ranging from 40 to 650 mm/zz were recovered. The identification was carried out based on the build library (Mahmoud *et al*., 2019). A compound with 100% similarity was reported in the following study.

RESULTS AND DISCUSSION

Scientifically, chemical composition was important in medicinal plants identification. Plant taxonomy classification has hitherto relied on morphoanatomical characteristics (Abdulrahman, 2021). There is a need for each medicinal plant to be chemically identified. Based on fresh weight, the distilled oil yields from the leaves section were 2.4, 1.8 and 2.7 %, respectively. The yield recovery of the oil from the leaf shows the plant to be a good source of essential oil (Figure 1).



B. Pinnatum was extracted using three different solvents, dichloromethane, hexane and hexane-acetone. The essential oil extracted with dichloromethane constituted 39 compounds (Figures 2 and 5). Bis(2-ethylhexyl) phthalate (38.35) and Ledol (10.34) are considered the major constituents of the essential oil extracted with dichloromethane (Table I). Twenty-five compounds were identified from the essential oil extracted with hexane (Table I). Bis(2-ethylhexyl) phthalate (50.71), Ledol (17.70) and 1H-Cycloprop[e]azulen-7-ol, decahydron (7.67) are major constituents of the essential oil extracted with hexane) (Figures 3 and 5). The essential oil extracted with hexane-acetone was also dominated by o-Xylene (24.77), Bis(2-ethylhexyl) phthalate (22.72) and Benzene, 1,3-dimethyl- (11.14) (Figures 4 and 5). The discrepancies in the compositional contents were due to the nature and manner of the solvents used for the essential oil extraction. But the three solvents were found to be dominant by Bis(2-ethylhexyl) phthalate (Table I). The study provides the first chemical composition of *B. Pinnatum,* which industry and pharmaceutical companies can fully utilise.

Table I. Chemical composition of *Bryophyllum pinnatum* essential oil extracted from three different solvents.

S/N	Dichloromethane				Hexane			Hexane-acetone	
	Retention Time	Compound	Area	RT	Compound	Area	RT	Compound	Area
1	4.580	o-Cymene	0.60	3.599	Ethanone, 1-cyclohexyl-	0.22	3.061	Pentanal, 2-methyl-	0.34
2	4.670	p-Cymene	0.82	4.510	o-Cymene	0.80	3.385	2,2-Diethylacetamide	0.27
3	4.745	Eucalyptol	0.82	4.590	p-Cymene	1.12	3.810	2-Hexanol	0.82
4	10.685	Triacetin	1.39	4.665	Eucalyptol	0.64	4.556	Ethylbenzen	5.76
5	11.552	1-Pentadecene	1.55	10.069	Octadecane, 1-chloro-	0.90	4.700	o-Xylene	24.77
6	11.672	Hexacosane	0.87	11.543	1-Pentadecene	0.29	5.062	Benzene, 1,3-dimethyl-	11.14
7	12.356	Alloaromadendrene	0.75	12.347	Aromandendrene	0.99	5.442	1-Dodecene	3.29
8	12.421	Cyclohexane, octyl-	0.82	12.606	Cycloheptasiloxane, tetradecamethyl-	0.39	5.485	Octane, 4,5-diethyl-	1.12
9	12.986	Butanoic acid, 3-methyl-, 2-phenylethyl e	0.58	12.660	Alloaromadendrene	0.33	5.564	Benzene, (1-methylethyl)	0.98
10	13.621	Dimethyl-4-(1-methylethyl) cyclodeca	0.17	12.980	Butanoic acid, 3-methyl-, 2-phenylethyle	0.88	5.736	alpha.-Pinene	1.03
11	13.965	Cyclohexane, 1,1'-[3-(3-cyclopentylprop	0.18	14.027	(-)-Globulol	3.29	5.920	Pyrrolidine	0.67
12	14.031	(-)-Globulol	2.38	14.133	Ledol	1.27	5.953	Cyclohexane, 1-methyl-2-propyl-	0.75
13	14.138	Ledol	0.84	14.207	1H-Cycloprop[e]azulen-7-ol, decahydron	7.67	7.286	o-Cymene	2.45
14	14.211	1H-Cycloprop[e]azulen-7-ol, decahydron	5.51	14.331	Ledol	17.70	7.367	D-Limonene	0.68
15	14.281	1-Hexadecanol	5.05	14.446	1H-Cycloprop[e]azulene, 1a,2,3,5,6,7,7a	5.02	7.432	Eucalyptol	1.72
16	14.335	Ledol	10.34	14.576	2-Naphthalenemethanol, 2,3,4,4a,5,6,7,	1.84	12.979	1-Pentadecene	0.57
17	14.449	1H-Cycloprop[e]azulen-4-ol, decahydron	3.60	14.632	Caryophyllene oxide	0.68	15.417	1H-Cycloprop[e]azulen-4-ol, decahydron	1.06
18	14.580	Cyclohexanemethanol, 4-ethenyl-.alpha	1.17	14.690	Cyclooctasiloxane, hexadecamethyl-	0.36	15.609	1H-Cycloprop[e]azulen-7-ol, decahydron	3.94
19	14.635	Azulene, 1,2,3,5,6,7,8,8a-octahydro-1,4	0.35	14.793	Cyclohexanemethanol, 4-ethenyl-.alpha	1.40	15.734	(-)-Globulol	7.16

20	14.795	5-Azulenemethanol, 1,2,3,3a,4,5,6,7-oc	1.02	14.873	Guaiol	0.25	15.851	1H-Cycloprop[e]azulen-4-ol, decahydro-	1.84
21	15.014	tau.-Cadinol	0.79	15.173	2-Naphthalenemethanol, 1,2,3,4,4a,5,6	2.01	18.017	1-Nonadecene	0.73
22	15.111	Cyclohexane, decy	0.72	16.081	Aromandendrene	0.32	18.778	1,2-Benzenedicarboxylic acid, bis(2-me	5.69
23	15.175	2-Naphthalenemethanol, decahydro-.alp	1.26	16.327	Alloaromadendrene	0.36	20.173	1-Nonadecene	0.51
24	15.215	Phytol	0.17	25.173	Bis(2-ethylhexyl) phthalate	50.71	25.122	Bis(2-ethylhexyl) phthalate	22.72
25	16.328	1H-Cyclopropa[a]naphthalene, decahyd	0.22	27.376	Squalene	0.54			
26	16.633	1-Nonadecene	2.17						
27	16.718	Heneicosane	0.66						
28	16.805	alpha.-Phellandrene	0.31						
29	17.533	1,2-Benzenedicarboxylic acid, bis(2-me	10.33						
30	17.717	9-Heptadecanone	1.19						
31	18.251	Dibutyl phthalate	0.57						
32	19.511	Behenic alcohol	1.39						
33	19.596	Heneicosane	0.37						
34	20.610	Dodecylcyclohexane	0.35						
35	21.958	Behenic alcohol	0.64						
36	22.921	n-Heptadecylcyclohexane	0.24						
37	23.964	Octacosanol	0.24						
38	25.173	Bis(2-ethylhexyl) phthalate	38.35						
39	26.846	1,3-Benzenedicarboxylic acid, bis(2-ethy	1.24						
		Total	100			100			100

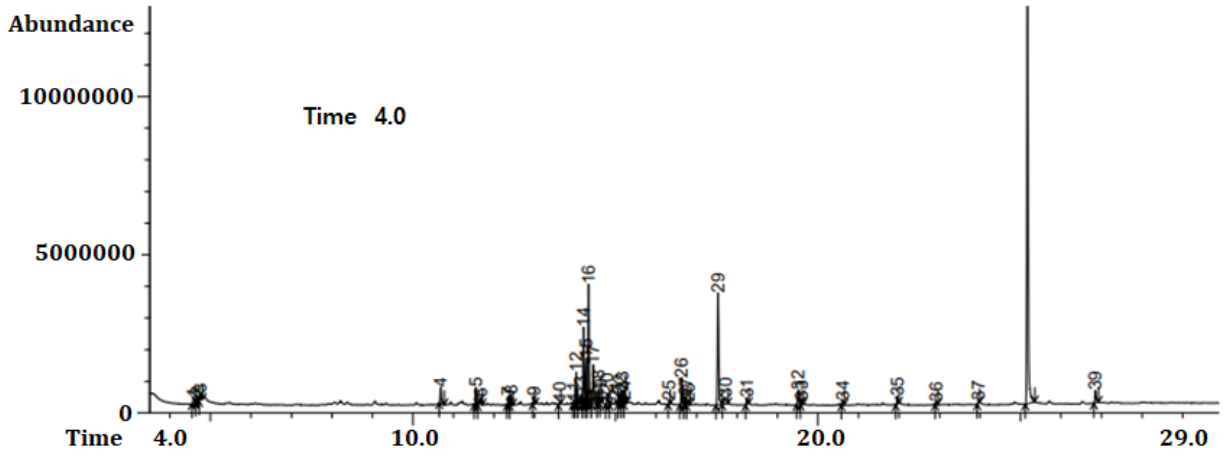


Figure 2. Chromatogram of Essential oil *Bryophyllum Pinnatum* extracted with Dichloromethane

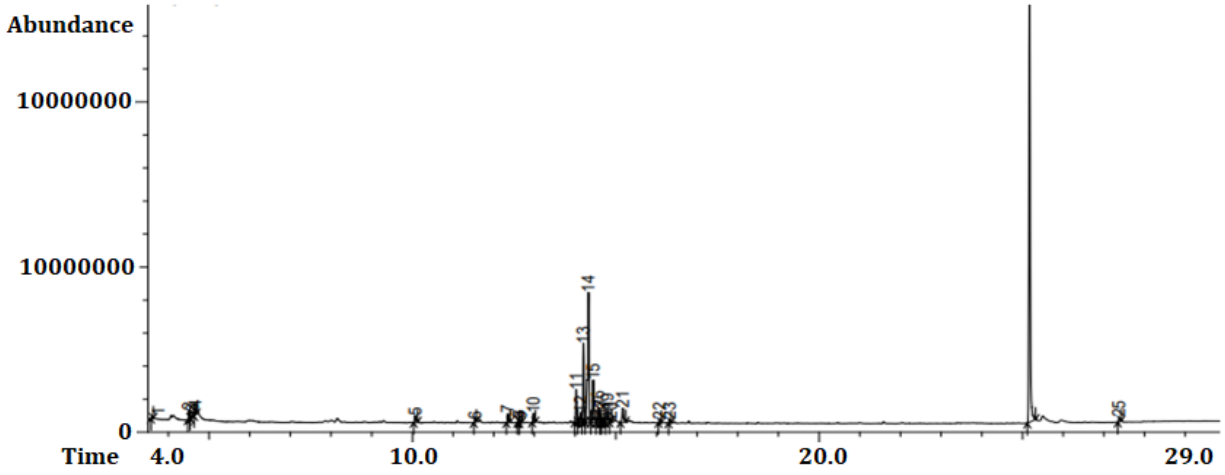


Figure 3. Chromatogram of Essential oil *Bryophyllum Pinnatum* extracted with Hexane

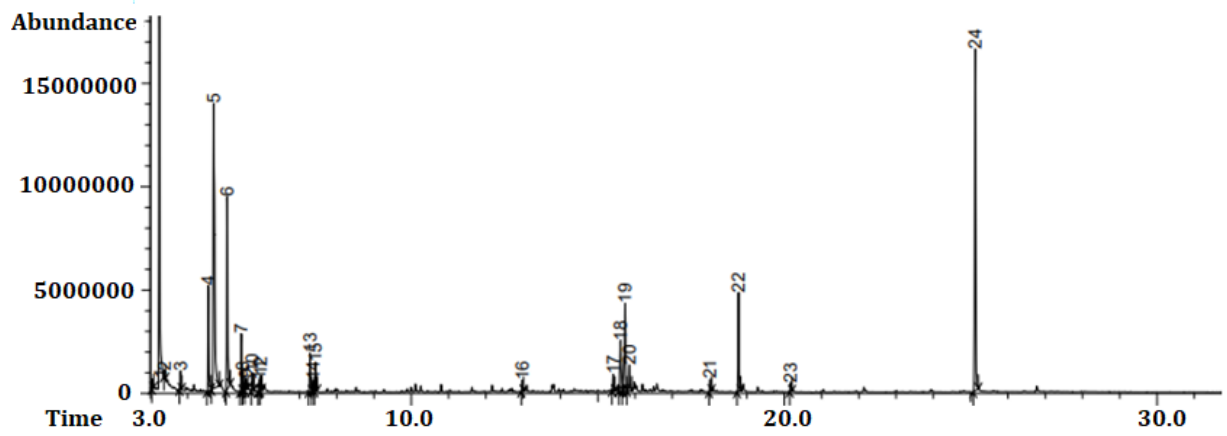


Figure 4. Chromatogram of Essential oil B. Pinnatum extracted with Hexane-acetone

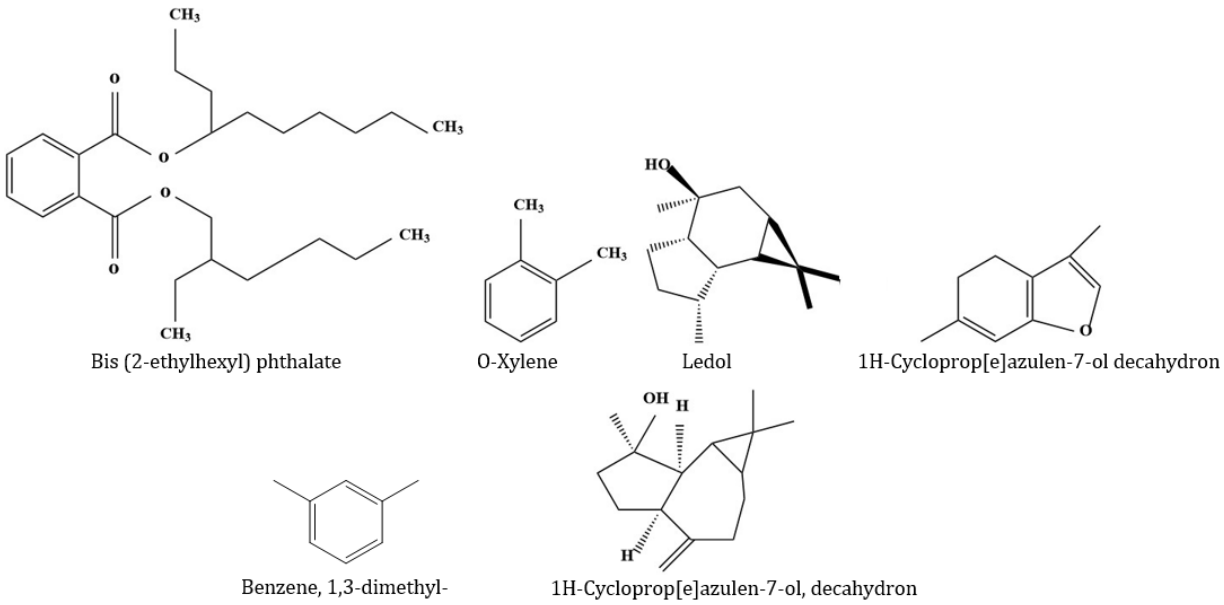


Figure 5. Chemical structure of the major compounds found in the Essential oil *B. Pinnatum*

CONCLUSION

There is no literature information on the chemical composition of *B. Pinnatum* in northern Nigeria to the best of our literature search. The dearth of information on the composition of the plant's oil inspired the current investigation, as the plant is said to have traditionally been used to treat and manage cancer, malaria, typhoid fever, and many more ailments. The study provides a comprehensive report on the chemical composition of the essential oil extracted from the leaves *B. Pinnatum* in northern Nigeria. The research provides baseline information for further research on the said plant.

ACKNOWLEDGEMENTS

I am appreciative to the chief editor and all of the other reviewers who contributed their time and skill. I must also thank Professor Tim Walters for his kind generosity in English proofreading.

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