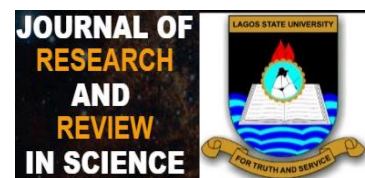


ORIGINAL RESEARCH



Chemical composition of essential oils from *Bambusa vulgaris* Leaf (Fresh and Dried) Schrad. Ex J.C. Wendl. [Poaceae] obtained in Nigeria

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Abstract:

Introduction: Essential oil is a hydrophobic concentrated liquid which contains volatile aroma compounds from plants. *Bambusa vulgaris* grows widely in the tropical and subtropical regions and has been reported to have different ethnomedicinal values such as antimalaria and antioxidant. It is also known to be an ornamental plant.

Aims: To extract and characterized the essential oils of *Bambusa vulgaris*.

Materials and Methods: The essential oil was extracted from both the fresh and dried leaves of *Bambusa vulgaris* by hydro distillation method using a Clevenger apparatus. The chemical constituents of the essential oils were characterized using gas chromatography and gas chromatography-mass spectrometry.

Results: The essential oils obtained were colourless with an herbal odour giving a yield of 0.64 w/w for the fresh sample and 1.08 w/w for the dried sample. A total of thirty-nine (39) compounds were identified from the essential oils of both samples. The major constituents in the fresh leaves were 3-aminodibenzofuran (19.2%), β -ocimene (11.1%), undecane (9.6%), tridecane (8.6%), [3,2-b] pyridin-6-octahydropyrano (7.1%), 2-mono laurin (6.9%) and vinyl decanoate (5.9%). Prominent compounds of the essential oil in the dried leaves were chlorophenoxymethylenimino sulfur pentafluoride (74.5%) and 2,2,6,6-tetramethyl-3,5-heptanedione (17.3%). Undecane, tridecane, hexadecane and octadecane were found both in the fresh and dried leaves.

Conclusion: The chemical constituents of the essential oils from Nigeria *Bambusa vulgaris* were reported in this study for the first time to the best of our knowledge and this could be useful in aromatherapy.

To Keywords: *Bambusa vulgaris*, Clevenger apparatus, essential oils, gas chromatography-mass spectrometry [GC-MS]

All co-authors agreed to have their names listed as authors.

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1. INTRODUCTION

Bambusa vulgaris Schrad. Ex J.C. Wendl., commonly known as bamboo in English and ' Oparun ' in Yoruba Southwest Nigeria, belongs to the *Poaceae* family. It grows widely in tropical and subtropical regions throughout the world [1]. It has lemon-yellow culms (stems) with green stripes and dark green leaves. The culms are basically straight or flexuous (bent alternatively in different directions) drooping at the tip [2]. Among the species in the genus, *Bambusa vulgaris* is one of the largest and most easily recognized and it has been recorded that 75 genera and 1250 species occur in the world [2]. The phytochemical screening of *Bambusa vulgaris* showed the presence of alkaloids, terpenoids, flavonoids, saponin, tannins, Phytates and Oxalates while the mineral content revealed the presence of calcium, and iron [3]. The main constituents of the culms are holocellulose, pentosans, hemicellulose, lignin and minor constituents like resins, tannins, waxes and inorganic salts [4]. *Bambusa vulgaris* also contains glucose, fructose and sucrose [5]. *B. vulgaris* had been reported to contain low fat but high proportion of carbohydrates, dietary fibers, potassium and vitamins. *B. vulgaris* shoots could be consumed raw, fermented, boiled, canned and frozen [6]. It has been reported also to have antidiabetic [7], anti-inflammatory [8], antimicrobial [9] and antifatigue [10] properties. In Nigeria, the decoction of this plant is used for treating diseases like gonorrhea, diarrhea, inflammation, wounds, fever, worm and ulcer [11,12,13]. The processes of wound healing and the orderly scheme are disturbed as a result of bacteria and bacteria products like endotoxins and metalloproteinase [14]. Science and communities have benefited from some genius of *B. vulgaris* [15]. Despite all these ethno pharmacological properties little is known about the essential oil constituents of *Bambusa vulgaris*, hence this study aims at isolating its essential oil and characterizing its composition.

2. MATERIALS AND METHODS / EXPERIMENTAL DETAILS / METHODOLOGY

2.1 Plant materials

Fresh leaves (1 kg) of *Bambusa Vulgaris* (*Poaceae*) were collected from Olabisi Onabanjo University, Ago-Iwoye. The plant was identified at the Department of Plant Science and Applied Zoology of Olabisi Onabanjo University and then authenticated from Forestry Research Institute of Nigeria (FRIN), Ibadan where a voucher specimen was deposited with the Herbarium Number FHI 111967.

2.2 Isolation of Essential Oils

The fresh (500 g) and dried (185 g) leaves were hydro-distilled in an all glass Clevenger-type apparatus for

four hours (4 h) in each case. The oils obtained were dried over anhydrous sodium sulphate (Na_2SO_4), stored in vials and kept inside a refrigerator until ready for analysis.

2.3 Gas chromatography (GC)

The essential oils were subjected to GC analysis on an Agilent model 7890A. A gas chromatograph fitted with a flame ionization detector (FID) and DB-5 (30 x 1.0 mm, 0.25 μm film thickness). Helium was used as carrier gas at 99.99% purity on a stationary phase column (HP5 MS). The GC oven temperature was programmed at 75°C (held for 3 min) at 4°C/min heated to 250°C (held for 10 min), with final hold time of 58.14 min. Injector and detector temperatures were fixed at 75°C and 250°C respectively.

2.4 Gas chromatography-mass spectrometry (GC-MS)

The GC-MS analyses were performed on an Agilent model 5975C GC-MSD system with split/splitless automated injection interfaced to a 5973 mass selective detector operated at 70 eV with a mass range of m/z 50-500. The oven temperature was programmed from 70-280 °C (held for 5 min) at a rate of 4 °C/min. The same operations and temperature programming were used as for GC. Relative percentage amounts of the separated compounds were calculated from FID chromatograms.

2.5 Identification of components

Identification of the essential oil components were based on their retention indices (determined with a reference to a homologous series of n-alkanes) and by comparison of their mass spectral fragmentation patterns in computer matching against in-built data (NIST database/Chemstation data system) with data previously reported in the literature [16,17] and the use of pherobase (www.pherobase.net).

3. RESULTS AND DISCUSSION

The essential oils of *Bambusa vulgaris* of both the fresh and dried leaves were found to be colourless with an herbal smell. The yield obtained from the hydrodistillation of both the fresh and dried leaves were 0.64% and 1.08 % respectively which is similar to the percentage yield of essential oils from *Bambusa vulgaris* from China [18]. Gas chromatography-mass spectrometry (GC-MS) analysis of the essential oil of fresh *Bambusa vulgaris* leaves revealed the presence of twenty-five constituents representing 96.9% of the total oils whereas in the dried leaves, there were nineteen components making up 99.9% of the total oil as shown in Table I. The major compounds found in the fresh leaves essential oil are 3-aminodibenzofuran (19.2%), Ocimene (11.1%), Undecane (9.6%), Tridecane (8.6%), [3,2-b]pyridin-6-on octahydropyrano (7.1%), 2-mono Laurin (6.9%), β - Vinyl decanoate (5.9%), while the minor constituents are Decanoyl

chloride (4.8%), Lauric anhydride (4.1%), 1-mono laurin (4.1%), Dodecane (3.3%), Dodecanoic acid, ethenyl ester (3.1%) and Nerolidol (3.1%), classified as hydrocarbons, fused heterocyclic compounds, ester, and terpenes. The major constituents of dried leaves oil are (Chlorophenoxy methylenimino) sulphur pentafluoride (74.46%) and 2,2,6,6-tetramethyl 3,5-heptadione (17.27%), while its minor constituents include Undecane (1.80%), Squalene (1.62%) and Tridecane (1.04%), classified as heterocyclic compounds, ketone, hydrocarbon, ester, fatty acid, terpenes and alcohol. The following compounds; dicyclopentadiene, undecane, tridecane, hexadecane, dihydro dicyclopentadene and tetradecane are present in both essential oils. Essential oils are found to be a complex mixture of compounds which could be about twenty to sixty constituents [19]. *Bambusa vulgaris* has been reported to contain alkaloids, tannins, flavonoids and are useful as chemotherapies for microbial infections [20]. The leaf extracts of *Bambusa vulgaris* were reported to be a source of natural antioxidants and also of great pharmaceutical potentials [21,22]. The result obtained is similar to the report of Yue Jun *et al.*, (2010) on essential oils from *Bambusa vulgaris* leaves from China in which 6,10,14-trimethyl-2-pentadecanone – a ketone, 5,6,7,7a-tetrahydro-4,4,7a-trimethyl-2 (4H) benzofuranone – heterocyclic compound and isophytol – terpene was present which were also identified in the fresh and dried leaf essential oils. However, in addition, these compounds: (Chlorophenoxy methylenimino) sulphur pentafluoride (74.46%) and 2,2,6,6-tetramethyl 3,5-heptadione (17.27%) are present in the *Bambusa vulgaris* leaves from Nigeria. The FT-IR of *Bambusa vulgaris* extracts have been reported to show the presence of aromatic compounds, aliphatic Halide compound (C-X), thiols, and amines [23] which also supported the presence of (Chlorophenoxy methylenimino) sulphur pentafluoride and 3-amino dibenzofuran found in the dried sample of the essential oil. The presence of esters in the oil suggests it could be used as anti-inflammatory, antifungal and sedative agents. The oils could also be used as analgesic because of the presence of ketone in the oils.

Table I. Chemical composition of essential oils of *Bambusa vulgaris* leaf.

No.	Identified Compounds	RI	% Composition on Dried Leaves	% Composition on Fresh Leaves	Molecular Formula
1	Dicyclopentadiene	1018	0.08	0.72	C ₁₀ H ₁₂
2	β-Ocimene	1026		11.05	C ₁₀ H ₁₆
3	Dihydro dicyclopentadene	1050	0.22		C ₁₀ H ₁₄
4	Undecane	1100	1.80	9.63	C ₁₁ H ₂₄
5	2,2,6,6-tetramethyl 3,5-Heptadione	NA	17.27		C ₁₁ H ₂₀ O ₂
6	Dodecane	1200		3.33	C ₁₁ H ₂₆
7	Tridecane	1300	1.04	8.60	C ₁₃ H ₂₈
8	Decanoyl chloride	1316		4.75	C ₁₅ H ₁₉ ClO
9	Tetradecane	1400	0.21		C ₁₄ H ₃₀
10	Allyl decanoate	1476		0.51	C ₁₃ H ₂₄ O ₂
11	Nerolidol	1570		3.10	C ₁₅ H ₂₆ O
12	Hexadecane	1600	0.24	0.81	C ₁₆ H ₃₄
13	Heptadecane	1700	0.24		C ₁₇ H ₃₆
14	Octadecane	1800	0.20	0.79	C ₁₈ H ₃₈
15	Phytane	1806		1.24	C ₂₀ H ₄₂
16	Vinyl decanoate	1812		5.98	C ₁₂ H ₂₂ O ₂
17	Hexahydrofarnesyl acetate	1847	0.16		C ₁₈ H ₃₆ O
18	Eicosane	2000	0.20		C ₂₀ H ₄₂
19	Cis-Vaccenic	2116	0.30		C ₁₈ H ₃₄ O ₂

Key: RI = Retention Index; NA = Literature Retention Index Not Available

4. CONCLUSION

The essential oil constituents of *Bambusa vulgaris* fresh and dried leaf samples were found to contain thirty-nine compounds. While some constituents of both oils are the same and similar to the constituents in literature, we report here the presence of some constituents that are detected in this plant from Nigeria but were absent in the one from China which may be due to their geographical and weather condition. The essential oil of this plant could be used as anti-inflammatory, analgesic and antifungal due to the presence of ester, ketones, aldehydes and terpenes. However, biological activities such as anti-

inflammatory, cytotoxicity and antimicrobial could be carried out in order to establish its efficacy.

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COMPETING INTERESTS

" Authors have declared that no competing interests exist."

AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration among all Authors: ' Author OA' designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. ' Author OO' and ' Author EA' managed the analyses of the study. ' Author AH and AO' managed the literature searches. ' All authors read and approved the final manuscript.

CONSENT

Not Applicable

ETHICAL APPROVAL

Not Applicable

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