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Chemical Constituents of Leaf Essential Oil of *Cochlospermum planchonii* (Hook Ef. x Planch) Grown in Nigeria

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ABSTRACT: Leaf essential oil of *Cochlospermum planchonii* was obtained by hydrodistillation. GC and GC/MS analysis of the oil revealed that, the oil was rich in sesquiterpenes(51.7%). Nonterpenic and monoterpenic compounds constituted 35.5 and 11.9% of the oil. The principal constituents of the oil were; methylcyclopentane (26.3%), caryophyllene (11.4%), germacrene-D (8.8%), caryophyllene oxide (6.5%), copaene (5.6%), 2 – methylpentane (5.0%), δ-cadinene (4.9%), β-myrcene (4.3%) and α – cadinol (4.0%).In all, terpinic compounds that are biologically active against disease causing organisms constituted 63.6% of the oil. With the predominant of this class of metabolite, the oil could serve as therapeutic agents for pathogenic diseases.

KEYWORDS: Cochlospermaceae, essential oil, methylcyclopentane, carophyllene, germacrene-D

1.0 Introduction

Cochlospermum planchonii (family Cochlospermacea) is a shrub of about 2-2.5 m in height, it is widespread in the tropical regions from Senegal to West Cameroun and East Cameroun. It also grows in the Northern part of Nigeria especially the Chambas of the Vogel peak area (Benue River valley, Taraba state). It is commonly known as "Gbehutu" or "Feru" among the Yoruba speaking populace (Iwu, 1993; Olotu *et al*., 2011).

The plant is used in ethnomedicine for the treatments of schitosomiasis, jaundice, fever; back pains intestinal worms, bilhariasis, hepatitis, diabetes, infertility and diarrhea, (Burkill, 1985; Aliyu, 1995; Blench, 2007). The fresh root of the plant is also used as a concoction together with fresh stem bark of *E. senegalensis* for the treatment of stomach disorder, typhoid and urinary tract infection (Togotla *et al*., 2008). Similarly, the stem decoction is used in the treatment of menstrual disorders. The root decoction is used for the treatment of uncomplicated malaria caused by *Plasmodium falciparum* without any major side effects (Adjanahoun, 1991) and Gonorrhea (Burkill, 1985). Biological activities of the plant extracts such as; anti-malarial (Abu *et al*., 2012) antibacterial (Beniot-Vical *et al.*, 2003), spermatogenesis (Quattara *et al*., 2007), analgesic and anti-inflammatory (Olotu *et al* 2011), anitidiabetes (Nafiu *et al*., 2011a) and anti-diarrhoeal (Abu *et al*., 2012) justified its use as therapeutic agents in traditional medicine.

Phytochemical investigations of the plant extracts revealed the presence of carbohydrates, saponins, phenolics, alkaloids, steroids, tannins, flavonoids, phlobatannins, triterpenes, cyanogenetic glycosides, cardiac glycosides, anthraquinones, and triacylbenzenes (Nafiu *et al*., 2011b). The presence of the metabolites in the plant extracts could be responsible for the activities reported by various workers.

Earlier work on the rhizome essential oil of Burkina Faso (Outtara *et al*, 2007) and Benin (Bossou *et al*, 2003) grown *C. planchonii* showed the predominance of tetradecan-3-one in

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the oils. Terpenic compounds in the oil of Burkina Faso grown plant were β-elemene, β-selinene, α-selinene and 7-diepi-α-selinene while those of Benin grown plant were *p*-cymene, citrolenal, β-elemene, cyperene, Z-α-bergamotene, E-caryophellene, E-α-bergamotene, epi-β-santalene, Z-α-bisabolene, β-bisabolene, Z-γ-bisabolene, δ-amorphene, E-γ-bisabolene, caryophyllene oxide, α-bisabolol and Neointermediol. The Burkina Faso grown oil was active against; *Streptococcus pyogen, Eschirichia coli, Salmonella enterica and Listeria innocua* and the Benin grown oil showed insecticidal activity against *Anopheles gambiae (Giles)*.

To the best of our knowledge, phytochemical profile of leaf oil of the plant growing in Nigeria has not been reported. It is on the basis of this we investigate phytochemical profile of the oil with the aim of deducing its therapeutic potential against pathogenic diseases. The profile will also be compared with the profile of the previously studied rhizome oils of the plants from Bukina Faso and Republic of Benin.

2.0 Materials and Methods

2.1 Plant Materials

The leaves of *Cochlospermun planchonii* were collected in Malete, Moro Local Government of Kwara State, Nigeria. Identification was carried out at the herbarium of Forestry Research Institute of Nigeria, Ibadan, where voucher specimen was deposited (FHI: 99093).

2.2. Isolation of oil

Pulverized leaves (500 g) of *C. planchonii* were hydro-distilled for 3 hours using Clevenger type apparatus according to the British pharmacopoeia specification (1980). The oil was collected in a sealed glass tube and stored under refrigeration at 4℃ for three days.

2.3 Gas Chromatographic Analysis

GC analysis was performed on an Orion micromat 412 double focusing gas chromatography system fitted the two capillary column coated with CP-Sil 5 and CP-Sil 19 (fused silica, 25m x 0.25mm x 0.15 μm film thickness) and flame ionization detector (FID). The volume injected was 0.2 μL and the split ration was 1:30. Oven temperature was programmed from 50-230^{o}C at 50^{o}C/minute using hydrogen gas as carrier gas. Injector and Detector temperature were maintained at 200 and 250^{o}C respectively. Qualitative data were obtained by electronic integration of FID area percents without the use of correction factors.

2.4 Gas Chromatography/Mass Spectrometry

The roots were washed and thereafter the root-bark was peeled and cut into pieces. The aqueous root extract of *T. cacao* was prepared according to the earlier procedure described by Oyedapo *et al* (2004), with slight modification. Typically, 750 g of fresh root was boiled in 6.0 L of distilled water for 30 minutes. The infusion was allowed to settle for 24 hours at 25^{0}C, after which it was filtered. The filtrate was evaporated to dryness under reduced pressure (40^{0}C) on Edward High Vacuum Pump (Crawley, England) to yield a flaky brown residue.

3.0 Results and Discussion

Pulverized leaves of *Cochlospermum planchonii* yielded 0.40% v/w of essential oil. Table 1 shows the retention indices, mass spectra data, identities and relative percentages of the constituents of the oil. 29 compounds that represent 99.1% of the oil were identified from their mass spectra. Oxygenated and hydrocarbon sesquiterpenes constituted 15.2 and 36.5% of the oil, while, percentage composition of monoterpenoids and non terpenic compounds in the oil were; 11.9 and 35.5% respectively.

Caryophylleneoxide (6.5%), α-cadinol (4.0%) and muurolol (2.9%) were the abundant oxygenated sesquiterpenes in the oil. Sesquiterpenoids that were also detected in significant proportions include; cubenol (0.8%), globulol (0.5%) and nerolidol (0.5%). Predominant hydrocarbon sesquiterpene in the oil was caryophyllene (11.4%). Other principal constituents that were sesquiterpenes include; germacrene-D (8.8%), copaene (5.6%) and δ-cardinene (4.9%). Armophene (1.5%), α-

Table 1: Chemical composition of leaf essential oil of *Cochlospermum planchonii*

Compound[a]	RI[b]	Composition (%)	Mass spectra data
2-methylpentane	582	5.0	71, 57, 55, 53, 86
Methylcyclopentane	627	26.3	56, 55, 69, 84, 57
methylcyclohexane	716	2.3	55, 56, 69, 70, 83
Toluene	762	1.1	63, 65, 89, 91, 92
3-hex-1-enol	857	0.8	55, 57, 67, 69, 82
α-pinene	939	1.0	53, 67, 77, 91, 93
β-myrcene	991	4.3	53, 69, 79, 93, 136
Limonene	1031	1.9	68, 79, 93, 121, 136
cis- β-Ocimene	1040	2.2	79, 91, 93, 121, 136
m-cymene	1082	0.5	55, 69, 71, 80, 93
Linalool	1089	0.5	71, 86, 93, 111, 154
Bicyclosesquiphellandrene	1147	0.7	91, 105, 120, 161, 204
terpinen-4-ol	1177	0.7	71, 86, 93, 111, 136
α-cubebene	1351	0.5	81, 93, 107, 121, 161
β-elemene	1375	0.8	55, 81, 105, 123, 161
Copaene	1376	5.6	81, 93, 105, 119, 161
Caryophyllene	1418	11.4	69, 79, 93, 105, 133
γ-elemene	1430	0.7	81, 93, 107, 121, 161
α-caryophyllene	1454	1.3	80, 93, 121, 147, 204
γ-muurolene	1477	1.1	93, 105, 119, 161, 204
germacrene-D	1480	8.8	91, 105, 120, 161, 204
α-amorphene	1485	1.5	91, 105, 119, 161, 204
δ-cadinene	1524	4.9	105, 119, 134, 161, 204
Nerolidol	1564	0.5	55, 69, 81, 93, 107
Globulol	1576	0.5	55, 69, 81, 109, 161
caryophyllene oxide	1581	6.5	55, 69, 79, 93, 109
Muurolol	1608	2.9	79, 95, 121, 161, 204
Cubenol	1642	0.8	59, 93, 105, 119, 161
α-cadinol	1653	4.0	79, 105, 119, 161, 204
Total		**99.1%**	

[a]Compounds are listed in order of elution from silica capillary column coated on CP-Sil 5.
[b]Retention indices on fused silica capillary column coated with CP-Sil 5

(1.3%), γ-muurolene (1.1%), β-elemene (0.8%), γ-elemene (0.7%), bicyclosesquiphellandrene (0.7%) and α-cubebene (0.5%) were detected in significant proportions. The most abundant non terpenic compound in the oil was methyl cyclopentane (26.3 %). Other non terpenic compounds that were detected in significant amounts were; 2-methylpentane (5.0%), methyl cyclohexane (2.3%), toluene (1.1%) and 3-hex-1-enol (0.8%). The most abundant monoterpene in the oil was β-myrcene (4.3%). Other monoterpenes in the oil were; α-pinene (1.0%), limonene (1.9%), cis-β-ocimene (2.2%) and, m-cymene (0.5%). Linalool (0.5%) and terpinen-4-ol (0.7) were the only oxygenated monoterpenes detected in the oil.

There are both qualitative and quantitative differences in the constituents of the oil and rhizome oils of Bukina faso and Benin grown *C. planchonii*. (Outtara *et al*, 2007; Bossou *et al*, 2013). For instance, monoterpenoids that characterized most essential oils were detected in significant amounts in the leaf oil but, were not found in the rhizome oils. The monoterpenoids include; β-myrcene, cis-β-ocimene, limonene, terpnen-4-ol, m-cymene, linalool, and α-pinene. Furthermore, sesquiterpenoids like caryophyllene, copaene, germacrene-D, caryophyllene oxide, α-cadinol, murolol and δ-cardinene that were found in appreciable quantities in the leaf oil were not detected in the rhizome oil. On the other hand, β-selinene, α-selinene and 7-diepi-α-selinene that existed in significant quantities in the rhizome oil were not found in the leaf oil. Meanwhile, β-elemene was detected in both oils but of greater abundance in the rhizome oil.

Nonterpenic constituents of the oil were mainly alicyclic hydrocarbons of which methyl cyclopentane was the most abundant compound. Others class of compounds that were nonterpinic were aromatics and unsaturated alkanol. But in contrast, the nonterpenic compounds detected in the rhizome oil were esters and ketones.

It has been established that phytochemical profile of essential oils determine their biological activities from which their usage as therapeutic agents, insecticides and herbicides can be determined (Lahlou, 2004). For instance, the antibacterial, antiviral, antidiabetes and insecticidal activities of leaf essential oils of *Lantana camara*, *S. aegyptus Var*., Juniper, *Tagetes minuta*, *Satureja khuzestanica*, *Ligusticum hultenii*, Lippia were linked with separate and synergistic actions of mono- and sesquiterpenoids in the oils (Bammi *et al*, 1997; El-shazly *et al*., 2002; Kasali *et al*., 2002; Abdollahi *et al*, 2003; Pepeljnjak *et al*, 2005; Meepagala *et al*, 2006; Badilla *et al*, 2007; Koul *et al*, 2008). With the abundance of terpenoids in the oil, the oil may be biologically active against pathogens and if active, could serve as therapeutic agent for pathogenic diseases.

References

Abdollahi, M., Salehnia, A. and Mortazavi, S. (2003). Antioxidant, antidiabetic, antihyperglycemic, reproduction stimulatory properties and safety of essential oil of *Satureja khuzestanica* in rat in vivo: a toxicopharmacological study. Medical Science Monitor **9**: 331-335.

Abu, A. H., Ochalefu D. O. and Ibrahim A. (2012). Aqueous ethanolic extract of *Cochlospermum planchonii* rhizome enhances spermatogenesis in male albino rats. African Journal of Biotechnology 11(53): 11636-11639.

Adams, R. P. (1995). Identification of essential oil components by gas chromatography and mass spectrometry. Allured publ. corp, carot stream, Illinois.

Adjanahoun, E., Ahyi M. R. A., Ake-Assi, L., Elewude, J. A., Dramane, K., Fadoju, S. O., Gbile, Z. O., Goudole, E., Johnson, C. L. A., Keita, A., Morakinyo, O., Ojewole, J. A. O., Olatunji, A. O. and Sofowora, E. A. (1991). Traditional medicine and pharmacopoeia, Contribution to ethnobotanical floristic studies in Western Nigeria, Pub. Organization of African Unity, Scientific Technical and Research Commission Lagos, Nigeria, pp 420.

Aliyu, R., Okoye, Z. S. C. and Thomas, S.W. (1995). *Cochlospermum planchonii* Rhizome extract with Hepatoprotective Activity Inhibits Cytochrome P_{450} monooxygenases. Phytotherapy Research 9(8): 600-602.

Badilla, B., cambronero, J. C., Cordero, T. and Mira, G. (2007). Determination of topical anti-inflamatory activity of the essential oil extract of *Lippia alba* (Mill), N. E. boom (Verbenaceae), using the model of mouse ear edema induced by TPA and AA. Pharmacognosy Magazine 3(11): 139-144.

Bammi, J., Khelifa, R. and Remmal, J. (1997). Etudes de l'activite antivirale de queques hucle e ssentielles. In Proceedings of the intern. Congr.

Aoom. Medicinal Plants and Essential oil; N. Zrira, S. (Eds) Aetes Editions, Rabat, Morocco; 502.

Beniot-Vical F., Vaaletin, A., Da. B., Dakuyo, Z., Descamps, L. and Mallie, M. (2003). N'Dribala (*Cochlospermum planchonii*) versus chloroquine for treatment of uncomplicated *Plasmodium falciparum* malaria. Journal of Ethnopharmacology 89(1): 111-114.

Blench, R. (2007). In: Haussa names for plants and trees. 2nd (edn). pp. 8.

Bossou, A. D. Mangelinck, S. Hounnankpon, Y. Pelagie, M. B., Martin, C. A., Norbert, D. K., Félicien, A. and Dominique, C. K. S. (2013). Chemical composition and insecticidal activity of plant essential oils from Benin against *Anopheles gambiae* (Giles). Parasite and Vectors 6: 337

British Pharmacopoeia II.(1980). 109, H. M, Stationary Office, London.

Burkill, H. M. (1985). The useful plants of West Tropical Africa, 2nd Edition, Vol. 1, Royal Botanical Gardens, Kew, pp. 386-960.

El-shazly, A., Diral, G. and Wink, M. (2002). Chemical composition and biological activities of the essential oils of *Senecio aegyptius* var. discopideus Bioss. Zeitschrift fur Naturforschung 57C: 434-437

Iwu, M. M. (1993). Handbook of African Medicinal Plants. CRP Press, Boca Raton,

Jenning, W. and Shibamoto, T. (1980).Qualitative analysis of flavour and fragrance volatiles by glass capillary column gas chromatography. Academic Press, New York, 248-250.

Joulain, D. and Koeing, W. A. (1998). The Atlas of spectra data of sesquiterpene hydrocarbons. F. B. Verlary Hamburg, Germany.

Kasali, A. A., Eshuntokun, A. O., Koenig, W. A. and Adeola, S. (2002). Volatile constituents of *Dacryodes edulis* (G. Don) H. J. Lam leaves. Journal of Essential Oil-Bearing Plants, **5(2)**: 77 – 82.

Koul, O., Wasilia, S. and Dhaliwal, G. S. (2008). Essential oils as green pesticides: Potential and Constraints. Biopesticides International. **4(1)**: 63 – 68.

Lahlou, M. (2003). Composition and molluscicidal properties of essential oils of five Morocan pinaceae. Pharmaceutical Biology 41: 207-210.

Meepagala, K. M., Osbrink, W., Sturtz, G. and Lax, A. (2006). Plant derived natural products exhibiting activity against Formosan subterranean termites (*Copotermes formosanus*). Pest Management Science 62: 565-570.

Nafiu, M. O., Akanji, M. A. and Yakubu, M. T. (2011a). Effect of aqueous extract of *Cochlospermum planchonii* rhizome on some kidney and liver functional indicies of albino rats. African Journal of Traditional, Complementary and Alternative Medicine 8(1): 22-26.

Nafiu, M. O., Akanji, M. A. and Yakubu, M. T. (2011b) Phytochemical and mineral constituents of *Cochlospermum planchonii* (Hook. Ef. x Planch) Root. Bioresearch Bulletin, 5: 342-347.

Ouattara, L., Jean, K., Louis, C. E., Obama, D. S., Karou, A. T. and Jean, M. B. (2007). Chemical composition and antibacterial activity of *Cochlospermum planchonii* Hook Ef. x Planch Essential Oil from Burkina Faso. Pakistan Journal of Biological Science 10(22): 4177-4179.

Pepeljnjak, S., Kosalec, I., Kalodera, Z. and Blazevic, N. (2005). Antimicrobial activity of Junipper berry essential oil (*Juniperus communis, L. Cupresscaee*). Acta Pharmaceutica **55**: 417-422.

Togotla, A., Austerheim, I., Theis, A., Diallo, D. and Paulsen, B. S. (2008). Ethno-pharmacological uses of *E. senegalensis*: a comparism of three areas in Mali and a link between traditional knowledge and modern biological science. Journal of Ethnobiology & Ethnomedicine 4(6): 1–9.