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Chemical Composition of Rhizome Essential Oil of *Curcuma longa* L. Growing in North Central Nigeria

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Abstract: Pulverized rhizome of *Curcuma longa* on hydrodistilation, afforded oil in the yield of 1.24% v/w. The oil was investigated by GC and GC/MS. Hydrocarbon monoterpenes (46.9%) constituted bulk of the oil. The major constituents of the oil were, $-bisabolene (13.9%), trans-ocimene (9.8%), myrcene (7.6%), 1,8-cineole (6.9%), "-thujene (6.7%) and thymol (6.4%).

Key word: Index: *curcuma longa* % Zingiberaceae % $-bisabolene % 1,8-cineole % Trans-ocimene % Thymol

INTRODUCTION

Curcuma longa L. (Zingiberaceae) is a rhizomatous herbaceous perennial plant widely grown in Nigeria. It is commonly known as Ajo, laali pupa or Obedo by the Yorubas [1]. The plant is used in ethno medicine for the treatment of several ailments like Jaundice, gastric ulcer, skin diseases, joint inflammation, diabetics, cold and flu symptoms [2]. The therapeutic properties of this plant have been established by various workers. For instance, the plant extracts were found to possess anti-inflammatory, antitumor, anti-diabetic, antimicrobial, hypotensive and vasorelaxant properties [3-10]. Larvicidal and insect repellant properties of the extract have also been reported [11, 12].

Phytochemical investigations of the plants, revealed the presence of curcumin, demethoxy curcumin and bis-demethoxy curcumin [9]. Tumerone and carvacrol have been reported as the most abundant constituents of rhizome essential oil of yellow and red varieties of Bangladesh grown *C. longa* [13]. Oguntimehin *et al*. (1990) have identified "-phellandrene and terpinolene as the predominant constituents of leaf oil of south-west Nigerian grown *C. longa* [14]. Earlier work on rhizome essential oil of south-west Nigerian grown plant also revealed the presence of ar-tumerone as the most abundant constituent [11].

It has been established that composition pattern of essential oil could be affected by the geographical and climatic conditions [15]. It is on the basis of these, we investigate the rhizome essential oil of North central Nigerian grown *C. longa*.

Experimental

Plant Materials: The fresh rhizome of *Curcuma longa* were obtained in Ilorin, Kwara State, North Central Nigeria. Identification was carried out at the herbarium of Forestry Research Institute of Nigeria (FRIN), Ibadan where voucher specimens were deposited.

Oil Isolation: Pulverized rhizome were hydrodistilled for 3h in a Clevenger-type apparatus, according to the British Pharmacopoeia (1980) specification [16]. The resulting oil was collected, preserved in a sealed sample tube and stored under refrigeration until analysis.

Gas Chromatography: GC analysis were performed on an orion micromat 412 double focusing gas chromatography system fitted with two capillary columns coated with CP-Sil 5 and CP-Sil 19 (fused silica, 25m × 0.25mm, 0.15μm film thickness) and flame ionization detector (FID). The volume injected was 0.2μL and the split ratio was 1:30. Oven temperature was programmed from 50°C-230°C respectively. Qualitative data were obtained by electronic integration of FID area percents without the use of correction factors.

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Gas Chromatography/Mass Spectrometry: A Hewlett Packard (HP 5890A) GC interfaced with a VG Analytical 70-250S double focusing mass spectrometer was used. Helium was the carrier gas at 1.2ml/min. The MS operating conditions were: ionization voltage 70ev, ion source temperature 230°C. The GC was fitted with a 25m×0.25mm, fused silica capillary column coated with CP-Sil 5. The film thickness was 0.15µm. the GC operating conditions were identical with those of GC analysis. The MS data were acquired and processed by online desktop computer equipped with disk memory. The percentage compositions of the oil were computed in each case from GC peak areas. The identification of the components was based on the retention indices (determined relative to the retention times of series of n-alkanes) and mass spectra with those of authentic samples and with data from Literature [17-19].

RESULTS AND DISCUSSION

Pulverized rhizome of *Curcuma longa* on hydrodistilation afforded oil in yield of 1.24% v/w. The yield compared favourably with the yield from yellow type of Bangladesh grown *C. longa* [13].

Table 1 shows retention indices, relative percentages and the identities of the constituents of the oil. A total of 22 compounds representing 96.5% of the oil were identified from their retention indices and mass spectra.

Hydrocarbon and oxygenated monoterpenes constituted 46.9 and 15.4% of the oil. Percentage composition of hydrocarbon sesquiterpenes and aromatic compounds were 24.3 and 9.9% respectively. Trans-ocimene (9.8%), myrcene (7.6%), "-thujene (6.7%), limonene (5.3%) and car-2-ene (4.0%) were the abundant hydrocarbon monoterpenes in the oil. Other notable hydrocarbon monoterpenes were; $-phellandrene (3.1%), "-pinene (2.8%) and (-terpinene (2.6%).

The most abundant oxygenated monoterpenes in the oil was 1,8-cineole (6.9%). Borneol (3.3%), terpine-4-ol (2.1%) and "-terpineol (2.0%) existed in appreciable quantities. The two carbonyl monoterpenes, geranial and neral were found in trace amounts. The most abundant aromatic compound in the oil was thymol (6.4%), while tumerone (3.5%) existed in significant amount. $-bisabolene (13.9%) was the most abundant hydrocarbon sesquiterpene. Meanwhile, zingiberene (5.2%) and $-sesquiphellandrene (5.2%) were found in appreciable quantities.

Table 1: Chemical composition (%) of rhizome oil of *Curcuma longa*

Compound [a]	RI [b]	Percentage composition	Mass spectra
"-thujene	923	6.7	105, 91, 77, 73, 51
"-pinene	931	2.8	121, 105, 93, 79, 41
$-pinene	973	2.4	121, 107, 93, 79, 67
Myrcene	989	7.6	107, 93, 80, 69, 53
Car-2-ene	1002	4.0	121, 93, 79, 65, 51
$-phellandrene	1027	3.1	120, 93, 77, 67, 51
Limonene	1028	5.3	107, 93, 79, 67, 60
1,8-cineole	1029	6.9	108, 81, 59, 55, 43
cis-ocimene	1035	2.6	105, 93, 79, 67, 53
Trans-ocimene	1050	9.8	121, 100, 91, 79, 53
Iso-Artemisia ketone	1053	1.1	120, 100, 83, 69, 55
(-terpinene	1057	2.6	121, 105, 93, 69, 51
Borneol	1162	3.3	121, 110, 95, 81, 55
Terpineol	1176	2.1	107, 93, 81, 67, 55
"-terpineol	1180	2.0	121, 93, 81, 67, 59
Neral	1237	Tr	135, 95, 69, 53, 41
Geranial	1267	Tr	123, 95, 83, 59, 41
Thymol	1290	6.4	150, 135, 77, 60, 51
Zingiberene	1495	5.2	161, 133, 119, 77, 41
$-bisabolene	1508	13.9	119, 105, 93, 79, 69
Sesquiphellandrene	1525	5.2	120, 105, 91, 69, 41
Turmerone	1611	3.5	216, 201, 173, 132, 119
Total		96.5	

[a]Compounds are listed in order of elution from silica capillary column coated in CP-Sil 5; [b]retention indicies on fused silica capillary column coated with CP-Sil 5 t=trace (<0.1%).

The qualitative and quantitative composition of the oil was found to be different from the rhizome oil of south-west grown *C. Longa* in Nigeria [11]. For instance, the most abundant constituent of the oil, β-bisabolene did not exist as major constituent of the oil obtained from south-west grown *C. Longa.* Hence, the oil was of β-bisabolene chemotype. On the other hand, notable constituent of the oil, ar-tumerone was found to be the most abundant constituent of the oil obtained from rhizome of South-West grown C. longa. Similarly, α-tumerone and β-tumerone that were found as major constituents of the oil obtained from the leaves of South-West grown C. longa were not found in this study. Thus, the oil obtained from South-West grown C. longa was of tumerone chemotype like the rhizome oils studied in different parts of the world [20-24]. However, the oil shared similar composition pattern with respect to the notable constituents like zingberene and β-sesquiphellandrene in the rhizome oil of yellow type of C. longa grown in Bangladesh [13].

REFERENCES

1. Maurice, M.I., 1993. Handbook of African medicinal plants, CRC Press, New York, pp: 164-166.
2. Anonymous, 1950. The Wealth of India, Raw Materials, CSIR, New Delhi, India, 113(1): 166-172.
3. Ukil, A., S. Maity, S. Karmakar, N. Datta, J.R. Vedasiromoni and P.K. Das, 2003. Curcumin, the major component of food flavor turmeric reduces mucosal injury in trnitrobenzene sulphonic acid-induced colitis, British J. Pharmacol., 139: 209-218.
4. Chum, K.S., Y.S. Keun, S.S. Han, Y.S. Song, S.H. Kim and Y.J. Surh, 2003. Curcumin inhibits phorbol ester-induced expression of cyclooxygenase-2 in mouse skin through suppression of extracellular signal-regulated kinase activity and NF-kappa B activation, Carcinogenesis, 91 24(9): 1515-1524.
5. Shukla, Y., A. Arora and P. Taneja, 2002. Antimutagenic potential of curcumin on chromosomal aberrations in Wistar rats, mutation Research, 515: 197-202.
6. Arun, N. and N. Nalini, 2002. Efficacy of turmeric on blood sugar and polyo pathway in diabetic albino rats, Plant Foods for human Nutrition, 57: 4-52.
7. Nwozo, S., O. Adaramoye and E. Ajaiyeoba, 2009. Oral administration of extract from *Curcuma longa* lowers blood glucose and attenuate alloxan-induced hyperlipidemia in diabetic rabbits, Pakistan J. Nutrition, 8(5): 625-628.
8. Rambir, S., C. Ramesh, B. Mridula and M.L. Pratibha, 2002. Antibacterial activity of *Curcuma longa* rhizome extract on pathogenic bacteria, Current Science, 83(6): 737-740.
9. Wuthi-Udolmlert, M., W. Grisanapam, O. Luanratana and W. Caichompoo, 2000. Antifungal activity of *Curcuma longa* grown in Thailand, Southeast Asian J. Trop. Med. Public health, 3(1): 178-182.
10. Adaramoye, O.A., R.M. Anjos, M.M. Almeida, R.C. Versas, D.F. Silvia, F.A. Oliveira, K.V. Cavalante, I.G. Araujo, A.P. Oliveira and I.A. Medeiros, 2009. Hypotensive and endothelium-independent vasorelaxant effects of methanolic extract from *Curcuma longa* L. in rats, J. Ethnopharmacol., 124(3): 457-462.
11. Ajaiyeoba, E.O., W. Sama, E.E. Essien, J.O. Olayemi, O. Ekundayo, T.M. Walker and W.N. Setzer, 2008. Larvicidal activity of turmerone rich essential oils of *Curcuma longa* leaf and rhizome from Nigeria on Anopheles gambiae, Pharmaceutical Biology, 46(4): 279-282.
12. Tripathi, A.K., V. Prajapati, N. Verma, J.R. Bahl, R.P. Bansal, S.P.S. Khanuja and S. Kumar, 2002. Bioactivities of the Leaf Essential Oil of *Curcuma Longa* (Var. Ch-66) On Three Species of Stored-Product Beetles (Coleoptera), J. Econ. Entomol., 95(1): 183-189.
13. Chowdhury, J.U., N.C. Nandi, M.N.I. Bhuiyan and M.H. Mobarok, 2008. Essential oil constituents of the rhizomes of two types of *Curcuma longa* of Bangladesh, Bangladesh J. Sci. Ind. Res., 43(2): 259-266.
14. Oguntimehin, B.O., P. Weyerstahl and H. Marschall-Weyerstahl, 1990. Essential oil of *Curcuma longa* L. leaves, Flavour and Fragrance J., 5(2): 89-90.
15. Lahlou, M., 2004. Methods to Study the Phytochemistry and Bioactivity of Essential Oil, Phytother. Res., 18: 435-448.
16. British Pharmacopoeia II., 1980. 109, H M, Stationary Office, London.
17. Adams, R.P., 1995. Identification of Essential Oil Components by Gas Chromatography and Mass Spectrometry. Allured Publ. Corp., Carol Stream, IL.
18. Joulain, D. And W.A. Koenig, 1998. The Atlas of Spectra Data of Sequiterpene Hydrocarbons. E.B. Verlag Hamburg, Germany.
19. Jennings, W. And I. Shibamito, 1980. Qualitative Analysis of Flavour Volatiles by Gas Capillary Chromatography. Academic Press, New York.

20. Mitra, C.R., 1975. Important Indian species.1. *Curcuma longa* (Zingiberaceae), Riechst Aromen, Koerperpflegem, 25: 15.
21. Sharma, R.K., B.R. Misra, T.C. Sarma, A.K. Bordoloi, M.G. Pathak and R.A. Leclercq, 1997. Essential oils of *Curcuma longa* L. from Bhutan, J. Essent. Oil. Res., 9: 589-592.
22. Nigam, M.C. and A. Ahmad, 1990. *Curcuma longa* terpenoid composition of its essential oil. Indian Perfumer, 35: 255-257.
23. Zwaving, J.H. and R. Bos, 1992. Analysis of the essential oils of five Curcuma species. Flav. Fragr. J., 7: 19-22.
24. Jayaprakasha, G.K., L.J.M. Rao and K.K. Sakariah, 2005. Chemistry and biological activities of *C. longa*. Trends in Food Sci. Technol., 16(12): 533-548.