COMPARATIVE STUDY OF THE ESSENTIAL OILS OF *MONODORA MYRISTICA* FROM NIGERIA

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The essential oils from seeds and stem-bark of *Monodora myristica* (Annonaceae) growing wild in south western Nigeria and used as spice in many parts of Nigeria were extracted by hydrodistillation and analysed by GC- MS. The percentage yields of oils were 2.16%v/w and 0.25%v/w, respectively. The essential oil of seeds contained germacrene D-4-ol (25.48%), tricyclo[5.2.1(1,5)dec-2-ene (13.35%), *δ*-cadinene (11.09%) and linalool (15.10%) as major constituents while the dominant constituents of the stems-bark oil were γ-cadinene (31.31%), α-elemene (17.98%), α-cubebene (6.70%) and γ-muurolene (5.94%). The major constituents of the seeds oil of *Monodora myristica* from Nigeria were compared based on literature.

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Introduction

Monodora myristica (Annonaceae) commonly known as 'Ariwo' in South Western Nigeria is a tropical tree that grows wild in many African countries including Nigeria.[1,2] Nutritional value of *M. myristica* centres on its usefulness as a seasoning because of its aromatic flavor. The kernel obtained from the seeds is a popular condiment used as spicing agent in both African and Continental cuisines in Nigeria.[3] The seeds are aromatic and used as stimulating addition to snuff and medicine.[4]

There are several reports of its medicinal use; the bark is used in the treatments of stomach-aches, febrile pains, eye diseases and hemorrhoids. [5] In Central African Republic, the seeds are used as condiment and drug in the treatment of headache and hypertension.[6] The antisickling effect of *M. myristica* has also been demonstrated.[4] Earlier determination of the chemical constituents of the seeds reveals the presence of Fiberro-latic oils, resins, terpene, lactose, arocine, saponins, flavonoids and tannins.[7]

M.myristica seeds seem to be the major research focus around the globe. Literature report on the essential oils from other parts of the plant is scant. Also significant variation exists in the composition of the seeds essential oils of this plant published in literature, especially from Nigeria. In view of these, we investigate the essential oil compositions of the seeds and stem-bark of *Monodora myristica* grown in Nigeria and compared the seeds' essential oils based on literature.

Experimental

Plant materials

The seeds and stems-bark were collected at a farm at the bank of River Igbeta in Iwaro-Oka, Ondo state, South West Nigeria. The identification was done at the Forest Research Institute of Nigeria, Ibadan. The seeds and the stem-bark (cut into beans) were air dried and then pulverised using a fast rotating blender. The samples were then separately subjected to hydro distillation using an all glass Clevenger- type apparatus[8] for 3 hours. The essential oils collected were kept in the refrigerator at 0^0C before GC-MS analysis without any further treatment.

Gas chromatography/mass spectrometry analysis

The essential oils were analysed using GC-MS Agilent 6890N GC Coupled with MS-5973-634071Series .The capillary column type was DB-1MS [30.0 m (length) X320.00µm (diameter) X1.00µm (film thickness)]. The carrier gas was Helium at constant flow rate of 1.0ml/min and average velocity of 37cm/s; the pressure was 0.78psi. The initial column temperature was set at 100^0C (hold for 2min) to the final temperature of 250^0C at the rate of 5^0C/min, Volume injected was 1.0µL and split ratio was 50:1. The total chromatogram was auto-integrated by Shem-Station and the constituents were identified by comparison with published mass spectral database (NIST02.L) and data from literature.

Results and Discussion

Percentage yield

The percentage yield of essential oil of seeds and stem-bark were 2.16% and 0.25% v/w respectively.

GC-MS analysis

A total of forty-two compounds were identified in the essential oils of the seed and stem-bark of *Monodora myristica*. The seed oil contained twenty-two compounds while twenty compounds could be identified in the stem-bark oil (Table 1).

In the seed oil, germacrene-D-4-ol (25.48%), tricyclo[5.2.1(1,5)]dec-2-ene (13.35%), δ-cadinene (11.09%) and linalool (15.10%) were the major constituents while the dominant constituents of the stem-bark oil were γ-cadinene (31.31%), α-elemene (17.98%), α-cubebene (6.70%) and γ-muurolene (5.94%). Caryophyllene and γ-muurolene were the only two constituents common to both the seeds and the stem-bark oils of *M.myristica.* tricyclo[5.2.1(1,5) dec-2-ene found in the seeds oil had not been previously reported.

Table 1. Chemical composition of the essential oils of seed and stem-bark of *Monodora myristica*

Chemical compounds	Retention times, min	Percentage composition (%)	
		Seeds	Stem-bark
γ-terpinene	2.16	1.31	-
linalool	2.37	15.10	-
trans-p-menth-2-en-1-ol	2.49	1.23	-
cis-p-menth-2-en-1-ol	2.60	0.93	-
1,2,3,4-tetramethylcyclobutene	2.78	1.37	-
1,3-dimethyl-1-cyclohexene	2.81	0.92	-
α-terpineol	3.04	3.35	-
tricyclo[5.2.1(1,5)]dec-2-ene	3.21	13.35	-
hydroxymethyl furfuraldehyde	3.50	1.81	-
p-thymol	4.27	1.39	-
p-fluoroanisole	4.47	1.64	-
α-cubebene	5.80	-	6.70
α-bergamotene	5.99	-	1.31
caryophyllene	6.42	1.17	5.42
α-farnesene	6.84	-	1.87
α-guainene	7.01	0.77	-
β-guainene	7.05	-	0.92
γ-cadinene	7.16	0.80	-
γ-muurolene	7.46	1.35	5.94
β-pachoulene	7.80	2.10	-
1,2,4a,5,6,8a-hexahydro-4,7-dimethyl-1-(1-methylethyl)naphthalene	7.95	2.26	-
α-elemene	7.97	-	17.98
2-isopropyl-5-methyl-9-methylenebicycle[4.4.0]dec-1-ene	8.22	6.73	-
δ-cadinene	8.46	11.09	-
γ-cadinene	8.58	-	31.31
acoradiene	8.94	-	4.35
dehydroarionine (TDN)	9.06	-	0.96
cis-nerolidol	9.46	-	7.62
germacrene-D-4-ol	9.47	25.48	-
β -germacrene	9.66	-	0.96
3-(4-methoxyphenylamino)pyrrolidine-2,5-dione	9.79	-	0.81
guaiol	9.91	-	1.79
2, 2, 4, 8-tetramethyltricyclo[5.3.1.0(4, 11)]undec-8-ene	10.09	-	1.90
cadinadiene	10.44	-	3.00
copaene	10.72	-	2.71
α -cadinol	10.78	1.74	-
cadala-1(10), 3, 8-triene	11.02	-	0.93
α–bisabolol	11.53	-	1.16
4-(3-methyl-2-butenyl)-1H-indole	13.53	-	1.06
4-chloro-N, N-diethylbenzenamine	16.03	1.62	-

The presence of p-thymol would account for the antimicrobial activity[9] of the *M. myristica* seed oil while the presence of hydromethyl furfuraldehyde (HMF) may be an indicator to toxicity.[10] Literature reports on the chemical constituents of the seed essential oils of *M. myristica* in Nigeria present great variations (Table 2). C.C. Igwe et al. reported [11] α-phellandrene epoxide (3.02%), carvacrol (2.09%) and δ-cadinene (2,21%) as the major constituents of a Nigerian sample of *M. myristica* seed oil, Owolabi et al. reported [12] geranial(40.1%), neral (29.74%) and myrcene (11.3%) in yet another sample from Nigeria. While Onyenekwe et al. generated [13] α-phellandrene (50.4%), α-pinene (5.5%), myrcene (4.35%) and germacrene-D-4-ol (9.0%).

The oils of the seeds of *M. myristica* obtained now was similar to the oils of Owolabi's[12] and Onyenekwe's [13] oils, only the presence of δ–cadinene (11.09%) and germacrene-D-4-ol (25.48%), respőectively were the differences. The presence of myrcene also showed a little similarity between Owolabi's[12] and Onyenekwe's oils.[13] Igwe' oil[11] was completely different from the remaining three oils from Nigeria.

The reasons for this variation may possibly be the origin of the fruits, which were not certain in many cases; Owolabi et al (2009) purchased the seeds used for their analysis at Agege market in Lagos, Nigeria and presumed it to have originated from south west Nigeria.

Table 2. Comparison of the percentage (%) composition of the major components of the seeds essential oils of *Monodora myristica* variously reported from Nigeria.

Compounds	Lagos	Agege Lagos	Kaduna	Iwaro-Oka
α.phellandrene epoxide	3.02	-	-	-
α-phellandrene	-	-	50.4	-
carvacrol	2.09	-	-	-
δ-cadinene	2.21	-	-	11.09
geranial	-	40.1	-	-
neral	-	29.7	-	-
myrcene	-	11.3	4.35	-
germacrene-D-4-ol	-	-	9.0	25.48
α-pinene	-	-	5.5	-
linalool	-	-	-	15.10
tricylo[5.2.1.0(1,5)]dec-2-ene	-	-	-	13.35

Also the kind of treatments the fruits underwent after the harvest may be another important reason. In explaining this type of variation in the chemical constituents of *Xyllopia aethiopica* from Benin, Ayedoun et al.[14] explained that the α-pinene and the sabinene could vary respectively from 4 to 16% and 3 to 36% according to whether the fruits were boiled or smoked before the drying.

In conclusion, the constituents of the seeds and stem-bark essential oils of *Monodora myristica* in this study were quite different chemically and the presence of hydromethyl furfuraldehyde in the seed oil raised some health concerns as this substance is toxic. The major composition of oils of *Monodora myristica* as reported from Nigeria were so different that one could not be sure whether this large differences were due to environmental, genetic or some procedural differences. Thus further studies would be required to determine these differences.

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