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Chemical composition of leaf essential oil of *Annona senegalensis* Pers. (Annonaceae) growing in North Central Nigeria

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ABSTRACT

Leaf essential oil of *Annona senegalensis* Pers. obtained by hydrodistillation was analysed using GC and GC/MS. The analyses revealed the abundance of oxygenated monoterpenes (65.0%). The major constituents were citronellal (30.0%), citronellol (14.8%), geranial (17.2%), thymol (8.1%), β – caryophyllene (7.8%) and carvacrol (6.92%).

Keywords: Annonaceae, *Annona senegalensis*, citronellal, citronellol, geranial, thymol.

INTRODUCTION

Annona senegalensis Pers. (Annonaceae) is a perennial shrub widely grown in Nigeria where it is commonly known as gwandar daaji among the Hausa speaking people and abo, ewe-aso by the Yorubas (Pinto et al., 2005; Suleiman et al., 2008; Kayode et al., 2009; Orwa et al., 2009).

The plant is used in folk medicine for the treatment of several ailments like guinea worm, diarrhoea, snakebite, headache and respiratory infections. The leaves are used for treating pneumonia, while gum from the bark is used in sealing cuts and wound (Orwa et al., 2009). The biological activities of the plant extract reported by various workers justified the use of the plant in traditional medicine. For instance, the plant extract were found to possess antimalarial, antidiarrhoea, antibacterial and anthelmintic properties (Alawa et al., 2003; Ajaiyeoba et al., 2006; Apak and Otila, 2006; Suleiman et al., 2008). The larvicidal, trypanocidal and cytotoxic properties of the extract have also been reported (Ajaiyeoba et al., 2006; Ogbadoyi et al., 2007; Magadula et al., 2009).

Phytochemical investigations of the plant led to the isolation of (-) – roemerine (You et al., 1995; Magadula et al., 2009) and ent–kaurene diterpenoids (Fatope et al., 1996). Similarly, p–cymene has been reported as the most abundant component of the stem bark essential oil of *A. Senegalensis* grown in Democratic Republic of Congo (DRC) (Farid et al., 2002). Germacrene D was reported to be the predominant constituent of the leaf essential oil obtained from Burkina Faso grown *A. senegalensis (*Nebie et al., 2005*)*, while analysis of the seed oil obtained from

Senegal grown *A. senegalensis* showed the predominance of terpinen–4–ol (Alassane et al., 2004). Earlier work on the leaves and fruits essential oil of the plant growing in South–West Nigeria also revealed the presence of car–3–ene and linalool as the major constituent of the fruit and leaf oils respectively (Ekundayo and Oguntimehin, 1986).

Variations in composition pattern of essential oil from the same plant species have been attributed to agro climatic and geographical conditions (Lahlou, 2004). It is on this basis, that we investigate the leaf essential oil of North Central Nigerian grown *A. senegalensis*.

MATERIALS AND METHODS

Plant materials

The fresh leaves of *Annona senegalensis* were obtained in Ilorin, Kwara State, Nigeria. Identification and authentication were carried out at the herbarium of Forestry Research Institute of Nigeria (FRIN), Ibadan, where voucher specimen was deposited.

Oil isolation

Pulverized leaves of the plant were hydrodistilled for 3 h in a Clevenger-type apparatus, according to the British Pharmacopoeia (1980) specification. The resulting oil was collected, preserved in a sealed sample tube and stored under refrigeration until analysis.

Gas chromatography

GC analysis was 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, 25 m × 0.25 mm, 0.15 μm film thickness) and flame ionization detector (FID). The volume injected was 0.2 μL and the split ratio was 1:30. Oven temperature was programmed from 50 – 230 °C respectively. Qualitative data were obtained by electronic integration of FID area without the use of correction factors.

Gas chromatography/mass spectrometry

A Hewlett Packard (HP 5890A) GC interfaced with a VG Analytical 70 – 250 S double focusing mass spectrometer was used. Helium was the carrier gas at 1.2 ml/min. The MS operating conditions were: ionization voltage 70ev, ion source temperature 230 °C. The GC was fitted with a 25 m×0.25 mm, fused silica capillary column coated with CP-Sil 5. The film thickness was 0.15 μm. 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 (Jennings and Shibamito, 1980; Adams, 1995; Joulain and Koenig, 1998).

RESULTS AND DISCUSSION

Pulverised leaves of *Annona senegalensis* afforded 0.02% v/w of essential oil. The yield compared favourably with the yield obtained from the leaf of *A. senegalensis* grown in South West Nigeria (Ekundayo and Oguntimehin, 1986). Table 1 shows the retention indices, relative percentage and identities of the constituents of the oil. A total of 36 compounds representing 97.2% of the oil were identified.

The oil was characterised by the abundance of oxygenated monoterpenes (65.0%). Aromatic compounds and hydrocarbon monoterpenes constituted 15.0 and 10.9% of the oil respectively. The percentage composition of hydrocarbon sesquiterpenes was 7.8%. Predominant oxygenated monoterpenes in the oil were citronellal (30.0%), geranial (17.2%), citronellol (14.8%) and linalool (2.8%). Aromatic compounds that were found as the principal constituents of the oil include thymol (8.1%) and carvacrol (5.4%).

Table 1: Chemical composition (%) of the leaf oil of *A. senegalensis.*

Compound [a]	RI [b]	% Composition	Mass Spectra Data
α–thujene	926	tr	91, 105, 121, 136
α–pinene	933	0.1	69, 79, 93, 121, 136
β–pinene	976	0.1	77, 93, 107, 121, 136
Myrcene	990	10.9	93, 107, 115, 121, 136
Cymene	1022	tr	41, 51, 58, 119, 134
Benzyl alcohol	1028	tr	51, 65, 73, 79, 91, 108
1, 8–cineole	1029	tr	81, 108, 129, 139, 154
Cis–ocimene	1035	tr	78, 93, 105, 121, 136
γ–terpinene	1057	tr	41, 51, 73, 105, 121
Iso–Artemisia	1057	tr	41, 55, 69, 83, 91
Linalool	1098	2.8	43, 67, 80, 97, 121, 137
Pinine–2–ol	1136	tr	55, 69, 79, 111, 139
Allo ocimene	1142	tr	67, 79, 91, 105, 121, 139
Citronellal	1150	30.0	41, 55, 69, 81, 121, 136
Borneol	1162	tr	67, 81, 95, 110, 121
Terpinen–4–ol	1175	tr	43, 111, 125, 136, 154
α–terpineol	1188	tr	59, 81, 93, 107, 121, 139
Citronellol	1226	14.8	41, 55, 69, 109, 138
Neral	1236	tr	69, 95, 109, 119, 135
Linalyl acetate	1255	0.2	43, 55, 93, 105, 121
Geranial	1268	17.2	53, 69, 83, 95, 99, 109
Borneol acetate	1284	Tr	67, 80, 95, 108, 121, 136
Thymol	1290	8.1	65, 77, 91, 135, 150
Carvacrol	1299	5.4	41, 51, 65, 135, 150
β–elemene	1300	tr	150, 165, 177, 193, 208
α–copaene	1375	tr	105, 119, 161, 189, 204
β–caryophyllene	1418	7.8	79, 91, 105, 119, 133
Ethyl cinnamate	1460	tr	79, 91, 105, 119, 133, 147
Germacrene D	1490	tr	91, 105, 133, 147, 204
Bicyclogermacrene	1494	tr	67, 79, 93, 107, 121
β–bisabolene	1509	tr	53, 69, 79, 93, 105
Acetyleugenol	1523	tr	121, 131, 149, 164, 207
Elemicin	1553	tr	150, 165, 177, 193, 208
Viridiflorol	1589	tr	109, 149, 161, 189, 205
Torreyol	1643	tr	105, 119, 133, 161, 204
Benzyl benzoate	1761	tr	51, 65, 77, 91, 105, 152
Total		97.2	

[a] Compounds are listed in order of elution from silica capillary column coated in CP-Sil 5; [b] Retention indices on fused silica capillary column coated with CPSil5 ; tr = trace (<0.1%).

The most abundant hydrocarbon monoterpenes was myrcene (10.7%), while β–caryophyllene was the only hydrocarbon sesquiterpene found in significant proportion in the oil. β–elemene, α–copaene, germacrene and β–bisabolene were detected in trace amounts.

Comparison of the composition pattern of the oil, with the oil obtained from south west grown *A. senegalensis* revealed both

qualitative and quantitative differences. For instance, oxygenated monoterpenes constituted 65% of the oil while the oil obtained from the leaf of South-West grown *A.senegalenses* was constituted by 19.5% of oxygenated monoterpenes. The principal oxygenated monoterpenes, citronellal, citronellol and geranial in the oil were not detected in the oil obtained from South West grown *A. senegalensis* (Ekundayo and Oguntimehin, 1986). Similarly, geraniol, one of the principal constituents of South West grown *A. senegalensis* was not detected in North Central grown *A. senegalensis*. Meanwhile, a bicyclic monoterpene; car–3–ene that was detected in the leaf oil of south west grown *A. senegalensis* was not found in this study. In addition, carvacrol and thymol, the most predominant aromatic compounds in the oil were not found in the oil obtained from south west grown *A. senegalensis*.

On the other hand, the most abundant constituent of the leaf oil of south west grown *A. Senegalensis,* linalool, was found in appreciable quantity in the leaf oil of North Central grown *A. senegalensis*. Hence, the oil of South-West grown *A. senegalensis* is of linalool chemotype. Meanwhile, the most abundant compound in the oil of North Central grown *A. senegalensis* is citronellal, thus, the oil is of citronellal chemotype.

Variation in composition patterns of the oil from the two locations may be due to agro-climatic and geographical conditions.

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