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SHORT COMMUNICATION

VOLATILE OILS OF FRANKINCENSE FROM *BOSWELLIA PAPYRIFERA*

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ABTRACT. The essential oil obtained by hydrodistillation of frankincense from *Boswellia papyrifera* was analyzed using GC, GC-MS and NMR. n-Octyl acetate (56%), octanol (8%) and limonene (6.5%) were found to be the major components.

INTRODUCTION

Boswellia Roxb. (Burseraceae) comprises nearly 20 species scattered in rough and inhospitable arid regions of Africa, Arabia and India at altitudes of 950-1800 m [1,2]. The genus commonly produces resins known as frankincense or olibanum. *B. papyrifera* is known to occur in Ethiopia, Sudan and in some parts of West Africa [1]. Its resin, commonly referred to as "Tigray type olibanum", is widely used in Ethiopia as incense at home and during religious ceremonies. It is also an important item of export for formulation of perfumes [3]. Resin from this species is normally obtained by making an incision on the bark and allowing white emulsion to exude out, which slowly dries into different shaped tears. The resin is then harvested every fortnight and the process repeated several times between December to May [4].

So far, limitation in the botanical knowledge of the genus has hindered chemical work on resins from properly identified species. Earlier reports [5] were based on frankincense from commercial sources. In this paper we describe the results of our study of the volatile oil obtained by hydrodistillation of frankincense from an identified plant, *Boswellia papyrifera* (Del.) Hochst.

EXPERIMENTAL

Plant material. Resins and botanical specimens were collected from trees growing wild in Metema, North Ethiopia in Oct. 1996. Locally *B. papyrifera* tree is called "Walya Meker" and its resin "Itan" (Amharic). The plant was identified by Dr. Kaj Vollesen, Kew Botanic Gardens, and specimen has been deposited at the National Herbarium of Addis Ababa University with voucher number Aman D.15 (Herbarium number 072807).

Isolation of the essential oil. The resin of the plant (100 g) was ground and hydrodistilled for 3 h in a Clevenger type apparatus to yield the essential oil (0.8 g, 0.8%). 300 mg of the oil was then applied to CC over flash silica gel (25 g) and eluted with hexane (150 mL) and EtOAc (150 mL) to yield hydrocarbon (15 mg, 5%) and oxygenated (280 mg, 93%) fractions, respectively.

GC and GC-MS analysis. GC was performed on HP 6890 GC series using HP-5 fused silica capillary column (30 m x 0.25 mm i.d.). The oven was programmed at 50-210 ^{0}C at a rate of 30/min using N_2 as carrier gas, injector and detector (FID) temperatures were 220^0 and 270^0, respectively. GC-MS was performed on Fisons GC model 8000 series chromatograph coupled to MD 800 quadrupole analyzer mass spectrometer at 70 eV. The capillary column type was DB-17 (30 m x 0.25 mm i.d.) and GC parameters were the same as above. The constituents were identified by matching their 70 eV mass spectra with NIST, Wiley databases and user generated mass spectral libraries and also confirmed by comparison with GC retention times of some authentic samples (Table 1). The ^{13}C NMR spectra of the crude oil and its hydrolysis product were recorded at 22.5 MHz using $CDCl_3$ as solvent.

RESULTS AND DISCUSSION

The results of the analyses are given in Table 1 and Figure 1. A total of 25 components were identified from the crude oil. The major component in the essential oil is n-octyl acetate (IR: 1740 cm^{-1}, C=O). Refluxing 150 mg of the oil in 5 mL 1% HCl resulted in total conversion of this ester to n-octanol (IR: 3195 cm^{-1}, O-H).

Table 1. Relative compositions (%) of volatile components of: **A**. resin of *Boswellia papyrifera*, **B**. Tigray type frankincense export grade from Natural Gum Processing and Marketing Enterprise, Ethiopia, **C**. Taken from Ref. 5.

Components*	(%) (A)	(%)(B)	(%)(C)
α-pinene	2.6[a]		3.5
camphene	0.3[a]		0.7
β-phellandrene	1.0		
β-pinene	0.4[a]		0.4
β-myrcene	0.7		0.2
limonene	6.5	3.3	1.7
n-hexyl acetate	1.3		0.1
cis-ocimene	0.8	2.0	0.2
trans-ocimene	2.0		1.3
1,8-cineole	2.2[a]		1.6
n-octanol	8.0[b]	4.5	12.7
linalool	3.2[a]		2.0
endo-borneol	1.5		
n-octyl acetate	56.0[b]	90.0	60.0
α-terpineol	0.5		0.1
nerol	1.8		
bornyl acetate	0.7		1.1
p-mentha-6,8-dien-2-one	0.7		
neryl acetate	0.5		t
α-muurolene	t		
1(5),6-guaiadiene	t		
4,7(11)-selinadiene	t		
β-elemene	1.1		
α-terpinolene	0.4		0.1
verticellol	0.5		

*Components are arranged in order of their elution from DB-17 capillary column; t = trace (< 0.1%);
[a]confirmed also by co-injection; [b]confirmed by co-injection and ^{13}C NMR.

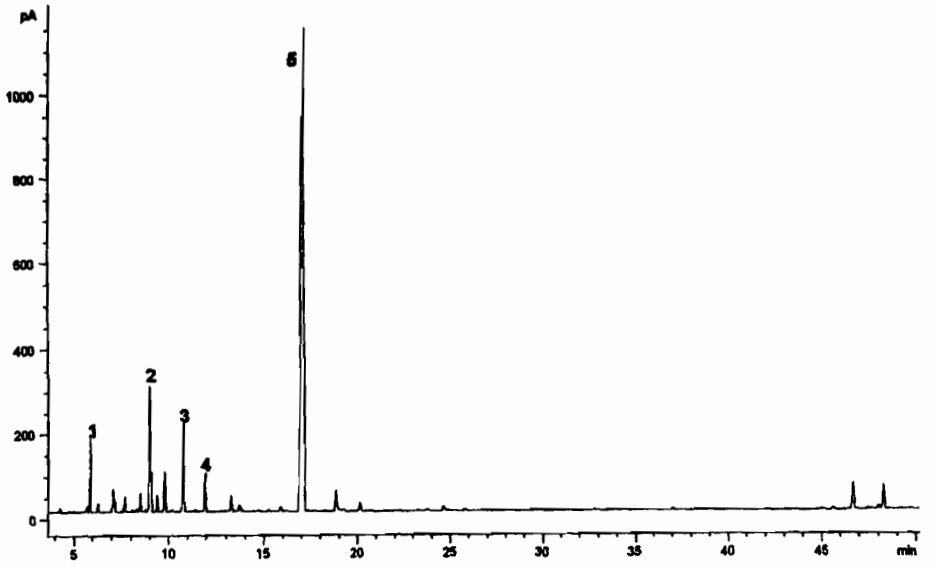

Figure 1. Gas chromatogram of hydrodistilled oil of *B. papyrifera* **1**: α-pinene (2.6%); **2**: limonene (6.5%); **3**: n-octanol (8.0%); **4**: linalool (3.2%); **5**: n-octyl acetate (56%).

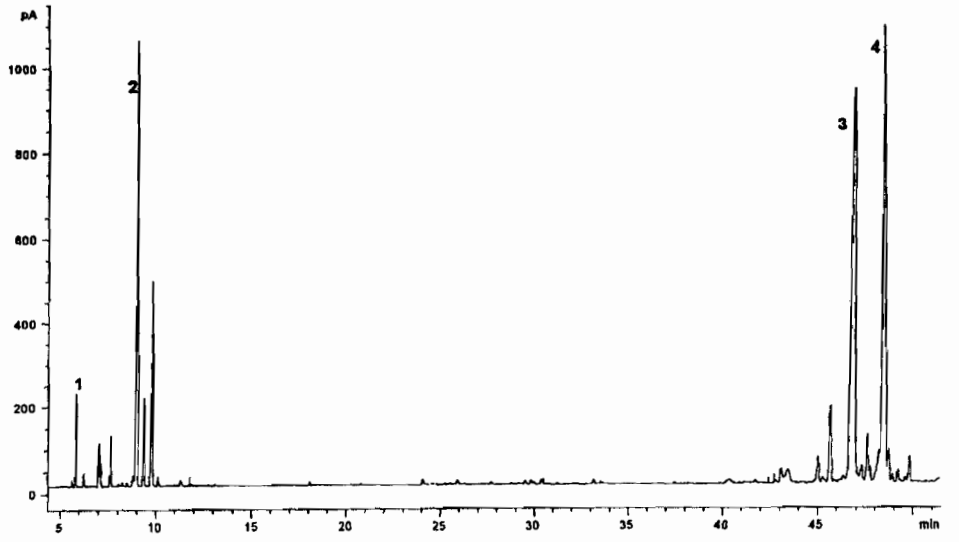

Figure 2. Gas chromatogram of hydrocarbon fraction of the oil of *B. papyrifera* **1**: α-pinene (2%); **2**: limonene (14%); **3**: caryophylene oxide (21%); **4**: β-elemene (29%).

The results of analysis of Tigray type olibanum on sample from export grade frankincense showed absence of many of the minor constituents, possibly caused by evaporation during storage. Our results are comparable to that reported by Abdel Wahab *et al.* on olibanum from Somalia [5], whereby nearly 15 components are found in common.

The crude oil was fractionated into hydrocarbon and oxygenated fractions by passing 300 mg through flash silica gel, first eluting with hexane to obtain 15 mg (5%) of the hydrocarbon fraction and then ethyl acetate to get 280 mg (93%) of the oxygenated fraction. In the hydrocarbon fraction (Figure 2) β-elemene, caryophylene oxide and limonene were the major components while in the oxygenated fraction (Figure 3) n-octyl acetate is dominant (76%).

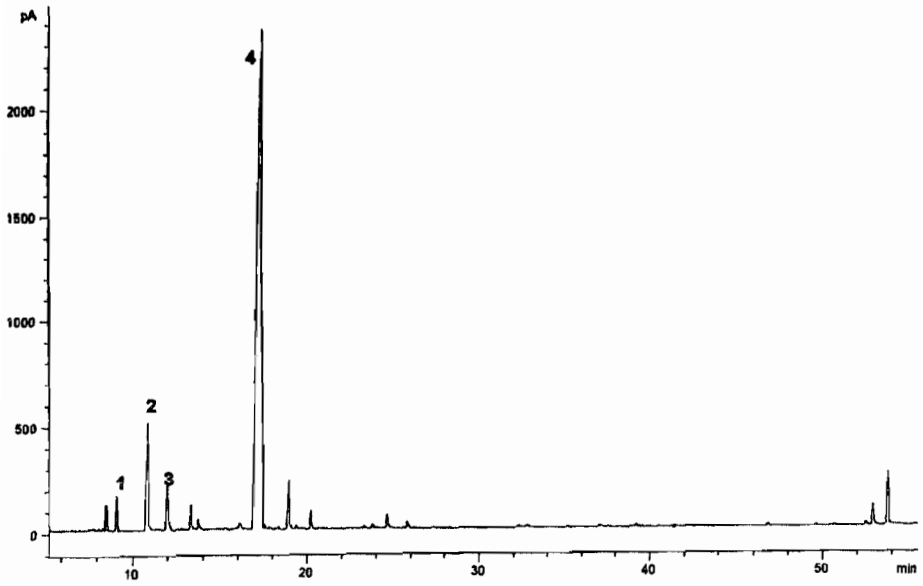

Figure 3. Gas chromatogram of oxygenated fraction of the oil of *B. Papyrifera* **1**: n-hexyl acetate (1%); **2**: n-octanol (7%); **3**: linalool (3%); **4**: n-octyl acetate (76%).

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