dialysed against 10 mM NaPi buffer (pH 6) for 24 hr. The clear soln was then applied to a column (15 × 2.5 cm) of DEAE-Sephadex A 25 equilibrated in the same buffer. The buffer washing fraction was collected, dialysed against $H_2O$ and freeze-dried (F-1). F-1 (1 g) was dissolved in $H_2O$ (200 ml) and $(NH_4)_2SO_4$ added to satn. The ppt was obtained by centrifugation and dissolved in $H_2O$. The above procedure was repeated once and the soln dialysed and freeze-dried to give AXG (475 mg). The AXG (30 mg) was treated with 0.05 M TFA (5 ml) at 100° for 2 hr and the degraded polysaccharide (XG) was recovered by EtOH (4 vol.) precipitation (yield, 23 mg). EtOH-soluble fraction contained L-arabinose and D-xylose in a molar ratio of 82:18.

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# CONSTITUENTS OF ESSENTIAL OIL *OF BOSWELLIA FREREANA*

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**Key Word Index**—*Boswellia frereana*; Burseraceae; terpenes; essential oil.

**Abstract**—The composition of the essential oil of *Boswellia frereana* was investigated by GC/MS. Ten terpenes were identified and *p*-cymene was by far the most abundant component of the oil.

## INTRODUCTION

Recently we started a program to investigate the chemical constituents of frankincense produced by *Boswellia frereana* (Somaliland name Meydi). Two triterpenes, lupeol and epilupeol, were previously isolated and identified from the neutral extract of frankincense produced by the same plant [1]. Here we describe the identification of several compounds contained in the essential oil of this gum-resin [2].

## RESULTS AND DISCUSSION

Two procedures were utilized to isolate the essential oil. Procedure (a) made use of steam distillation on the residue obtained by solvent extraction of the gum-resin, and procedure (b) made use of steam distillation directly on the gum-resin. For several reasons, attributable to decomposition or alteration of the terpenes, we used procedure (b) for the identification of terpene constituents of the essential oil.

The terpenes were identified by their mass spectra obtained in the GC/MS analysis and, when possible, by comparison with authentic samples. The mixture obtained from steam distillation was extracted with *n*-hexane and the solvent removed by distillation at low temperature. The final oil was analysed by GC in the following monoterpene and diterpene hydrocarbons: α-pinene, sabinene, myrcene, α-terpinene, limonene, *p*-cymene, α-cubebene, terpinen-4-ol, cembrene, isocembrene [3] and two unknown monoterpenes $C_{10}H_{16}$ and $C_{10}H_{18}O$. *p*-Cymene was the most abundant component of the mixture.

The first hydrocarbon ($C_{10}H_{16}$) showed a molecular peak at *m/z* 136 and the base peak was at *m/z* 93. Another peak at *m/z* 92 was important due to the formation of toluene which is possible with the direct loss of a $C_3H_8$ fragment without rearrangement of the double bond. This type of fragmentation is shown by bicyclic monoterpenes α-pinene and α-thuyene [4]. Therefore this hydrocarbon can be assigned to the class of bicyclic monoterpenes.

The second unknown compound, $C_{10}H_{18}O$, had a molecular ion peak at *m/z* 154 and base peak at *m/z* 119 and it is probably an ether derivative of a monocyclic monoterpene.

## EXPERIMENTAL

The gum-resin produced by *Boswellia frereana* was collected near Bari and Sanaag (Somaly). Frankincense (50 g) was extracted with EtOAc by percolation. After removal of the solvent, the residue was steam distilled. The distilled oil was separately extracted with *n*-hexane, dried over $Na_2SO_4$ and the solvent removed at low temp. yielding 1.3 g (2.6%) of oil.

Analytical GC employed the following columns: (a) Stainless steel, (2 m × 3 mm o.d.) packed with 3% OV-1 on Chromosorb W 80–100 mesh; (b) Stainless steel, (2 m × 3 mm o.d.) packed with 2.5% SE-30 on Chromosorb W 80–100 mesh. The MS were obtained by GC/MS analysis using column (b) temp. programmed from 70° to 250° (rate 4°/min) with $N_2$ as carrier gas. The mass spectrometer operating conditions were as follows: ionization voltage 75 eV; filament emission 200 A; source temp. 250°; resolving power 1000 (10% valley).

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# α-BISABOLOL β-D-FUCOPYRANOSIDE FROM *CARTHAMUS LANATUS*

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**Key Word Index**—*Carthamus lanatus*; Compositae; sesquiterpene glycoside; α-bisabolol β-D-fucopyranoside.

**Abstract**—A sesquiterpene glycoside has been isolated from the aerial parts of *Carthamus lanatus* and identified by its spectroscopic and chemical properties as α-bisabolol β-D-fucopyranoside.

The major component of the hexane extract from the aerial parts of *Carthamus lanatus* L. (Compositae; tribe Cynereae) is a sesquiterpene glycoside, **1**. This type of compound seems to be characteristic of the genus *Carthamus* because two other isomeric glycosides have been described from *C. oxyacantha* [1] and *C. turkistanikus* [2].

The IR spectrum of the product shows absorptions of double bonds and hydroxyl groups, and interpretation of the signals due to the glycoside in the $^1H$ NMR spectrum (60 MHz) was not possible. On acetylation it gave a triacetate, **2**, with no absorption of hydroxyl groups in the IR. The mass spectrum showed no molecular ion but two peaks at *m/z* 289 (10%) $C_{12}H_{17}O_8$ and 204 (99%) $C_{15}H_{24}$ and their respective fragmentation sequences (289, 273, 213, 153, 111 and 204, 134, 119) were readily assigned to the acetylated glycoside and the sesquiterpene moieties.

The $^1H$ NMR spectrum of the triacetate, **2**, shows a methyl doublet at δ 1.15 and a broad quartet at 3.70