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SHORT COMMUNICATION

ESSENTIAL OILS OF THREE *EUCALYPTUS* SPECIES ACCLIMATIZED IN ETHIOPIA

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ABSTRACT. The essential oils obtained by steam distillation of three *Eucalyptus* species acclimatized in Ethiopia were analyzed using GC and GC-MS. The species were *E. globulus* Labill, *E. camaldulensis* Dehn and *E. citriodora* Hook. 1,8-Cineole and citronellal are the major components of the essential oils of *E. globulus* and *E. citriodora*, respectively. The *E. camaldulensis* oil obtained from Wondo Genet yielded p-cymene (20.4 %) and cryptone (25.2 %) as major components, while the major components of the same species obtained from Addis Ababa were p-cymene (39.9 %) and α-phellandrene (12.9 %).

INTRODUCTION

The genus *Eucalyptus*, family Myrtaceae, contains nearly 700 species and is known as source of essential oils [1]. *Eucalyptus* oils are produced from plants belonging to this genus and have found uses in pharmaceutical, confectionery and cosmetics industries. Cineole is the most widely used component of the oil and is an important ingredient of many cough and expectorant preparations [2]. *E. globulus* is known to possess an oil rich in 1,8-cineole while *E. citriodora* is known for its high content of citronellal [3].

Many species of the genus *Eucalyptus* have been introduced into Ethiopia, among them are *E. globulus, E. citriodora* and *E. camaldulensis*.

Previous studies on the essential oils of *E. camaldulensis* have shown that the composition varies depending on the geographical location. Thus *E. camaldulensis* grown in Burundi [4] was reported to have 1,8-cineole (43%) as the major component. On the other hand Ndou *et al.* [2] reported p-cymene (48%) as the major component of *E. camaldulensis* grown in South Africa. Zrira *et al.* also reported qualitative and quantitative variations in oils of *E. camaldulensis* grown in different parts of Morocco [3, 5]. Review of literatures by Lawrence showed that oils of *E. citriodora* from India, Uruguay, Chile and Madagascar contained citronellal at concentration ranges of 60-85% [6]. 1,8-Cineole (72.8%) was reported as the major component from oil of *E. globulus* grown in Morocco [3].

The purpose of this study was to determine the yield and essential oil composition of the three *Eucalyptus* species grown in Ethiopia, and compare the results for the same species grown elsewhere.

EXPERIMENTAL

Plant material. Fresh leaves of *E. globulus* were collected from Addis Ababa; *E. citriodora* from Wondo Genet farm site of the Essential Oil Research Center (EORC); *E. camaldulensis* from

Wondo Genet and also from the Faculty of Science Campus, Addis Ababa. All species were identified by Dr. Sebsebe Demissew of Addis Ababa University and voucher specimens have been deposited at the National Herbarium, Addis Ababa University with Voucher numbers Abera A. S-767 for *E. globulus*, *E. citriodora* (Abera A. S-698), *E. camaldulensis* from Wondo Genet (Abera A. S-808) and *E. camaldulensis* from Addis Ababa (Pauline M. S-924).

Isolation of essential oils. Fresh leaves of the plants were hydro-distilled for 3 h in a Clevenger-type apparatus. The yield of essential oils after distillation were 1.2% for *E. globulus*, *E. camaldulensis* (Addis Ababa, 0.8% and Wondo Genet, 0.7%) and *E. citriodora* (1.4%).

GC and GC-MS analysis. The composition of the essential leaf oils of the three *Eucalyptus* species were analyzed by GC and GC-MS instruments. GC was performed on Varian 3700 chromatograph using HP-1 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 3^0/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 analyzermass spectrometer at 70 eV. The capillary column type was DB-17 (30 m x 0.25 mm i.d.) and the GC parameters were the same as above. The constituents were identified by matching their 70 eV mass spectra with NIST and WILEY databases and further confirmed by peak enhancement and GC retention time.

The ^{1}H and ^{13}C NMR spectra of the crude oils were recorded on a Joel FX 90Q instrument at 90 and 22.5 MHZ, respectively, using $CDCl_3$ as solvent.

RESULTS AND DISCUSSION

The results of the analyses are shown in Table 1. A total of 39 components were identified from the three species. Examination of these results showed that the *E. globulus* oil had 1,8-cineole (80%) and *E. citriodora* oil had citronellal (76.4%) as the major components, 1,8-cineole and citronellal were clearly identified by the ^{1}H and ^{13}C NMR spectra of their respective crude oils. Cryptone (25.2 %) and p-cymene (20.4%) were the major components in the *E. camaldulensis* leaf oil from Wondo Genet, while p-cymene (39.9%) and β-phellandrene (12.9%) were the major components in the same specimen obtained from Addis Ababa.

As can be seen from Table 1 the two *E. camaldulensis* oil samples are clearly different since 16 components detected in the oil of *E. camaldulensis* from Wondo Genet are not detected in the oil from the specimen grown in Addis Ababa. The nine carbon containing compound cryptone has not been previously reported in the essential oils of *E. camaldulensis* grown in different parts of Africa, but is one of the major components in the oil from Wondo Genet. Furthermore, p-cymene, which was reported as one of the major compounds (13-50%) in the essential oils of *E. camaldulensis* grown in South Africa, Burundi and Morocco [2-5] was also the major component in both of our *E. camaldulensis* samples.

The presence of citronellal as the major compound in the leaf oil of *E. citriodora* was in agreement with previous findings [6, 7] although minor quantitative and qualitative variations could be discerned. The 1,8-cineole content of the essential oil of *E. globulus* exceeded 70%, thus meeting the European pharmacopoeia specifications [8] required for medicinal *Eucalyptus* oil.

Table 1. Chemical composition (%) of the essential oils of three *Eucalyptus* species grown in Ethiopia.

Components*	*E. globulus*	*E. camaldulensis*		*E. citriodora*	Confirmation
		Wondo Genet	Addis Ababa		
α-pinene	3.1	0.6	-	0.2	PE
thujene	-	1.9	1.1	-	
β-pinene	-	1.8	-	0.2	
n-decane	-	1.2	-	0.2	PE
trans-ocimene	-	-	0.7	-	
β-myrcene	-	1.6	0.5	t	PE
limonene	1.3	-	1.3	-	PE
α-phellandrene	-	0.5	5.9	-	
β-phellandrene	-	-	12.9	-	
1,8-cineole	80.8	-	-	-	PE, NMR
γ-terpinene	-	-	1.4	-	PE
p-cymene	-	20.4	39.9	-	PE, NMR
4-thujanol	-	6.7	-	-	
α-thujone	-	0.4	-	-	
linalool	-	-	t	0.2	
trans-pinocarveol	1.0	-	-	-	
isopulegol	-	-	-	5.5	
cryptone	-	25.2	-	-	
citronellal	-	-	-	79.3	PE, NMR
terpinen-4-ol	0.6	7.3	4.5	-	PE
α-terpineol	3.1	0.9	-	-	PE
cis-piperitol	-	1.3	-	-	-
trans-piperitol	-	0.8	-	-	-
trans-carveol	-	0.4	-	-	-
trans-pinocarvone	0.8	-	-	-	-
cuminaldehyde	-	6.2	3.6	-	-
piperitone	-	0.6	-	-	-
citronellol	-	-	-	8.3	PE
phellandral	-	4.1	-	-	
p-cymene-7-ol	-	1.7	-	-	
carvacrol	-	0.7	-	-	
piperitone oxide	-	t	-	-	
citronellyl acetate	2.8	-	-	2.3	PE
α- terpinyl acetate	2.5	-	6.1	-	
trans-caryophyllene	-	-	-	0.2	
eugenol	-	-	-	0.1	
spathulenol	-	2.2	-	-	
caryophyllene oxide	-	3.3	-	-	
% of total identified	**96.0**	**89.8**	**77.9**	**96.7**	

*Components are arranged in order of their elution from a DB-17 capillary column.
PE = Peak enhancement ; t = trace (<0.1%); NMR = ^{1}H and ^{13}C NMR.

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REFERENCES

1. Formacek, V.; Kubeczka, K.H. *Essential Oils Analysis by Capillary Gas Chromatography and ^{13}C NMR Spectroscopy*, Wiley Heyden: London; 1982; p 87.
2. Ndou, T.T.; Wandruszka, R.M.A. *S. Afr. J. Chem.* **1986**, 39, 95.
3. Zrira, S.S.; Benjilali, B.B. *J. Essent. Oil Res.* **1992**, 4, 259.
4. Dether, M.; Nduwimana, A.; Cordier, Y.; Menut, C.; Lamaty, G. *J. Essent. Oil Res.* **1994**, 6, 469.
5. Zrira, S.S.; Benjilali, B.B. *J. Essent. Oil Res.* **1991**, 3, 443.
6. Lawrence, B.M. *Perf. & Flav.* **1996**, 21, 55.
7. Mwangi, J.W.; Guantai, A.N.; Muriuki, G. *East Afr. Agric. For. J.* **1985**, 46, 89.
8. Guenther, E. *The Essential Oils*, Van Nostrand Co.: New York; 1950; p 437.