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Short communication

ESSENTIAL OILS OF FIVE *EUCALYPTUS* SPECIES GROWN IN KENYA

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ABSTRACT: The leaf essential oils of five *Eucalyptus* species grown in Kenya have been analyzed using GC and GC-MS. These were: *E. globulus, E. camaldulensis, E. macarthurii, E. globulus ssp maidenii* and *E. citriodora*. The results showed that *E. globulus, E. globulus ssp maidenii* and *E. camaldulensis* were rich in 1,8-cineole (>70%) while the principal components in *E. citriodora* and *E. macarthurii* were citronellal and geranyl acetate, respectively (>80%).

Key words/phrases: ***Eucalyptus globulus, E. globulus ssp maidenii, E. camaldulensis, E. macarthurii, E. citriodora***

INTRODUCTION

The genus *Eucalyptus*, family Myrtaceae, comprises more than 700 species (Formacek and Kubeczka, 1982). In recent years many species of the genus have been introduced and acclimatized in Africa. Because of quantitative and some times even qualitative variations in the composition of the leaf constituents of many members of this genus, it is important to determine the chemical constituents of the introduced species. In this study we have investigated essential oils obtained by steam distillation from leaves of five *Eucalyptus* species that occur widely in Kenya. These are: *E. globulus* Labill., *E.*

camaldulensis Dehn., *E. macarthurii* Deane and Maiden, *E. globulus ssp maidenii* F. Muell and *E. citriodora* Hooker.

The *Eucalyptus* essential oils are generally classified into three types: Cineolic or medicinal essential oils, Perfumery essential oils and Industrial essential oils (Zrira *et al.*, 1992). The most important commercial oil rich in 1,8-cineole is derived from *E. globulus* (Zrira and Benjilali, 1996). This oil is used primarily in pharmaceutical preparations (Bauer *et al.*, 1990). *E. citriodora* and *E. macarthurii* are known to produce perfumery essential oils. The former contains citronellal, an important ingredient in perfumery, while the latter is known for producing the pleasantly aromatic oil due mainly to its high geranyl acetate content. Species such as *E. radiata* are known as sources of industrial essential oils, which are rich in compounds such as α-phellandrene, that is used in the manufacture of sanitary products.

MATERIALS AND METHODS

Sample collection

Plant materials were collected from Muguga Arboretum in Nairobi, Kenya. Voucher specimens are kept at KEFRI Herbarium with voucher numbers Wanjiku P1 (*E. globulus*), Wanjiku P2 (*E. citriodora*), Wanjiku P3 (*E. macarthurii*), Wanjiku P4 (*E. globulus ssp maidenii*) and Wanjiku P5 (*E. camaldulensis*).

Isolation of essential oils

Fresh leaves of the plants were hydro-distilled for 3 h in a Clevenger-type apparatus.

GC and GC-MS analysis

The composition of the essential leaf oils of the five *Eucalyptus* species were analyzed by GC and GC-MS. GC was performed on Varian 3700 chromatography using DB-17 fused silica capillary column (30 m x 0.25 mm i.d.). The oven was programmed at 50–210° C at a rate of 3° C(min)$^{-1}$ using N_2 as carrier gas, and injector temp was 220° C and detector temp (FID) 270° C. GC-MS was

performed on Fisons GC model 8000 series chromatography coupled to MD 800 mass selective detector. The column type and the GC parameters were the same as above. The constituents were identified by matching their 70 eV mass spectra with National Institute for Standards and Technology (NIST) and Wiley databases and further confirmed by peak enhancement and GC retention time.

RESULTS AND DISCUSSION

The compounds identified from the five species are listed in Table 1 in order of their elution from a DB-17 capillary column. Total of 22 components were identified from the five species. The essential oils obtained from *E. camaldulensis*, *E. globulus* and *E. globulus ssp maidenii* exhibited high percentage of 1,8-cineole (>70 %). The absence of α- and β-phellandrene in these oils is noteworthy as a result of which these medicinal essential oils meet the European Pharmacopoeia specifications for such oils (Singh, 1994). The perfumery essential oils obtained from *E. citriodora* and *E. macarthurii* were rich in citronellal (>80 %) and geranyl acetate (>80 %), respectively.

Table 1. Constituents of the essential oils of the five *Eucalyptus* species acclimatized in Kenya.

Components*	Absolute area percentage					Confirmation
	E. camaldulensis	*E. globulus*	*E. globulus ssp maidenii*	*E. citriodora*	*E. macarthurii*	
3-hexen-1-ol	-	-	-	-	0.4	
trans-ocimene	-	-	2.8	0.1	-	
α-pinene	0.4	7.2	-	-	-	PE
β-pinene	t	0.2	0.1	0.3	-	PE
β-myrcene	0.1	0.2	0.1	t	-	PE
D-limonene	2.2	2.8	1.0	0.1	-	PE
1,8-cineole	92.5	82.1	90.0	0.4	-	PE
γ-terpinene	-	0.6	-	0.1	-	PE
terpinolene	-	-	-	0.1	-	
isoamyl isovalerate	-	-	0.1	-	-	
linalool	-	0.1	-	-	1.4	PE

Table 1. (Contd.)

Components*	Absolute area percentage					Confirmation
	E. camaldulensis	*E. globulus*	*E. globulus ssp maidenii*	*E. citriodora*	*E. macarthurii*	
isopulegol	-	-	-	3.5	-	
citronellal	-	-	-	85.1	-	PE
terpinen-4-ol	0.6	0.5	-	-	-	
cis-carveol	-	-	-	-	0.1	
α-terpineol	2.0	4.0	3.0	-	t	PE, NMR
citronellol	-	-	-	4.1	-	PE
geraniol	-	-	-	-	5.0	PE
nerol	-	-	-	-	0.1	
α-terpinyl acetate	0.4	0.2	-	0.1	-	PE
citronellyl acetate	-	-	-	4.5	-	PE
trans-caryophyllene	-	-	0.3	0.2	-	
geranyl acetate	-	0.2	-	0.1	86.0	PE
myrtenyl acetate	-	-	-	-	0.2	0.2
alloaromadendrene	-	0.5	-	-	-	-
guaiol	-	-	-	-	1.7	1.7
β-eudesmol	-	-	-	-	2.8	2.8
Percentages of total components identified	98.5	98.80	96.7	99.1	97.0	97.0

*, Components are arranged in order of their elution from a DB-17 capillary column; PE, peak enhancement; NMR, ^{1}H and ^{13}C- NMR; t, trace.

The essential oil contents of the five *Eucalyptus* species reported above are comparable with results of analyses of these species acclimatized in other countries in Africa e.g. Morocco (Zrira *et al.*, 1992), Burundi (Dethier *et al.*, 1994), South Africa (Ndou and Von Wandruszka, 1986) and Madagascar (Lawrence, 1996).

We conclude from this study that the three medicinal essential oils obtained from *E. camaldulensis*, *E. globulus* and *E. globulus ssp maidenii* acclimatized in Kenya exhibit adequate 1,8-cineole content and no α- and β-phellandrenes. This indicates that these oils are suitable commercial sources for production of

medicinal *Eucalyptus* oils. *E. macarthurii* and *E. citriodora* with their relatively high geranyl acetate and citronellal content, respectively, should be suitable for the production of perfumery essential oils.

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