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ESSENTIAL OIL COMPOSITION OF *CHAMELAUCIUM UNCINATUM*

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Key Word Index—*Chamelaucium uncinatum*; Myrtaceae; Geraldton wax; essential oil; chemotypes.

Abstract—The composition of the essential oils of different genotypes of *Chamelaucium uncinatum* has been examined. The major compounds were identified as α-pinene, citronellal, limonene, linalool and α-terpinyl acetate. Three chemotypes of *C. uncinatum* were identified based on the relative proportions of α-pinene, citronellal and limonene present. Oils with α-pinene as the principal constituent were the most common.

INTRODUCTION

The genus *Chamelaucium* is represented by 33 species, all of which are woody, perennial shrubs endemic to Western Australia [1; Marchant and Chin, unpublished]. Of these, *C. uncinatum* (Geraldton wax) is horticulturally the most important, particularly in the cut-flower trade. Although recognized for a long time as a floriferous and fragrant plant, little work has been carried out on the composition of its essential oil despite the fact that it had been shown to have antibacterial activity [2, 3]. From early investigations [4, 5], (+)-α-pinene was identified as a major compound (30%) of the essential oil. A more recent investigation of *C. uncinatum* var. CWA Pink showed that the oil was composed mainly of α-pinene (44%), β-pinene (16%), citronellal (15%) and limonene (4%) [Dunlop, Ghisalberti and Zwicky (1989) unpublished].

We have initiated a systematic study of the content and composition of the essential oils of *C. uncinatum*, with particular emphasis on delineating infraspecific variations. The results from this investigation are the subject of this report.

RESULTS AND DISCUSSION

Simple hydrodistillation of *C. uncinatum* foliage produced a clear, colourless to pale yellow oil, with a mean yield of 0.43% (range 0.11–2.21%) or *ca* 51 kg oil ha^{-1}. The essential oil contained 32 compounds in which the major components were α-pinene (bulk%, range) (36.3%, 0.7–72.2), limonene (18.0%, 1.5–81.2), citronellal (16.1%, 0.5–61.9), linalool (4.2%, tr–16.3), geraniol (3.3%, 1.33–5.4), α-terpinyl acetate (3.9%, 4.7–10.0) and globulol

Table 1. Composition of essential oil of *Chamelaucium uncinatum*

Compound	% in oil
Isovaleraldehyde	1.74
4-Methyl-2-pentanol	0.74
4-Methyl-2-pentyl acetate (*S*-MPA)	1.26
4-Methyl-2-pentyl acetate (*R*-MPA)	0.70
α-Pinene	36.26
Camphene	0.48
β-Pinene	2.79
β-Myrcene	tr
α-Phellandrene	tr
α-Terpinene	0.68
Limonene	18.04
p-Cymene	0.95
1,8-Cineole	2.00
α-Terpinolene	0.64
Fenchone	tr
Linalool	4.20
Citronellal	16.10
Geraniol	3.30
Neral	0.42
Terpinen-4-ol	0.49
Aromadendrene	tr
α-Terpineol	0.40
Borneol	1.11
α-Terpinyl acetate	3.89
$C_{15}H_{24}$	tr
$C_{15}H_{24}$	tr
Globulol	2.89
Viridiflorol	0.64
$C_{15}H_{26}O$	tr
$C_{15}H_{26}O$	tr
Eudesmol	0.61
$C_{15}H_{24}O$	tr

tr < 0.1%.

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(2.9%, 2.0–3.9) (Table 1). A number of other mono- and sesquiterpenes present in small (< 3%) or trace (< 0.2%) quantities accounted for 10.4 and 4.2% of the oil, respectively.

Based on the considerable variation in the major constituents, three chemotypes were assigned to *C. uncinatum* oils (Fig. 1); distinct chemical forms also occur in other myrtaceous genera [6]. Type 1 oils were characterized by high citronellal and geraniol contents. Type 2 and 3 oils both contained a high percentage of α-pinene and a low citronellal content; these oils were further differentiated by the high levels of limonene in Type 3. Type 2 oils ($n = 180$) predominated in the assayed populations of *C. uncinatum*, followed by Type 1 ($n = 56$) and Type 3 ($n = 42$). In this context, it is worth noting that the essential oils of the taxonomically related genera *Asteromyrtus*, *Thryptomene* and *Neofabricia* may contain primarily α-pinene [7–9], rather than 1,8-cineole and/or terpinen-4-ol, which dominate the oils in other members (e.g. *Eucalyptus* and *Melaleuca*) of the Myrtaceae [6, 10].

From a biosynthetic perspective, Type 1 is the least complex, favouring production of citronellal, an oxygenated acyclic monoterpene. Types 2 and 3 produce more monoterpene hydrocarbons, with the structurally more complex α-pinene dominating the composition of Type 2 oils. Also interesting is the formation of 4-methyl-2-pentyl acetate, a metabolite only recently isolated from the essential oils of some *Eucalyptus* species [11]. Whereas the *R*-enantiomer predominates in *Eucalyptus* species, the *S*-enantiomer is favoured in *C. uncinatum* (Table 1).

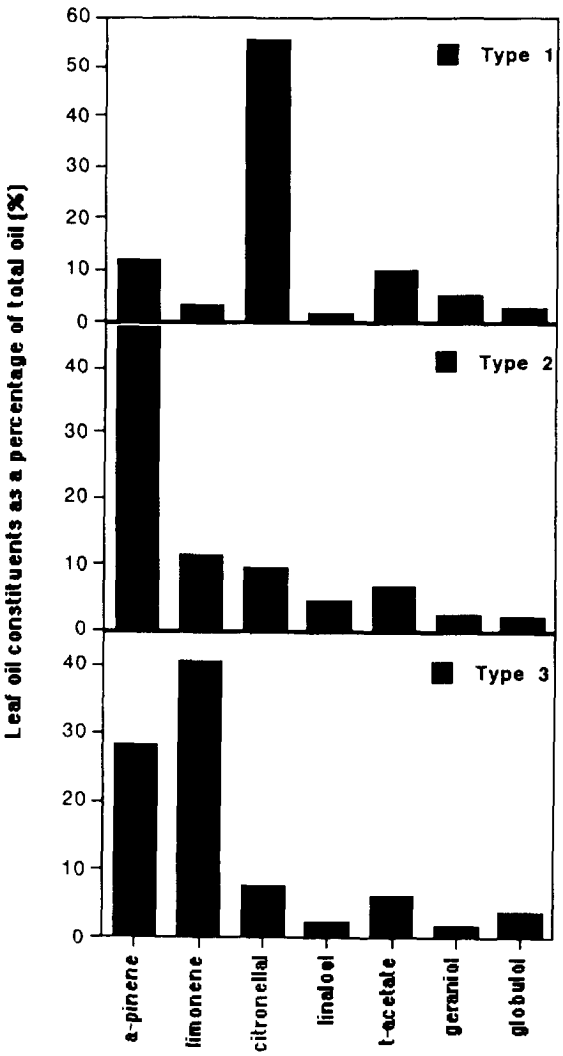

Fig. 1. Major leaf oil constituents as a percentage of the total oil in three chemotypes of *Chamelaucium uncinatum*.

EXPERIMENTAL

Plant material. C. uncinatum Schauer was collected in south-western Australia during 1991 from 44 locations covering the geographic range of the species (27–32°S distance 600 km, 114–116°E, distance 120 km). The material was vegetatively propagated and then planted out in a managed plot at Shenton Park, Western Australia (31°57′S, 115°51′E, 19 m above sea level).

Isolation of leaf oil. Foliage was collected from 278 plants, with 100 g of material from each plant hydrodistilled individually at atmos. pressure until no more oil was seen to be condensing (3 hr).

Analysis. Oil samples were analysed by GC on a Cydex-B column (β-cyclodextrin and Si, 25 m × 0.22 mm i.d.) using 30:1 split injection (injector temp. 240°; FID temp. 250°). The oven temp. was prog. from 75° (isothermal for 5 min) with a ramp of 4° min^{-1} to 220°, ending with a 5 min isothermal at 220°. The identity of compounds was confirmed by co-injection of authentic samples, comparison with GC retention data for standard compounds on two other columns of differing polarity (BP1, OV101) and GC-MS, using identical analytical conditions.

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