Phytochemistry, Vol. 25, No. 7, pp. 1637–1640, 1986.
Printed in Great Britain.

0031-9422/86 $3.00 + 0.00
Pergamon Journals Ltd.

COMPOSITION OF ESSENTIAL OILS OF SOME LIPIDOTE *RHODODENDRONS*

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(*Received* 15 *October* 1985)

Key Word Index—*Rhododendron*; Ericaceae; essential oil; terpenes.

Abstract—Essential oils from leaves of 43 species of *Rhododendron* comprising 21 subsections were generally complex, and contained a number of compounds that were not identified. Caryophyllene, humulene, and one or more eudesmol isomers were the most commonly identified constituents. α-Pinene was the major component in eight of the oils, and germacrone was the major component in five of the oils. Monoterpenes were the major components of the oils in eight of the 12 species of subsection *Triflora* that were examined. Sesquiterpenes were major components in about 80% of the other 31 species.

INTRODUCTION

The foliar scales of the lepidote rhododendrons contain essential oils that may function as insect feeding deterrents or repellents [1, 2]. Some of the compounds present in the oils have been identified with only a few species [1–7], the medicinal plant *R. dauricum* L. being the most thoroughly investigated [5, 7].

Reported below are the results of a study undertaken to learn something about the composition of the essential oils of 43 species of *Rhododendron* representing 21 of the lepidote subsections.

RESULTS AND DISCUSSION

Table 1 lists the compounds detected in the steam distillate from 43 species of *Rhododendron*. The numbers are estimates of percent composition. The essential oils were generally complex and, in most cases, only a fraction of the components could be identified. The most commonly identified compound was caryophyllene, which was found in oils from 23 species. This material has not previously been identified from *Rhododendron*. α-Humulene and the three eudesmol isomers were also common constituents of the volatile fraction.

In general, sesquiterpenes were prominent components of the oils. Germacrone, previously identified from several *Rhododendron* species [2, 4–7] was the major compound from five species representing several taxonomically distinct subsections. β-Elemenone may be a component of some oils, but this compound can also arise as an artifact as germacrone is subjected to gas chromatography [Doss, unpublished]. Monoterpenes were not detected in oils from those species where germacrone was the major compound.

Limonene [6, 7] and menthol [5], previously reported from *R. dauricum*, were not detected in oils from any of the species studied here. Neither were 3-carene, α-phellandrene, nonanal [6] or citronellol detected in any of the extracts.

Among a 12-species sample of subsection *Triflora*, monoterpenes represented the major components with eight species. α-Pinene was the most prominent compound with four of these. Camphene was detected only in oils from this subsection. Sesquiterpene compounds (many unidentified) were the major components of oils from all but two of the species of subsection *Lapponica* that were analysed.

There is controversy concerning the taxonomic treatment of the lepidote rhododendrons [8], and it would be helpful if essential oil profiles could be used chemotaxonomically. Before this will be possible, more complete analysis will be required and many, as yet unidentified compounds, must be characterized. The complexity of the essential oils suggests that they may have taxonomic value at several levels.

EXPERIMENTAL

Plant material. Species were chosen to represent as many subsections as possible. Choice of species within a subsection was made primarily on the basis of availability. Leaves were collected in the spring of 1983 and 1984 from plants growing at the Rhododendron Species Foundation at Federal Way, Washington, USA. Clone numbers are indicated in Table 1. Leaves were stored at −10° until extraction.

Extraction. Essential oils were extracted into hexane using a modified Nielsen–Kryger apparatus [9]. The hexane extract was dried over molecular sieve 4a, and an aliquot was concd so that major compounds would give one-quarter to full scale peaks when subjected to GC under conditions used for the analyses.

Gas chromatography. GC was carried out using 1.9 m × 3 mm glass columns. SP2100 and SP1000 liquid phases were used. Injector and FID were held at 260°. Column temp. was programmed from 60 to 200° with a rate of 7°/min, and initial and final holds of 2 min. Identification was made on the basis of cochromatography with authentic compounds. Although this method of identification was not without possibility of error, it was convenient and inexpensive, and, because liquid phases of

Table 1. Components present in essential oils from 43 *Rhododendron* species

Species	Clone	Subsection	Total peaks	cam-phene	α-pinene	β-pinene	β-myrcene	1,8-cineole
R. *edgeworthii* Hooker	65.383	Edgeworthia	18					
R. *ciliatum* Hooker	65.352	Maddenia	12					
R. *moupinense* Franchet	74.83	Moupinensia	09					
R. *hanceanum* Hemsley	76.34	Tephropepla	03					
R. *tatsienense* Franchet	70.422	Triflora	06		68*	20		
R. *rigidim* Franchet	73.353	Triflora	07					
R. *keiskei* Miquel	76.40	Triflora	13					
R. *concinnum* Hemsley	73.70	Triflora	17	06			27*	
R. *lutescens* Franchet	70.107	Triflora	12					
R. *bauhiniiflorum* Hutch.†	73.26	Triflora	10	20*	05			
R. *trichanthum* Rehder	73.280	Triflora	07		06	15		62*
R. *augustinii* Hemsley	77.207	Triflora	18		16*			
R. *triflorum* Hooker	70.26	Triflora	13			08		
R. *zaleucum* Balf. f. & W. Sm.	65.405	Triflora	13	13	40*			
R. *davidsonianum* Rehd. & Wilson	66.600	Triflora	08		35*	23		
R. *yunnanense* Franchet	70.333	Triflora	11				34*	
R. *scabrifolium* Franchet	70.155	Scabrifolia	03		90*	01	10	
R. *rubiginosum* Franchet	73.130	Heliolepida	15					
R. *carolinianum* Rehder	75.133	Caroliniana	09					
R. *dauricum* L.	66.590	Rhodorastra	11					
R. *chryseum* Balf. f. & Ward‡	75.28	Lapponica	17		19			
R. *hippophaeoides* Balf. f. & Ward	73.135	Lapponica	20					
R. *paludosum* Hutch.§	65.457	Lapponica	09		03	07		
R. *cuneatum* Sm.	65.497	Lapponica	14					
R. *polycladum* Franchet	65.459	Lapponica	16					
R. *nivale* Hooker	76.300	Lapponica	16					
R. *rusatum* Balf. f. & Forr.	73.245	Lapponica	17		20*		06	
R. *impeditum* Balf. f. & W. W. Sm.	76.102	Lapponica	18		11	03	04	
R. *dasypetalum* Balf. f. & Forr.	74.70	Lapponica	12					
R. *intricatum* Franchet	73.144	Lapponica	08					
R. *capitatum* Maxim.	74.64	Lapponica	09		32	47*		
R. *ferrugineum* L.	76.381	Rhododendron	18		20*	15		
R. *micranthum* Turcz	76.399	Micrantha	09			16		
R. *calostrotum* Balf. f. & Ward	66.573	Saluenensia	20					
R. *pemakoense* Ward	70.42	Uniflora	10		06	09		
R. *xanthocodon* Hutch.‖	73.305	Cinnabarina	18					
R. *virgatum* Hooker	65.404	Virgata	11					
R. *glaucophyllum* Rehder	76.98	Glauca	16				20	
R. *glaucophyllum* (var. luteoflorum) Rehder¶	64.114	Glauca	12					
R. *camphylogynum* Franchet	74.62	Camphylogyna	12				08	
R. *lepidotum* Wallich	79.53	Lepidota	13		50	22		
R. *baileyi* Balf	64.146	Baileya	13					
R. *leucaspis* Tagg	65.398	Boothia	03					
R. *rubrolineatum* Balf. f. & Forr.**	76.205	Trichoclada	08		19	14		18

*Largest peak in extract.

†*R. bauhiniiflorum* is considered a variety of *R. triflorum* Hooker by some authors [10].

‡*R. chryseum* is considered a variety of *R. rupicola* W. W. Sm. by some authors [10].

§*R. paludosum* is considered to be the same as *R. nivale* Hooker, subspecies *nivale* by some authors [10].

‖*R. xanthocodon* is considered a subspecies of *R. cinnabarinum* by some authors [10].

¶*R. glaucophyllum* var. *luteiflorum* is considered to be *R. luteiflorum* Cullen by some authors [10].

**R. *rubrolineatum* is considered a variety of *R. mekongense* Franchet by some authors [10].

linalool	α-terpineal	geraniol	caryophyllene	α-humulene	*cis*-neroli dol	*trans*-nerolidol	β-elemenone	γ-eudesmol	α/β-eudesmol	germacrone	farnesol isomers
				02	01		10	01	03	26*	01
			28	05						03	45*
			15						10		
				39							
06	04										
				30	09	06		04	07		01
									02	01	03
			04	06			09		03	05	02
			13	06		18					
				01							
			03				08				
			18								
			24	01		01					01
			08	06							
			02								
			14								
						10	30	01	07	46*	01
			02			01	09	06	11	49*	
			09		14			02	03		
			09	04		18	17	18	19	39*	07
			01	07							
				30*					17		
					02		08	11	09	01	
			03	05		05	08	07		13	03
		15									
	01		08	07		17*	14	05	06	11	02
					06	04		02	14	02	
			06		03				25		
				02							
		01									
			03						09		
			02	11	07	08	04	07	09	08	05
							10	07	03		
			38	02	03	09		08	10		12
								04	07		
			03	09	06	04	05	02	05	28*	
				05	03	60*		02			
			01						03		
			12	09				02			
				04							

greatly different McReynolds constants were used, quite reliable. An electrometer setting of 10^{-9} AFS was used for all analyses.

Acknowledgements—We thank the American Rhododendron Society for financial assistance and the Rhododendron Species Foundation for allowing collection of plant material. Technical help from Mrs. K. R. Riley and Mr. J. K. Christian is appreciated.

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