

Full Length Research Paper

## Variation in the essential oil constituents of *Pteronia incana* (Asteraceae)

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**The essential oil of *Pteronia incana* was collected and was investigated on a monthly basis using GC-MS. The oil volume and its constituents vary greatly with different time of sampling and distillation. The oil contains a high percentage of myrcene  $\alpha$ -pinene,  $\beta$ -pinene with sabinene,  $\alpha$ -terpinene, 1.8 cineole and limonene.**

**Key word:** *Pteronia incana*, Asteracea, essential oil.

### INTRODUCTION

*Pteronia incana* belonging to the Asteraceae family has been regarded as a weed in the Eastern Cape, Republic of South Africa (Webber et al., 1999). The plant cover approximately 60 000 hectares of land and is also regarded as unpalatable to livestock by the farmers in the region. Scientifically it has been demonstrated that plants produce secondary metabolites for defense purposes (Wink 2003; Koschier et al., 2002; Werker et al., 1993; Duke, 1993; Wagner, 1991; Bell, 1981; Reynolds and Rodriguez, 1984; Croteau, 1977). The unpalatability of this plant is believed to be a strategically defense mechanisms against herbivores and microbes. *P. incana* is also regarded as a plant that renders plant cultivation unnecessary, which is commonly required with other plants to increase the area under cultivation (Bruns and Meiertoberens 1987).

Attempt has been made to investigate the essential oil for commercial purposes by Prof. Graven and co-workers at the University of Fort Hare, Alice, South Africa and few main constituents were available from their studies. Our

interest was to investigate the quantity, quality and variation of the oil on monthly bases and try to compare its constituents. This will enhance which month is the best for harvesting this plant either for commercial or research purposes.

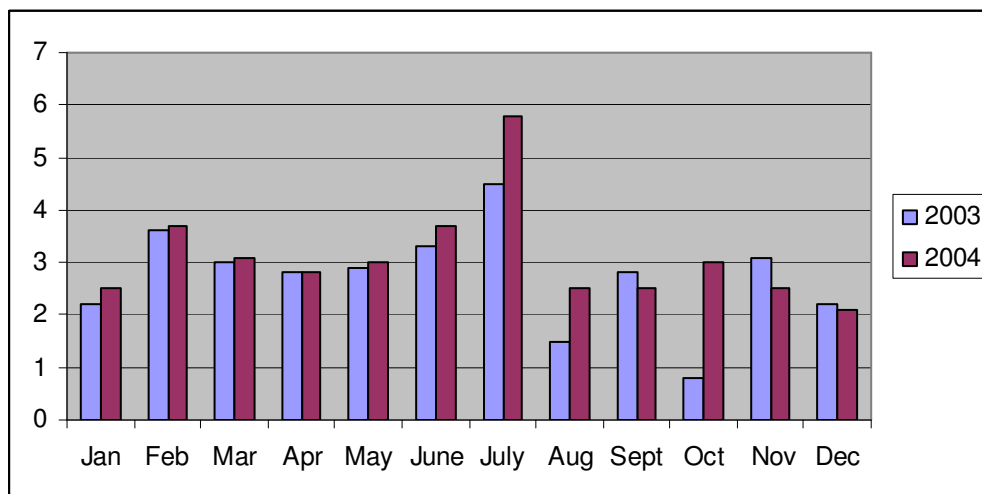
### MATERIALS AND METHODS

*P. incana* was collected in Double Drift Game Reserve of the Eastern Cape of South Africa. The plant was identified at Giffen Herbarium at Fort Hare University in the Eastern Cape. Each month, steam distillation was carried out on 500 g of the leaves of the plant for 2 h. The essential oil product was then collected and was cooled. The oil was analysed on a Hewlett Packard, Series II Gas Chromatograph with a flame ionization mass selective detector and a Hewlett Packard 2971 Series. A HP-5 MS (cross-linked 5% Phenyl Methyl Siloxane) column (30 m x 0.25 mm x 0.25  $\mu$ m film thickness) was used. Helium was used as a carrier gas. Initial temperature was 50°C and accelerated to a temperature of 240°C at a rate of 3°C/min.

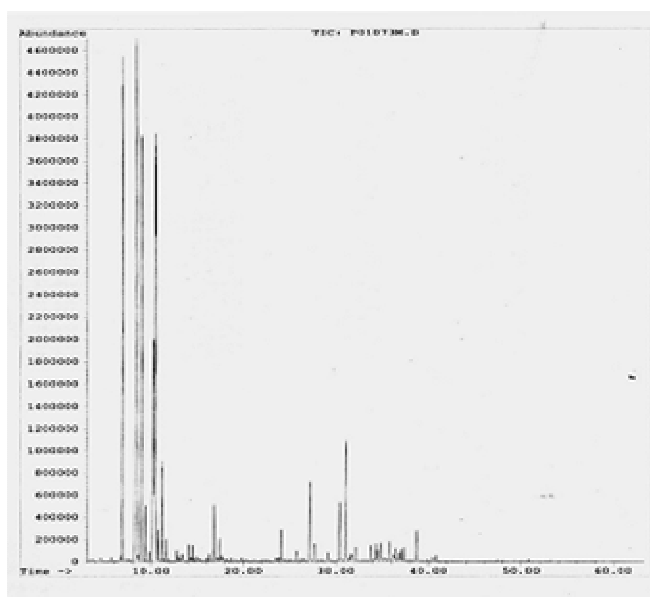
### RESULTS AND DISCUSSION

The essential oil obtained from *P. incana* was pale yellow in colour and had a fragrance somewhat reminiscent of

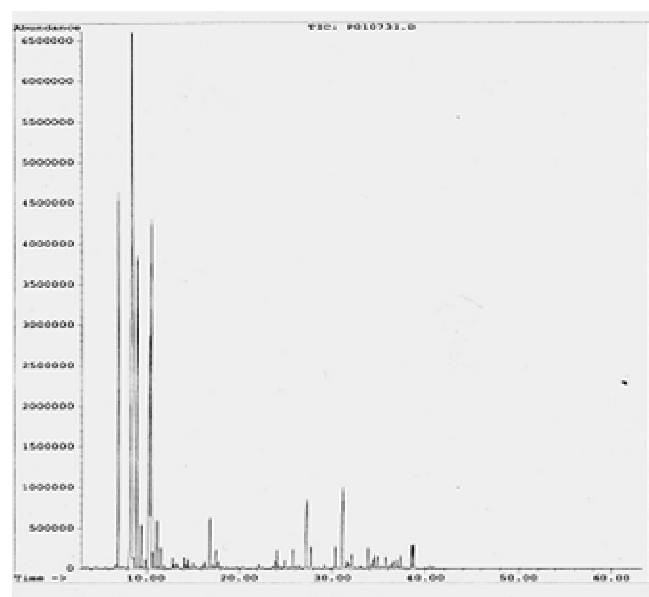
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**Figure 1.** Essential oil yield on a monthly sampling of leaves of *Pteronia incana* for a two year period. Note the volume of the oil (y-axis) was measured in millimeters.



**Figure 2.** Gas chromatogram of essential oil of *P. incana* during the month of December 2003. The main constituents are:  $\alpha$ -pinene, sabinene,  $\beta$ -myrcene, 2 $\beta$ -pinene, d-L-limonene, 1,8-cineole and epi-bicyclosesquiphellandrene.



**Figure 3.** Gas chromatogram of essential oil *P. incana* representing the oil in March 2004, showing the volatile compounds. Main constituents are:  $\alpha$ -pinene, sabinene,  $\beta$ -myrcene, 2- $\beta$ -pinene, 1,8-cineole and 1,3-dioxolo [4,5 -b] acridin-10 (5H)-0

dwarf pine, siber and fir leaf oil. The oil yield appeared to be high during the flowering season; however it is reduced during the drought periods although high volume was obtained in the May to June months (Figure 1).

GC-MS analysis has shown that the spectrum of the essential oil of *P. incana* sample varies with the season of analysis (Figures 2 to 6, Table 1). The GC spectrum of the oil sample in June had the characteristic peaks which appeared throughout the year. These peaks seemed to represent the compounds;  $\alpha$ -pine,  $\beta$ -pinene +  $\beta$ -myrcene, sabinene and 1.8 cineole. However the spectrum of the

samples obtained between March and August appeared to be characterized by the additional terpenoids like,  $\beta$ -thujene, d-L-limonene,  $\alpha$ -terpinene and  $\delta$ -4-carene. It appeared that the source of monoterpene is the oil glands since there is no intracellular structure which is associated with their accumulation. It has been also demonstrated by anatomical and gas chromatographic studies that these monoterpene and other volatile compounds are associated with the cuticular sac. This evidence is also supported by authors in the literature

**Table 1.** Constituents of the essential oil of *Pteronia incana* on a seasonal base.

Compounds	'03 Dec.	% of total oil	RT	'04 Mar.	% of total oil	RT	'04 Jun.	% of total oil	RT	'04 Sept	% of total oil	RT
$\alpha$ -Pinene	x	12.57	6.99	x	12.84	7.00	x	22.34	7.00	x	13.18	7.01
2- $\beta$ -Pinene	x	25.26	8.50	x	36.37	8.56	x	22.20	9.04	x	-	-
$\beta$ -Myrcene	x	16.99	9.05	x			x			-	-	-
Sabinene	x			x			-	-	-	-	-	-
Benzene, 1-menthyl-2-(1-methylethyl)	x	11.56	10.31	x	14.93	10.37	x	27.80	10.35	x	11.81	10.38
1,8-Cineole	x	16.16	10.58	x	12.10	10.55	x	24.78	10.59	x	20.07	10.64
1,3-Dioxolo[4,5-b]acridin-10(5H)-O	-	-	-	x	8.62	10.63	-	-	-	-	-	-
$\alpha$ -Thujene	-	-	-	-	-	-	x	2.88	9.43	x	0.72	9.43
1-Phellandrene	x	0.89	9.42	-	-	-	x			x		
Trans- $\beta$ -Farnesen	x	1.03	38.75	-	-	-		-	-	-	-	-
$\beta$ -Bisabolene	x											
Iso-bisabolene	x	0.23	36.48	-	-	-	-	-	-	-	-	-
1,4,4-TRIMETHY-BICYCLO(3.1.0)HEXA	x											
$\beta$ -Thujene	-	-	-	-	-	-	-	-	-			
2- $\beta$ -Pinene										x	23.30	8.52
$\alpha$ -Terpinene	x	0.19	9.88	-	-	-	-	-	-	x	0.25	9.89
DELTA.-4-Carene	x	1.17	11.19	-	-	-	-	-	-	x	0.83	10.78
Gamma.-Terpinene	x	0.28	11.58							x	0.39	11.20
$\alpha$ -Terpinolene	x	0.18	12.82							x	0.21	12.83
1- $\alpha$ -Terpineol	-	-	-	-	-	-	-	-	-			
3-Cyclohexene-1-methanol, $\alpha$										x	0.21	16.34
Linalyl propionate	x	0.40	17.43	-	-	-	-	-	-	x	0.62	17.46
1,4,6-HEPTATRIENE	x	-	-	-	-	-	-	-	-			
1,3,6-2,6,6-	x									x	0.44	24.11



Cont. Table 1.

. $\beta$ . -Bisabolene	x	1.03	38.75	-	-	-	-	-	-	-	x	1.35	38.77
. $\beta$ - Farnesene	x												
. $\alpha$ . -Bergamotene													
. $\beta$ -Ocimene	x	0.38	10.76	-	-	-	-	-	-	-	-	-	-
. $\alpha$ -PINENE	x												
Linalool	x	0.29	13.36	-	-	-	-	-	-	-	-	-	-
. $\beta$ .-Myrcene	x												
Octanoic acid, methyl ester	x	0.24	14.48	-	-	-	-	-	-	-	-	-	-
3-Cyclohexene-1-methanol, $\alpha$	x												
LINALOOL OXIDE (2)	x	0.19	16.33	-	-	-	-	-	-	-	-	-	-
1- $\alpha$ .-tERPINEOL													
Isoterpinolene	x	0.32	24.10	-	-	-	-	-	-	-	-	-	-
GAMMA.ELEMENE	x												
Germacrene B		1.60	31.08										
1,4,6-HEPTATRIENE-3,3,6-TRIMETHYL	x												
Clovane	x	0.42	31.53	-	-	-	-	-	-	-	-	-	-
Phenol, 4-(methylthio)-	x	1.37	34.58	-	-	-	-	-	-	-	-	-	-
8 -Acetyl-3,3-epoxymethano-6,6,7-tr	x												
dl -Limonene	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyclopropane, 1,1-dimethyl-2-(3-me	-	-	-	-	-	-	-	-	-	-	-	-	-

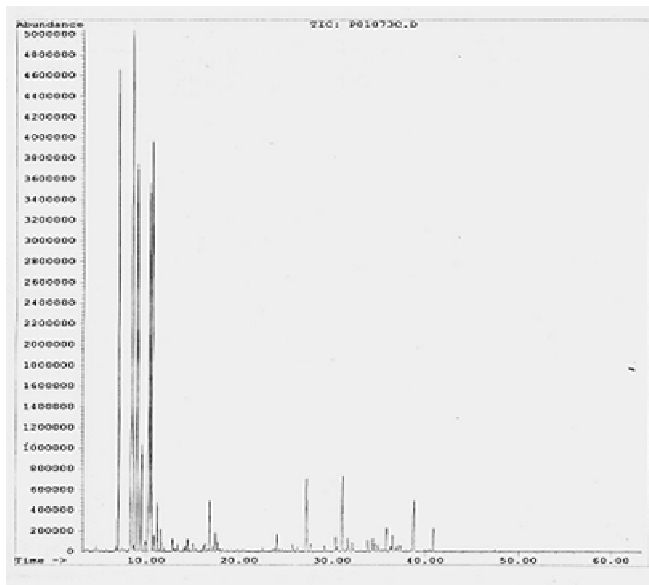
x represents the availability of that constituent in that mouth.

- represent the non-availability of the constituent on that mouth.

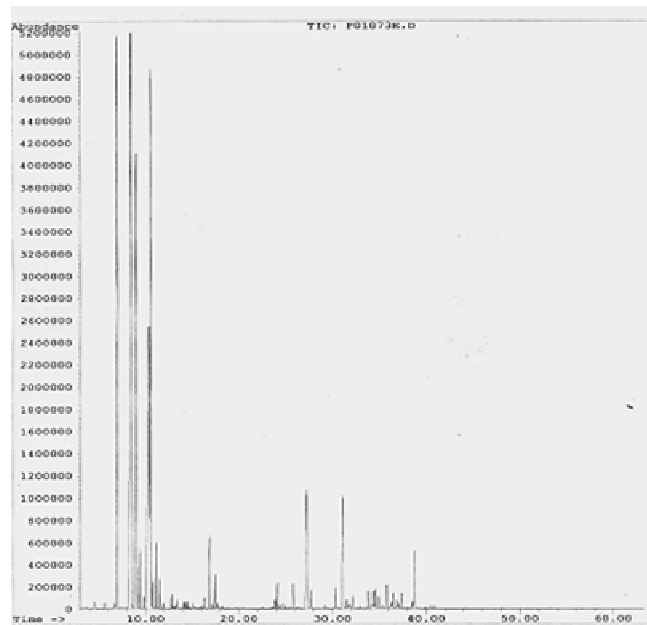
RT = Retention time

'03 = represent year 2003

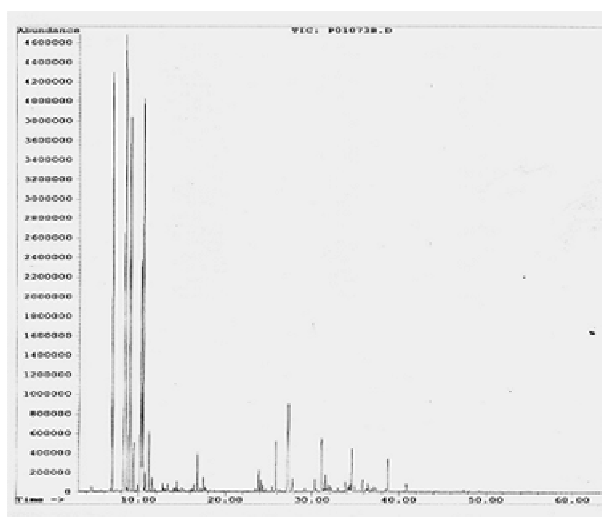
'04 = represent year 2004



**Figure 4.** Gas chromatogram of essential oil *P. incana* representing the oil in June 2004. The main volatile compounds,  $\alpha$ -pinene,  $\beta$ -myrcene, 2- $\beta$ -pinene 1,8-cineole,  $\alpha$ -thu



**Figure 6.** Gas chromatogram of essential oil *P. incana* representing the oil in December 2004, showing the volatile compounds. Main constituents are:  $\alpha$ -pinene,  $\beta$ -pinene  $\beta$ -thujene,  $\alpha$ -terpinene,  $\delta$ -4-carene, 1,8-cineole and  $\beta$ -bisabolene.



**Figure 5.** Gas chromatogram of essential oil *P. incana* representing the oil in August 2004, showing the volatile compounds. Main constituents are:  $\alpha$ -pinene,  $\beta$ -myrcene, 2 $\beta$ -pinene, 1,8-cineole, sabinene,  $\delta$ -3-carene, germacrene b and  $\beta$ -farnesene.

(Valant-Vetschera et al., 2003; Tan et al., 2002; Theimer, 1984; Hammond and Mahlberg, 1977; Schnepf, 1974).

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