African Journal of Botany Vol. 1 (3), pp. 035-040, August, 2013. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

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

B. Mayekiso[1], M.L Magwa [2] and R.M Coopoosamy[1]*

[1]Department of Botany, [2]Electron Microscopic Unit, University of Fort Hare, Private Bag X1314, ALICE, 5700, Eastern Cape, South Africa

Accepted 10 May, 2013

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 α-pinene, β-pinene with sabinene, α-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 Hewlet 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 μ 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

*Corresponding author. E-mail: rcoopoosamy@ufh.ac.za Tel: +27 40 602 2325. Fax: +27 40 602 2323.

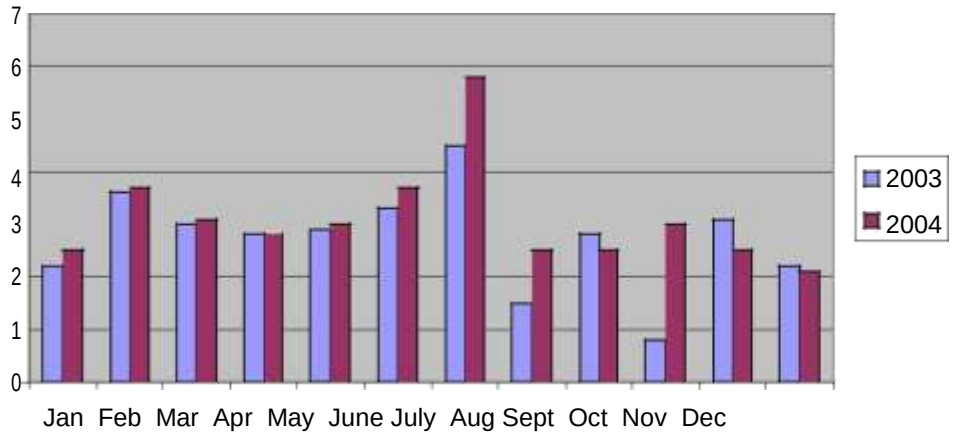

Figure 1. Essential oil yield on a monthly sampling of leaves of *Pteronia incana* for a two year period. Note the volume of the oil (y-axis) was measured in millimeters.

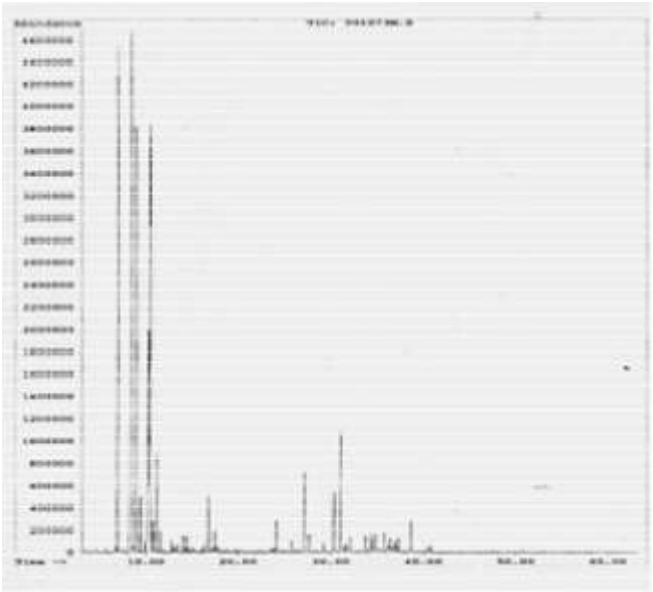

Figure 2. Gas chromatogram of essential oil of *P. incana* during the month of December 2003. The main constituents are: α-pinene, sabinene, β-myrcene, 2β-pinene, d-L-limonene, 1,8-cineole and epi-bicyclosesquiphellandrene.

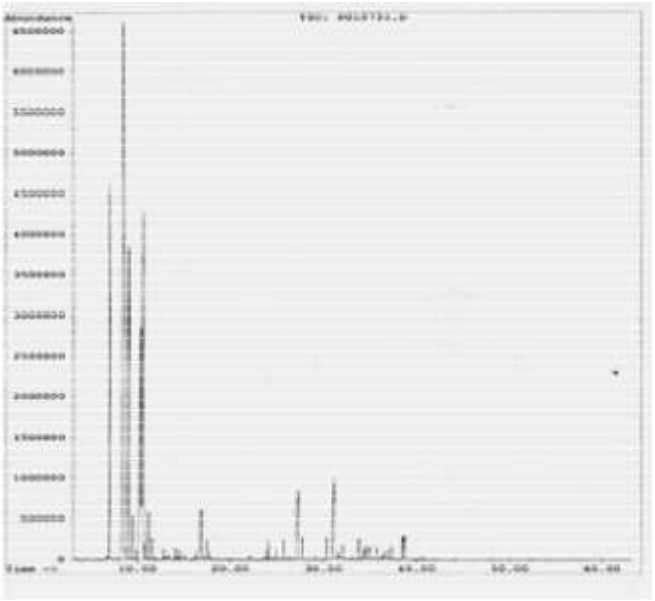

Figure 3. Gas chromatogram of essential oil *P. incana* representing the oil in March 2004, showing the volatile compounds. Main constituents are: α-pinene, sabinene, β-myrcene, 2-β-pinene, 1,8-cineole and 1,3-dioxolo [4,5 –b] acridin-10 (5H)-0

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; α-pine, β-pinene + β-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, β-thujene, d-L-limonene, α-terpinene and δ-4-carene. It appeared that the source of monoterpene is the oil glands since there is no intracellular structure which is associated with their accummulation. 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
α-Pinene	x	12.57	6.99	x	12.84	7.00	x	22.34	7.00	x	13.18	7.01
2-β-Pinene	x	25.26	8.50	x	36.37	8.56	x	22.20	9.04	x	-	-
β-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	-	-	-	-	-	-
α.-Thujene	-	-	-	-	-	-	x	2.88	9.43	x	0.72	9.43
1-Phellandrene	x	0.89	9.42	-	-	-	x			x		
Trans-.β.-Farnesen	x	1.03	38.75	-	-	-		-	-	-	-	-
β.-Bisabolene	x											
Iso-bisabolene	x	0.23	36.48	-	-	-	-	-	-	-	-	-
1,4,4-TRIMETHY-BICYCLO(3.1.0)HEXA	x											
β -Thujene	-	-	-	-	-	-	-	-	-			
2-β-Pinene										x	23.30	8.52
α.-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
α.-Terpinolene	x	0.18	12.82							x	0.21	12.83
1-α.-Terpineol	-	-	-	-	-	-	-	-	-			
3-Cyclohexene-1-methanol, α										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.

5,7-Dimethoxy-1-naphthol	-	-	-	-	-	-	-	-	-	
α-Gurjunene										x
2-(3'-(2','-Dimethylpyridyl)										
Benzene, 1,2-dimethoxy-				-	-	-	-	-	-	
4(2-propen)	x	3.43	27.28							x
trans-Caryophyllene	x	0.34	27.72	-	-	-	-	-	-	
Cis-CARYOPHYLLENE										x
EPI-				-	-	-	-	-	-	
BICYCLOSESQUIPHELL	x	30.37	0.34							
ANDRENE										x
1,4,6-HEPTATRIENE,		-	-	-	-	-	-	-	-	
2,2,6-TRIMETHYL	x									x
.delta.-Cadinene	x			-	-	-	-	-	-	
CADINENE	x	0.57	23.84							x
d-Nerolidol	x	0.29	33.83	-	-	-	-	-	-	x
NEROLIDOL ISOMER	x									
(-)-Spathulenol	x	0.26	34.37	-	-	-	-	-	-	x
2H-3,9a-Methanol-1-	-	-	-	-	-	-	-	-	-	x
benzoxepin										
7-Amino-1,4-										
dimethylpyrimido[4,5-c										
VERIDIFLOROL	-	-	-	-	-	-	-	-	-	
GLOBULOL										x
EPIGLOBULOL										
.beta.-Bisabolene	-	-	-	-	-	-	-	-	-	
Z-Citral										x
(1'R)-4-(1',5'-				-	-	-	-	-	-	
DIMETHYHEX-4'-ENYL	x	0.39	34.58							
3-Cyclohexene-1-										
methanol, α	x	1.0.5	17.43							x
1H-3a,7-										
Methanoazulene,2,3,4,7,8										
Bicyclo[2.2.1]heptane,2-	x	0.34	30.37	-	-	-	-	-		
ethyliden										x
Phenol,2-(1,1-										
dimethylethy)-4-me										

Cont. Table 1.

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

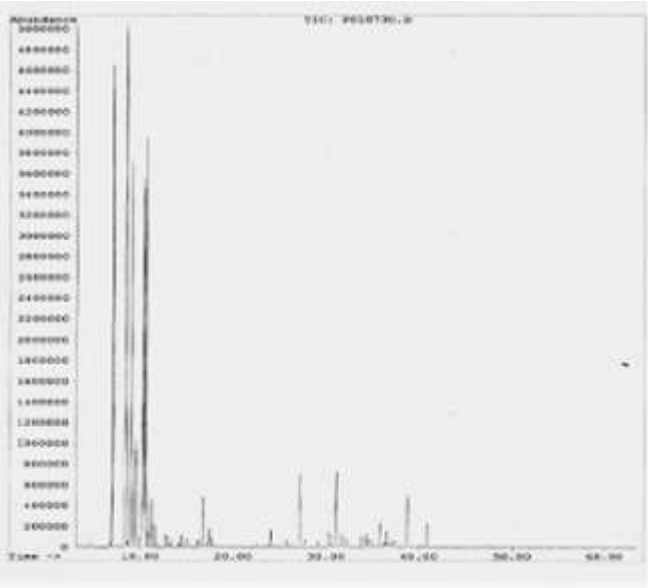

Figure 4. Gas chromatogram of essential oil *P. incana* representing the oil in June 2004. The main volatile compounds, α-pinene, β-myrcene, 2-β-pinene 1,8-cineole, α-thu

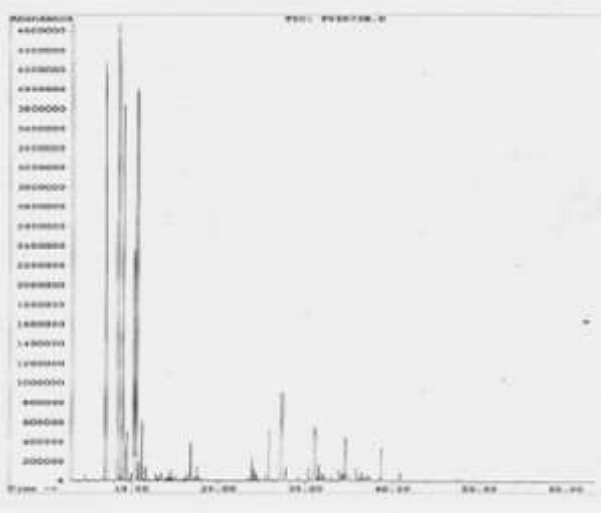

Figure 5. Gas chromatogram of essential oil *P. incana* representing the oil in August 2004, showing the volatile compounds. Main constituents are: α-pinene, β -myrcene, 2β-pinene, 1,8-cineole, sabine, δ-3-carene, germacrene b and β-farnesene.

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

ACKNOWLEDGEMENTS

We gratefully acknowledge the National Research Foundation for financial support and the University of Fort Hare for allowing us to use the electron microscopy unit (EMU), the GC- MS for essential oil analysis.

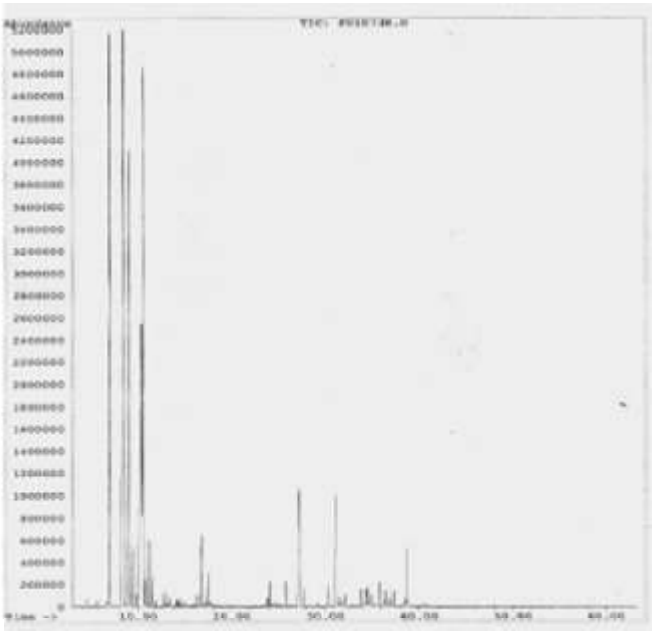

Figure 6. Gas chromatogram of essential oil *P. incana* representing the oil in December 2004, showing the volatile compounds. Main constituents are: α-pinene, β-pinene β-thujene, α-terpinene, δ-4-carene, 1,8-cineole and β-bisabolene.

REFERENCES

Bell EA (1981). The physiological roles of secondary (natural) products. In: Stumpf PK Corn EE, Eds. The biochemistry of plants: A comprehensive treatise. Vol. 7. Secondary plant products. New York: Academic press. 1 – 19.

Bruns K, Meiertoberens (1987). Volatile constituents of *Pteronia incana* (compositae). Flower and Fragrance J. 2: 157 -162.

Crotean R (1977). Site of monoterpene biosynthesis in *Majorana lortensis* leaves. Plant Physiology 59: 519 - 520

Duke OS, Paul NR (1993). Development and fine structures of the glandular trichome in *Artemisia* Annua L. Int. J. Plant. Sci. 154 (1): 107-118.

Hammond CT, Mahlberg PG (1977) Morphogenesis of capitate glandular hairs in *Cannabis sativa* (Compositae). Am J Bot 64: 1023-1031.

Johansen DA (1940). Plant Microtechnique. McGraw - Hill, New York.

Koschier EH, Sedy KA (2003). Labiate essential oil affecting host selection and acceptance of *Thrips tabaci* lindeman. Crop protection 22: 929 -934.

Rodriguez E, Healy PL, Mehta I (1984). Biology and chemistry of plant trichomes. Plenum Press. New York.

Schnepf E (1974). Gland cells. Pages 331-353 in AW Robards, (Eds). Dynamic aspects of plant ultrastructure. McGraw-Hill, London.

Tan N, Kaloga M, Radtake OA, Kiderlen AF, Oksuz S, Ulubelen A, Kolodziej H (2002). Abietane diterpenoids and triterpenoic acid from *Salvia cilicia* and their antileishmanial activities. Phytochemistry 61: 881–884.

Theimer E (1989). Grolier electronic encyclopedia (electronically). Grolier Interactive Inc. 330-340.

Valant–Vetschera KM, Roitman JN, Wollenweber E (2003). Chemodiversity of exudates flavonoids in some members of the Lamiaceae. Biochemical Systematics and Ecology 31: 1279 –1289.

Wagner GJ (1991). Secreting glandular trichomes more than just hairs. Plant Physiology 96: 675 -679.

Webber LN, Magwa ML, Van Staden J (1999). Alternative uses for some invader plants: Turning liabilities into assets. South African Journal of Science 95: 329-331.

Werker E, Ravid U, Putievsky E, Dudai N, Katzer I (1993). Glandular Hairs and Essential oil in Developing leaves of *Ocimum basilicum L*. Annals of Botany 71 : 43-50.
Wink M (2003). Evolution of secondary metabolites from an ecological and molecular phylogenetic perspective. Phytochemistry 64, 3 – 19.