

TERPENOIDS OF THE ESSENTIAL OIL OF EUCALYPTUS

RAMESHWAR DAYAL* AND M.L. MAHESHWARI**

Introduction

Eucalyptus (Family : Myrtaceae) is a large genus of evergreen aromatic trees. A large number of species are being grown now in India. These trees are mainly used as raw material for paper and pulp industry and to some extent for essential oil and tanning materials. The essential oils are obtained by hydro-distillation of leaves and are of commercial value. *Eucalyptus* oil may be grouped under (1) Pharmaceutical or medicinal oils (from *E. sideroxylon*, *E. leucoxylon*, *E. elaeophora*, *E. globulus* and *E. smithii*) (2) Industrial oils (from *E. dives*) and (3) Perfumery oils (CSIR, 1952) (from *E. citriodora* and *E. macarthuri*). Two hybrids namely FRI-4 (*E. tereticornis* X *E. camaldulensis*) and FRI-5 (*E. camaldulensis* X *E. tereticornis*) developed at this Institute (Venkatesh and Sharma, 1977) are potentially very high wood yielding hybrid tree varieties. In order to find the industrial use of their oils a comparative chemical study of the essential oils of two hybrids their parents and two other species i.e. *E. deglupta* and *E. robusta* was taken up.

Materials and Methods

The leaves collected during September, 1983 from trees growing

in the Forest Research Institute Campus, were dried in shade and distilled by hydro-distillation method. The oils thus obtained were dried over anhydrous sodium sulphate and their physicochemical characteristics were determined. Results are given in Table 1.

The chemical composition of the oils was examined by Gas Liquid Chromatography. The components were identified by comparing their retention values with those of authentic compounds under varying conditions.

Gas Liquid Chromatography

The GLC of the oils was performed over Hewlett Packard Gas Chromatograph Model 5835A equipped with Carbowax (10% 20 M) column (8') FID detector and a Printer Plotter. The programming was as follows :

| | |
|---------------------|------------|
| Temp. 1 | 90°C |
| Time 1 | 15 minutes |
| Rate | 30°/min |
| Temp. 2 | 180°C |
| Time 2 | 30 minutes |
| N ₂ flow | 34 ml/min |

Results and Discussion

As shown in Table 1 both the hybrids have given reasonably

* Minor Forest Products Branch, F.R.I. & Colleges, Dehra Dun.

** National Bureau of Plant Genetic Resources, IARI Campus, New Delhi.

Table 1

Oil contents and physico-chemical characteristics of essential oils from Eucalyptus species

| Sl. No. | Name of the species | % of oil (w/w) | nD ^{19°} | Sp. Gr. at 20° | Acid Value |
|---------|-------------------------|----------------|-------------------|----------------|------------|
| 1. | <i>E. camaldulensis</i> | 1.37 | 1.4900 | 0.9090 | 1.78 |
| 2. | <i>E. tereticornis</i> | 0.95 | 1.4845 | 0.8796 | 2.90 |
| 3. | FRI - 4 | 1.84 | 1.4970 | 0.9250 | 2.17 |
| 4. | FRI - 5 | 1.17 | 1.4885 | 0.9167 | 1.12 |
| 5. | <i>E. robusta</i> | 1.70 | 1.5600 | 0.9610 | 1.03 |
| 6. | <i>E. deglupta</i> | 0.26 | 1.4840 | 0.9354 | 1.58 |

good percentage of oil. Except *E. deglupta*, other tree species have also shown higher oil contents than reported in literature *E. camaldulensis*: 0.27%, *E. tereticornis*: 0.50%, *E. robusta*: 0.16%). In the earlier reports 7 compounds viz. α -pinene, β -pinene, α -terpinene, terpinyl acetate, p-cymene, cineole and phellandrene have been reported in *E. tereticornis* (Shiva *et al.*, 1984), 13 compounds viz. p-cymene, phellandrene, cuminal, phellandral, geraniol, cineole, α -pinene, β -limonene, isoamyl alcohol, isovaleric alcohol, cryptal, piperitone and linalool from *E. camaldulensis* (CSIR, 1952), 6 compounds viz. isovaleraldehyde, α -pinene, α -phellandrene, p-cymene, ocimene and neralidol in *E. deglupta* (Penfold & Willis, 1961) and 3 compounds viz. α -pinene, cineole and α -phellandrene in *E. robusta* (Penfold & Willis, 1961). The hybrids FRI-4 and FRI-5 (crossing of first two species) have

been examined for the first time by us and chemical composition are compared with those of above four species (Table 2). Out of 23 components, 15 compounds i.e., α -pinene, camphene, β -pinene, phellandrene, limonene, cineole, γ -terpinene, p-cymene, citronellal, linalool, terpine-1-ene-401, citronellyl acetate, borneol, α -terpineol and piperitone have been identified and their percentages are given in Table 2.

Conclusion

This is first report of the occurrence of these compounds in the essential oils of FRI-4 and FRI-5 and it may be concluded that the oils of FRI-4 and FRI-5 may not be used for industrial purposes.

Table 2
Gas Chromatographic Composition of Different Eucalyptus Oils

| Name of analytical species | α-Pinene | Camphene | β-Pinene | Thiolindrene | Limonene | Terpene (18H) | γ-Terpinene | p-Cymene | Citronellol | Indanone | Terpene (19H) | Terpene (20H) | Terpene (21H) | Terpene (22H) | Terpene (23H) | Terpene (24H) | Terpene (25H) | Terpene (26H) | Terpene (27H) | Terpene (28H) | Terpene (29H) | Terpene (30H) | |
|-------------------------------|----------|----------|----------|--------------|----------|---------------|-------------|----------|-------------|----------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|-------|
| <i>E. camaldulensis</i> | 0.06 | 0.08 | 10.25 | 1.42 | 0.82 | 1.65 | 0.20 | 0.53 | 1.93 | 0.57 | 3.28 | 10.30 | 6.12 | 3.97 | 2.20 | 6.05 | 7.87 | 2.66 | 6.20 | 3.95 | 7.77 | 6.56 | 5.73 |
| <i>E. nitens</i> | 2.87 | 0.04 | 2.5 | 1.76 | 0.53 | 0.15 | 1.18 | 0.56 | 0.92 | 0.13 | 2.03 | 6.10 | 5.17 | 1.20 | 6.21 | 4.11 | 1.50 | 1.63 | 1.03 | 1.03 | 1.46 | 6.24 | 13.18 |
| <i>E. globulus</i> | 13.16 | 0.11 | 1.95 | 2.07 | 0.97 | 7.20 | 0.15 | 0.65 | 0.68 | 0.43 | 1.19 | 5.01 | 5.76 | 3.30 | 3.84 | 3.16 | 3.25 | 2.04 | 2.07 | 1.50 | 5.80 | 5.80 | 7.62 |
| <i>E. teretifolia</i> | 6.65 | 0.46 | 5.50 | 0.60 | 11.70 | 0.36 | 9.57 | 6.22 | 0.80 | 0.10 | 2.57 | 4.75 | 9.20 | 2.20 | 5.25 | 1.07 | 1.00 | 0.94 | 0.94 | 0.87 | 1.07 | 6.37 | 1.00 |
| <i>E. globulus</i> | 3.25 | 0.05 | 1.10 | 2.59 | 0.50 | 0.75 | 0.20 | 7.90 | 0.23 | 0.56 | 0.80 | 3.21 | 0.71 | 1.57 | 2.51 | 5.64 | 1.23 | 13.18 | 1.00 | 3.78 | 28.10 | 3.90 | 0.54 |
| <i>E. nitens</i> | 0.28 | 0.01 | 0.02 | 0.05 | 0.06 | 0.34 | 0.17 | 0.65 | 0.49 | 0.29 | 1.10 | 3.80 | 2.09 | 3.55 | 0.00 | 5.99 | 11.37 | 1.75 | 1.85 | 1.33 | 4.66 | 21.78 | 1.77 |

Acknowledgement

The authors express their deep sense of gratitude to Shri R.S. Mathur, I.F.S., Director, Forestry Research and Shri N.K. Gulati, I.R.S., Officer-in-Charge, M.F.P. Branch, F.R.I. & Colleges, Dehra Dun for encouragement.

Summary

The essential oils obtained from the leaves of two hybrids namely FRI-4, FRI-5 and from *E. camaldulensis*, *E. tereticornis*, *E. deglupta* and *E. robusta* were analysed by GLC. Fifteen compounds viz. α -pinene, camphene, β -pinene, phellandrene, limonene, cineole, γ -terpinene, p-cymene, citronellal, linalool, terpin-1-ene-4-Ol, citronellyl acetate, borneol, α C-terpineol and piperitone in varying ratios have been identified in all of them. Physico-chemical properties of the oils have also been determined.

युकेलिप्टस के उत्पन्न तेल के टपिनायड
रामेश्वर दयान व एम० के० महेश्वरी

खाराख

दो संकरो एफ आर आई - 4, एफ आर आई-5 तथा यु० कैमेलदुलेंसिस, यु० टेरेटिकॉनिस, यु० डेग्लुप्टा और यु० रोबस्टा की पत्तियों से निकाले गए उत्पन्न तेल का जीएलसी रीति से विश्लेषण किया गया। सभी में से विभिन्न अनुपातों में ये 15 जैविक पहचाने गए एक्स - पाइनीन, कैम्फीन, बी पाइनीन, कैलाड्रीन, लाइनोमीन, सिनियोल, एक्स - टपिनीन, पी० सायमीन, साइट्रोनीलॉन, लाइनालूल, टपिन-लीन 401, साइट्रोनीलाइन एसिटेट, हानियोल, एक्स-टपिनियोल और पाइरेरिटोन। तेलों की भौत-रासायनिक विशिष्टताएं भी विनिश्चित की गई।

References

- CSIR (1952). The Wealth of India, Raw Materials, New Delhi, 3 : 205.
- CSIR (1952). The Wealth of India, Raw Materials, New Delhi, 3 : 206.
- Penfold, A. P. and J. L. Willis (1961). The Eucalyptus, Botany, Cultivation, Chemistry and Utilisation, Inter Science Publishers, Inc. New York, p. 276.
- Shiva, N. P., G. S. Paliwal, K. Chandra and M. Mathur (1984). Pinene rich essential oil from *Eucalyptus tereticornis* leaves from Terai and Bhabar areas of Uttar Pradesh. *Indian For.* 23: (1) : pp. 110.
- Venkatesh, C. S. and U. K. Sharma (1977). Rapid growth rate and higher yield potential of Heterotic *Eucalyptus* species hybrids FRI-4 and FRI-5. *Indian For.* 103 (12) : pp. 795.