Aromatic Components of the Leaves of the New Zealand Lemonwood Tree *Pittosporum eugenioides*

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The major aromatic components of the essential leaf oil of the New Zealand lemonwood tree *Pittosporum eugenioides* are octyl acetate (33%), terpinen-4-ol (13%), decanol (6%) and (*Z*)-hex-3-enol (5%). These products are responsible for the characteristic *Citrus*-like aroma which is detected when the leaves are crushed, a phenomenon which provided the species with its common name. The major component of the oil, octyl acetate is also an abundant component of the essential oils of *Heracleum* and *Boswellia* species.

Key words: *Pittosporum eugenioides*, Essential Oil, Octyl Acetate

Introduction

Pittosporum eugenioides A. Cunn. (Pittosporaceae), commonly called the lemonwood tree (Maori name, Tarata) is found in lowland forest throughout New Zealand where it is endemic. The Tarata, when full grown, is the largest *Pittosporum* species in New Zealand. Its leaves, when crushed, emit a strong lemon-like aroma, which is unique in the endemic flora and characteristic of the species, and this attribute gave rise to its common name. The author recently described the composition of the essential oils from the leaves of seven New Zealand species of the genus *Pittosporum* (Weston, 2003). The composition of Tarata leaf oil is discussed in more detail in the present paper, in view of the unique fragrance of the leaves and the former cultural use of the oil by the native Maori people of New Zealand (Colenso, 1869).

Materials and Methods

Plant material

Leaf material was collected in March (late summer to early autumn) from one specimen of *Pittosporum eugenioides* which was located in the Otari Native Plant Reserve, Wellington, where documentation for the specimen is held.

Isolation of leaf oil

The fresh leaves (0.5 kg) were covered with water (4 l), which was boiled for 5 h and the oil was isolated by hydrodistillation. The distillate was extracted with dichloromethane (3 × 100 ml) and the organic solution was then concentrated to approximately 200 ml on a rotary evaporator, at 40 °C and atmospheric pressure. It was dried over magnesium sulfate and the solvent was then completely removed on a rotary evaporator, at 40 °C and atmospheric pressure.

Analysis of oil composition

Combined gas chromatography and mass spectrometry was carried out on a Hewlett-Packard (HP) 5890 gas chromatograph coupled to a HP 5970 mass selective detector, using the following conditions: column, HP-Ultra 2 (5% methylphenylsilicone), 30 m × 0.2 mm with film thickness 0.33 μm; carrier gas (He), flow rate of 75 ml/min with split 75:1; injector temperature, 285 °C; transfer line, 300 °C; temperature program, 60 °C (1 min), 10 °C/min to 150 °C, 3 °C/min to 220 °C and 15 °C/min to 300 °C. Mass spectrometry was performed at 70 eV and 2.5 scans/s from *m/z* 41 to 350. The oil composition was determined from the mass spectral total ion chromatogram, which was integrated using the HP Standard ChemStation software, version A.03.00. The chromatogram obtained by FID was very similar to that shown in Fig. 1. Only those components of the leaf oil which exceeded 1% in abundance were recorded and to the nearest 1% as leaf material was taken from only one specimen which may not have been truly representative of the species. Components were identified by comparison of their retention indices (RI) and mass spectra with those recorded by Adams (2001).

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Discussion

Composition of Tarata oil

The aroma of its crushed leaves is a unique property of the lemonwood tree. The *Citrus*-like aroma is unusual outside that genus. Exceptions are the oils from *Cymbopogon* and *Verbena* species. Oils from plants of these genera all contain significant proportions of limonene, neral, geranial, decanal and linalool. Several medium chain alcohols, aldehydes and esters also have a *Citrus* aroma (Heath, 1978) and contribute such a fragrance to numerous essential oils. The present work was carried out to determine whether these same compounds were responsible for the aroma of Tarata leaves.

Carter and Heazlewood (1949) researched the composition and properties of the essential oil from Tarata leaves prior to the advent of gas chromatography. They identified few components, among which were nonane, sabinene and limonene, and indicated that the oil was unique in view of the high level (60%) of nonane which it contained. The leaf oil was examined again recently (Weston, 2003) and was found to contain only 0.7% nonane, 0.5% sabinene and limonene was not detected. The disparity between the levels of nonane detected in the previous and present work may be due to the existence of chemotypes but that possibility has not yet been researched.

A total ion chromatogram of the leaf oil of Tarata is shown in Fig. 1. The major component of the oil was octyl acetate (33%) and the three other significant components were terpinen-4-ol (13%), decanol (6%) and (*Z*)-hex-3-enol (5%). Other minor components, which exceeded 1% in abundance, in order of elution were hexanol (1%), β-pinene (1%), (*Z*)-hex-3-enyl acetate (1%), terpinolene (1%), linalool (1%), heptyl acetate (2%),

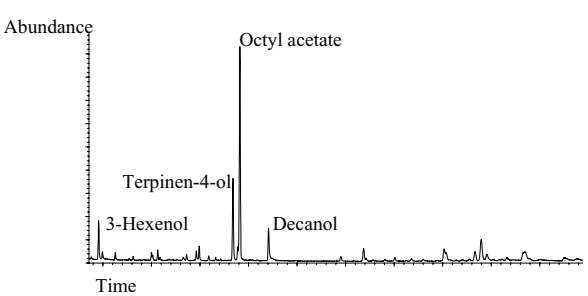

Fig. 1. Total ion chromatogram of the essential oil of *Pittosporum eugenioides*.

α-terpineol (2%), decyl acetate (1%), aromadendrene (3%), elemol (3%), nerolidol (2%), and a group of four sesquiterpene alcohols which could not be identified (Weston, 2003). All these compounds, except elemol, are known components of *Citrus* oils and most contributed a *Citrus* note to Tarata oil. However, the four major components dominated the perceived fragrance of Tarata oil and of these, octyl acetate was the most abundant. This ester occurs in all *Citrus* oils but only as a very minor component. It has a fruity, floral aroma, "recalling that of orris with a backing of orange and jasmine" (Poucher, 1974), but not one, which is strongly characteristic of *Citrus*, as is limonene and neral (see above). The identification of octyl acetate as the major component of Tarata leaf oil was therefore unexpected and remarkable.

Occurrence of octyl acetate

Octyl acetate is a rare natural product but a major component of the essential oils of various parts of *Heracleum* (Apiaceae) species, *e.g.* 75% of the seed oil of *H. antasiaticum* (Dzhaparidze, 1977), 72–77% of the fruit oil of *H. platytaenium* (Kurkcuoglu *et al*., 1995), 43% of the fruit oil of *H. ponticum* (Tkachenko and Kozhin, 1983), 31.5% of the fruit oil of *H. paphlagonicum* (Baser *et al*., 2000) and other *Heracleum* species (Tkachenko, 1987 and 1993). The trunks of *Boswellia* (Burseraceae) species yield a resinous gum, commonly known as Olibanum or Frankincense from which an essential oil is obtained that also contains a large proportion of octyl acetate, *e.g.* 52% in the oil from Eritrea resin (Obermann, 1977), 50% in the oil from *Boswellia carterii* (Vernin *et al*., 1990), 56% in the oil of Frankincense from *Boswellia papyrifera* (Dekebo *et al*., 1999) and 68.5% in Turkish Olibanum oil (Hayashi *et al*., 1998). Octyl acetate is an abundant component of essential oils of a number of other plant species, *e.g.* 29.8% in the seed oil of *Peucedanum cervaria* (Apiaceae) (Domokos *et al*., 2000), 13.3% in the seed oil of *Platytaenia lasiocarpa* (Apiaceae) (Ashraf and Bhatty, 1978), up to 62% in the leaf oils of some *Backhousia* species (Myrtaceae) (Brophy *et al*., 1995) and oils from the wild parsnip *Pastinaca sativa* (Apiaceae) are characterized by the presence of octyl acetate (Kubeczka and Stahl, 1977; Poucher, 1974). *Pittosporum eugenioides* joins these plants as a source of octyl acetate, albeit in low yield.

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