

## THE AUSTRALIAN TEA TREE OIL INDUSTRY

**Richard L. Davis**

G.R. Davis Pty Ltd.

29 Princes St., Riverstone, NSW 2765, Australia

[ [grdavis@bigpond.com](mailto:grdavis@bigpond.com) ]

The Australian tea tree oil industry has charted a fascinating course over the last 50 or so years. From a beginning as a minnow, tea tree oil production expanded over the 1980/90s to become, in dollar terms, Australia's largest essential oil export earner.

As the 1990s drew to a close, however, the fortunes of the tea tree oil industry underwent a reversal. Production had shot past demand by upwards of 100% and the market price halved, and then halved again.

### The Tea Tree Plant

The ISO standard for tea tree oil has the following rather dry title '*Oil of Melaleuca; Terpinen-4-ol type*'. Whilst any species of melaleuca that conforms to the standard can be traded as Australian tea tree oil, only one species, *Melaleuca alternifolia*, represents 99% of world trade.

### *Melaleuca alternifolia*



**Mature *M. alternifolia* in the bush**



**Natural distribution of *M. alternifolia***



**A natural stand of *M. alternifolia***



**Young foliage**

*Melaleuca alternifolia* is a medium sized tree that occurs naturally in a very limited area of Australia, on the north coast of New South Wales (NSW) where it is restricted to the narrow plain between the coast and the dividing range. The tree occurs mainly in wetter areas and swamps, generally in fairly dense stands that often contain relatively few other species.

**Other, minor exploited species**

Two related species that are exploited commercially, albeit on a small scale: *Melaleuca linariifolia* and *Melaleuca dissitiflora*.



**Wild growing *M. linariifolia***

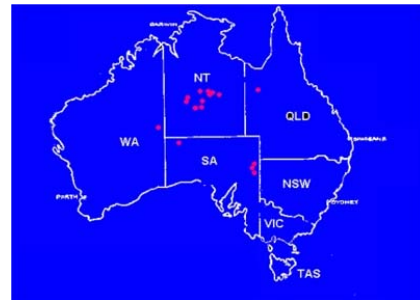


**Natural distribution of *M. linariifolia***

*Melaleuca linariifolia* occurs in a similar area to *M. alternifolia* but extends further south. The low cineole type of *Melaleuca linariifolia* is similar in morphological form to *M. alternifolia* and, indeed, has been identified in plantations originally presumed to be pure *M. alternifolia*.



**Mature *M. dissitiflora* tree**



**Natural distribution of *M. dissitiflora***



**Young plant**



***M. dissitiflora* foliage**

*M. dissitiflora* also meets the tea tree oil standard. It occurs only in significant quantity in the Northern Territory. This species has a somewhat different morphological appearance; the leaves are slightly broader and the bark is less papery.

The oil from *M. dissitiflora* is generally higher in terpinen-4-ol than *M. alternifolia*, with natural populations containing up to 58% terpinen-4-ol.

## **The Chemistry, Standards and Biological Activity of Tea Tree Oil**

### **Chemical composition**

As indicated by the title of the ISO standard, tea tree oil is rich in terpinen-4-ol, typically in the range of 35-42%. 1:8-cineole has also been noted as an important constituent, even though it rarely exceeds 5% in commercial oil.

In the early days, 1:8-cineole was noted in order to distinguish the various chemotypes of tea tree oil available: low cineole (2 – 10%), high cineole (20-40%) and very high cineole (60%+).

During the 1980s boom time, however, the cineole content of tea tree oil became an indicator of quality – the lower the better. Various reasons were given as to why cineole was supposedly detrimental to the oil, such as it being a skin irritant. This was despite much published information that cineole was not a skin irritant, including one report that named nearly all the components of tea tree oil other than cineole as being potential skin irritants.

### **Typical gas chromatographic profile for Australian tea tree oil**

Components	Min. (%)	Max. (%)
$\alpha$ -Pinene	1	6
Sabinene	Traces	3.5
$\alpha$ -terpinene	5	13
Limonene	0.5	4
$\rho$ -Cymene	0.5	8
1,8-Cineole	-	15
$\gamma$ -Terpinene	10	28
Terpinolene	1.5	5
Terpinen-4-ol	30	48
$\alpha$ -Terpineol	1.5	8
Aromadendrene	traces	3
Ledene	traces	3
$\delta$ -Cadinene	traces	3
Globulol	traces	1
Viridiflorol	traces	1

Slowly, the industry realised that terpinen-4-ol was the main indicator of antimicrobial activity, or at least up to levels of 40%. Interestingly, none of the individual components of tea tree oil, including terpinen-4-ol, are as widely active as the whole oil.

### **Standards**

The publication of quality standards for tea tree oil commenced in 1949 with its inclusion in the British Pharmaceutical Codex. The first Australian standard was published in 1967. Improvements in analytical techniques combined with the increasing popularity of the oil on the world markets saw several new standards published, and existing standards revised. The first International Standard for tea tree oil was published in 1996, but with a substantial typographical error; the words minimum and maximum were reversed, so that the first ISO standard for tea tree oil set a maximum of 30% for the oils main constituent, terpinen-4-ol.



### The evolution of published standards for tea tree oil

Year	Origin	Standard #	Title
1949	British Pharmacopoeia		<i>Oleum Melaleuca</i>
1967	Australia	AS K-175	<i>Oil of Melaleuca alternifolia</i>
1972	Martindale		<i>Melaleuca oil</i>
1985	Australia	AS 2782	<i>Oil of Melaleuca Terpinen-4-ol type</i>
1991	France	FS T 75-358	<i>Huile essentielle de Melaleuca type</i>
1996	International Organisation for Standardisation	ISO 4730	<i>Oil of Melaleuca Terpinen-4-ol type</i>
1996	Germany		<i>Teebaumol</i>
1997	Australia	AS 2782-1997	<i>Oil of Melaleuca Terpinen-4-ol type</i>
2001	World Health Organisation (WHO)		
2002	European Pharmacopoeia		<i>Tea Tree Oil, Melaleuca aetheroleum</i>
2002	International Organisation for Standardisation		<i>Oil of Melaleuca Terpinen-4-ol type</i>

#### Antimicrobial Activity

In 1925, A.R. Penfold demonstrated that as an anti-microbial agent tea tree oil was 10 times more effective than carbolic acid in the then standard test of the day, the Rideal-Walker co-efficient. However, unlike carbolic acid, tea tree oil could be applied direct to the skin. With the discovery of both a safe and effective antimicrobial agent, commercial production commenced the very next year.

The main benefit of tea tree oil is its antibacterial and antifungal properties. Various clinical studies, both *in vitro* and *in vivo*, have demonstrated the oil's ability to control or kill a range of bacteria and fungi. At the same time, the oil is generally recognised as safe and a history of use on human skin going back over 70 years.

Among its many uses, the single greatest attribute of the oil is its ability, via topical application, to control a range of antimicrobial problems, and to do this without slowing the healing process of the skin. In fact, anecdotal evidence suggests tea tree oil often speeds the rate of skin healing, particularly for burns.

Whilst tea tree oil has been incorporated into nearly any imaginable personal care and household item, its most popular product forms are:

- Pure bottled oil
- Antiseptic creams
- Acne preparations
- Tinea treatments
- Burn treatments
- Dental applications
- Antiseptic cleaners, wipes and disinfectants
- Sunburn Lotion

The product boomed because it was both a natural product, and one that clearly worked. It is a powerful antimicrobial that is safe, or in this modern era - we must say relatively safe, to use on human skin. Unfortunately the industry now has a large and extremely expensive job ahead of it to convince the regulators that tea tree oil is indeed a safe and effective product for the control of a range of minor skin ailments.



When Penfold first established the efficacy of the oil in 1925, he commenced an interest in tea tree oil research that continues to this day. Over the last 10 years, a careful process of assessing anecdotal evidence on various applications of the oil has been taken through laboratory tests to actual human trials. A larger focus of the work in recent times has been to establish the safety of the oil, particularly in regard to meeting the requirements of various regulatory bodies.

Three recent medical research projects in Australia provide an interesting look at the sort of applications that are being studied:

- ‘Regulation of Immune Responses in Human Skin by Tea Tree Oil’ at Flinders University. It has been shown that single application of tea tree oil significantly reduced swelling following a histamine injection in human trials, while two applications lessened both redness and swelling compared to the control.
- ‘Antimicrobial activity of tea tree oil against oral micro organisms’ at the University of Western Australia. This study on the susceptibility of a range of oral bacteria to tea tree oil has shown that 162 isolates of bacteria were rapidly killed by tea tree oil at a concentration of 2%, with many being killed at concentrations down to 0.5% and lower.
- ‘Clinical efficacy of tea tree oil for treating cold sores’ - preliminary results of a human trial testing cold sore treatments on 214 patients indicate that tea tree oil can significantly reduce the size of cold sores.

### **Production of Tea Tree Oil in Australia**

#### **1926 to the 1970s**

Production of tea tree oil commenced in 1926 from natural stands on the North Coast of NSW. The main production areas were centred around the Grafton, Casino and Lismore areas. The trees were cut by hand, generally with cane knives, and the crop was bagged for transport since the leaves tend to fall off on drying out. The oil was distilled in small ‘bush stills’.



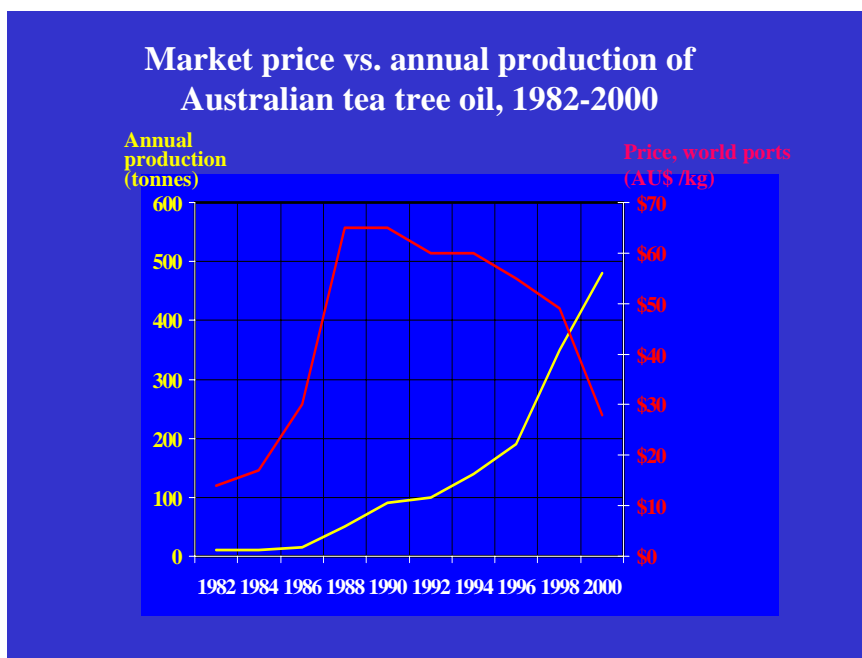
Oil production levels varied from 2 to 20 tonnes / year, and it was not unusual for there to be extended periods – of several years – of very low demand. During these periods, many of the tea tree stands on private land were cleared for cattle grazing, and, hence, by the 1970/80s the most of the oil produced came from forest leases.

During the early days the oil was used for the topical treatment of minor skin infections, cuts and abrasions, insect bites, fungal infections and sunburn. The oil was generally used in pure form from the bottle, or sometimes in mixture with alcohol. For a while it was incorporated in a mainstream product, Colgate’s Protex soap; however this product was dropped in the 1960s when floral rather than functional soaps became popular with marketing departments.

The industry supplied tea tree oil to the US citrus industry on a couple of occasions during the 1970s. A couple of dry seasons had forced processors in Florida and California to import citrus from South America, but the South American oils did not contain terpinen-4-ol. As the US standard specified a minimum content of this component in citrus oils, tea tree was used as feedstock for terpinen-4-ol extraction, which was then added to the citrus oil, so that this oil would meet the US standard for ‘pure citrus oil’.

### The 1980s boom period

The world wide rise in interest for natural products in the early 1980’s combined with a new marketing campaign both in Australia and in the USA saw demand for tea tree oil increase at a dramatic pace. Whilst the initial increased demand was met by bringing in new bush areas, it soon became apparent that plantations would need to be established to ensure an even supply of oil.



At the start of the tea tree boom, prices were floating around the \$12 - \$15/kg level. Within three years the price had doubled, and in another two years it doubled again. Many new entrants poured into the industry, and it was an exciting period. In the headlong rush to make their fortune in the tea tree gold rush, new entrants poached lease areas, stole oil and improved their margins by filling the bottom of drums with water.



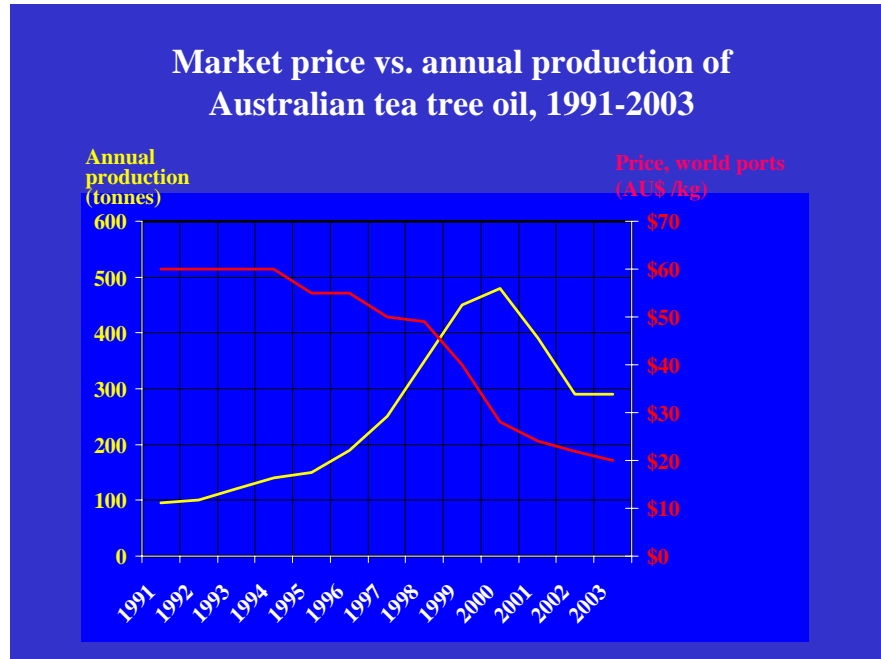
Many of the new entrants at this time had no knowledge of essential oils, chemistry or even agriculture. The first wave of 'corporate' plantation establishment commenced, with plans to plant tea tree from one side of the country to the other. However, many of the early plantations failed and many an investor lost their entire investment.

### The 1990s

By the mid 1990s the industry had matured, the price was high, plantation management skills had increased substantially and the smart operators made substantial profits. This was the real peak for the industry, the oil was proving to be exceedingly popular on world markets, new products were being introduced and the research community was validating the anecdotal claims of oil efficacy. The future for the market was unlimited!

Then the industry was hit with the second wave of corporate investment, only this time it was different. Experienced plantation managers could be hired, seedling propagation techniques had been perfected and harvesting and distillation technology was well advanced. The knowledge for large-scale plantation development was available, and thanks to a loophole in Australian taxation laws, so was the money. Massive plantations were planned and commenced. At a time when the total world market was less than 100 tonnes, several plantations set about to plant enough trees to produce over 1,000 tonnes.

The inevitable fate for the industry of massive oversupply was prolonged by a second solid kick in the world market. From the mid 1990s to the year 2000, the market for tea tree oil increased to at least 300 tonnes and possibly as much as 400 tonnes. Despite this spectacular market growth, production soon roared past demand, and prices collapsed.



## Modern production systems

After 70 years of production of tea tree oil from natural bush stands, this part of the industry all but closed down.

Today, close to 99% of tea tree oil comes from plantations located largely in the same geographic area as the natural stands, but also in areas of Queensland where tea tree did not previously exist.

There are estimated to be 300 tea tree oil growers/distillers in Australia today, with plantations covering in excess of 3,000 hectares in total.

**Production system summary (2003)**

Major producing areas	Northern NSW (main), plus Queensland
Wild trees as resource	Trivial
Plantations as resource	Dominant
Total plantation area	3,000 ha
# of growers / distillers	Ca. 300
Plantation size range	3 – 1,000 ha
Av. planting densities	30,000 / ha
Harvesting frequency	Once per year
Average oil yield	150 kg/ ha / year
Mechanisation	Used for all operations on large plantations

Plantation sizes vary from just a few hectares to over 1,000 hectares, with the bulk of the Australian production coming from the North Coast of New South Wales.

20% of the producers account for around 80% of the total production of tea tree oil, and these figures clearly show the significance of large operations in the industry today.

The common planting density is 30,000 trees per hectare and whilst all producers use some form of irrigation for seedling establishment, most rely on rainfall for subsequent moisture. The exception is the far north Queensland producers who routinely use irrigation for growth.

Most producers take their first harvest 12 months after planting and, thereafter, on an annual basis. From the second harvest onwards, the industry oil yield averages about 150kg per hectare per annum for planting densities of 25,000 – 35,000 per ha. Yields can vary considerably from less than 100kgs per hectare to over 500kg per hectare, though both these extremes are unusual.

The plants are harvested at soil level in order to produce a shredded stem, which encourages rapid regeneration.

The large producers:

- have adopted mechanisation of all field operations, including the planting of seedlings and harvesting;
- employ tank vessels to receive the harvested crop and
- on arrival at the distillery, their tank lids are sealed and steam is injected to perform distillation.

After distillation, the spent charge is dried. This dried residue is universally returned to the plantation and is applied as a mulch.

Some companies also employ the dried spent charge as a boiler fuel. Only 15-30% of the dried, recovered spent charge is required to fuel the boiler furnace for another distillation. Hence, it is a fuel positive process.





**Modern large-scale planting and harvesting methods:**



**Mechanised planting**



**Irrigation of young plants**



**Young growth**



**Mechanical harvesting**



**Harvested plant**



**Regeneration after harvesting**

**Modern large-scale post-harvest methods:**



**Transporting the crop to the distillery**



**Tank cars being connected for distillation**



**Emptying spent charge from tank cars**

**Applying spent charge as field mulch**



**Spent charge fuelled steam boiler**

## **Oil sales by producers**

How producers market their oil is far more varied than how they grow it, and the full range of marketing options are utilised.

In some instances, a producer sell oil to a local trader, who may sell to an overseas distribution agent, who will then sell to the end-user.

Other growers sell their oil directly from the farm to the overseas buyer / end-user.

Generally speaking:

- smaller growers (less than 5 tonnes per annum) tend to sell through traders or grower co-operatives,
- larger growers (5 – 20 tonnes per annum) tend to do a mixture of both, and
- very large operators (20 – 100 tonnes+) usually do their own marketing.

## **The Current Situation in the Industry**

Whilst the obvious result of overproduction has been the 70% reduction in price, there has been a possibly even more devastating result in the recent period. With massive overproduction came a desperate attempt to sell oil – virtually at any price. End-users saw the value of their stock fall almost monthly, and stopped committing to forward contracts. This reduction in purchasing pushed the selling frenzy even further – over a few short years the price halved, and then halved again. Tea tree oil had become a commodity.

To further exacerbate the industry's woes, another factor came into effect. Supermarket chains, particularly in Europe, decided to sell tea tree oil. They put out tenders for large quantities of oil at rock-bottom prices and then put oil on shelves at up to a quarter of the pharmacy/health food store price. At first consumers swapped from chemist to supermarket, so volumes were maintained and maybe even increased. However, what happened in this move was that tea tree oil was no longer being marketed – all the small chemists and health food shops had provided indications of use, often backed up with pamphlets and books extolling the virtues of the oil. The supermarkets simply put product on the shelves. Without the oil being actively promoted to consumers, demand eased. The supermarkets responded to the fall in demand by moving the oil from prominent shelves to lower shelves, further exacerbating the problem.

Tea tree oil is no longer the 'wonder from down under'. To drive sales in the natural products industry you need a new, exciting, preferably somewhat hard-to-get, slightly mysterious oil. You also need the oil to be promoted to the public – which is why it does so well in the natural health market and far less well in the cosmetic market where product competition is fierce.

## **The Future**

Whilst tea tree oil might have lost its initial 'excitement factor', the oil is still as efficacious as it ever was, it is still popular and continues to be used in quite substantial volumes, certainly in excess of 300 tonnes per annum.

There is some very interesting and promising work being conducted on the oil. The increasing incidence of resistance to antibiotics in hospitals around the world is a major problem. Tea tree oil has



shown good activity against Methicillin resistant *Staphylococcus aureus* (golden staph) and work is being conducted to determine whether early results can be clinically confirmed. In a completely different area, tea tree oil is also showing good results in industrial and agricultural applications.

As work continues on applications for the oil, further market growth is almost inevitable, and Australia is well placed to capitalise on increased demand. Whilst tea tree oil is produced overseas, current price levels have kept further development in check. Of particular importance to Australia is the industry's Tea Tree Breeding Project. Established 10 years ago, this project is delivering major oil yield and oil quality advantages to Australian producers, and will ensure Australia remains a competitive supplier of tea tree oil.

Finally, I have been asked to comment on whether Australia will be the dominant supply source in 2013. It is my view that it will be, and there are two main reasons for this opinion:

- Firstly, and despite having had close experience with the move of eucalyptus oil production from Australia to overseas many years ago, one of the reasons for Australia remaining a dominant supplier of tea tree oil is the increased attention these days to oil quality. Australia remains a supplier of eucalyptus oil on world markets because the quality of the oil is well recognised. However, many buyers swapped over to inferior eucalyptus oil in the days when price was more important than quality and, therefore, allowed other producing nations to get established. In the current market, buyers will not be buying inferior tea tree oil, and with ever increasing regulation on oil quality and safety I do not envisage this situation changing.
- The second reason relates to technology. Already, a fair amount of work has been done on various grades and types of tea tree oil. It is quite likely that particular oils may have increased efficacy for targeted applications. With the entire species resource located here in Australia, and a high quality tree breeding and cloning infrastructure already in place, Australia will be able to quickly respond to market opportunities requiring new oil types.

*Richard Davis is the son of Geoff Davis, founder of GR Davis Pty Ltd. Richard has been the managing director of the company since 1985, and continues the company's specialisation in the growing, distillation and rectification of essential oils, primarily eucalyptus and tea tree*

