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Therapeutic Properties of New Zealand and Australian Tea Trees

(*Leptospermum* and *Melaleuca*)

by Anitra C. Carr

New Zealand and Australian tea trees

There has recently been a significant increase in the use of therapeutically active compounds extracted from plants as opposed to chemically synthesised drugs. The demand for natural products is increasing and in many cases currently exceeds supply. The flora of New Zealand and Australia is rich in unique species, however, very few of these native plants have been tested for medicinal constituents [1]. The family Myrtaceae contains many plants, including the Australian tea tree (*Melaleuca alternifolia*) and its New Zealand equivalents manuka (*Leptospermum scoparium*) and kanuka (*Kunzea ericoides* formerly *Leptospermum ericoides*), which are currently being investigated for their therapeutic properties. These natives have become known collectively as "tea trees" since Captain Cook used to brew a stong tea from the leaves for his men. They were used extensively by the early settlers of both countries and the Maori and Aboriginal people have been using parts of the tea trees for therapeutic purposes for centuries [2]. Various preparations of the gum, sap, seed pods, leaves, bark and flowers of manuka were used both externally and internally to treat many conditions (Table 1).

Table 1. The folk lore uses of manuka [2].

Plant Part	Preparation	Administration	Action/Use
whole plant	tea/strong infusion	internal	causes vomiting
whole plant	decoction	internal	increases urine reduces fever
leaves	steam inhalation	inhaled	treats head colds
leaves/bark	decoction	internal	stiff back/joints
	steam inhalation	inhaled	reduces secretions
crushed bark	infusion	internal	treats constipation
inner bark	infusion	internal	sedative for sleep
		external	pain/fractures
	decoction	external	mouthwash/gargle bathe sore eyes
gum	whole	external	soothe
		internal	burns/scalds ease bad coughs relieve constipation
fresh sap	whole	internal	blood purifier
seed capsules	decoction	external	inflammations
		internal	diarrhoea/dysentry
	whole/chewed	external	alleviates colic
	powdered	external	dry wounds/sores

Therapeutic properties of Australian tea tree oil

Australian tea tree oil is rich in terpene alcohols such as terpinen-4-ol, which is thought to be the active germicidal component, and 1,8-cineol (eucalyptol) which gives eucalypts their characteristic fragrance and medicinal properties (Fig. 1). The use of a low-cineol oil is important therapeutically since it is thought that high-cineol oils irritate mucous membranes and the skin. Instances of contact dermatitis associated with the use of tea tree

oil have been reported [3]. The main components of the oil were separated and patch tested and the allergan was found to be 1,8-cineol. Most commercial tea tree oils contain less than 10% 1,8-cineol and 30-45% terpinen-4-ol [4].

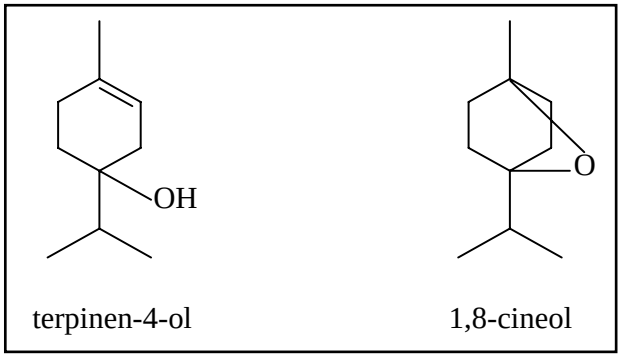

Figure 1. Structures of the two active constituents in tea tree oil, terpinen-4-ol and 1,8-cineol [4].

The antimicrobial activity of tea tree oil has been demonstrated *in vitro* against several common bacterial and fungal pathogens [5,6]. This included determination of the MIC (minimum inhibitory concentration) for *Aspergillus flavus* (0.25%), *Candida albicans* (0.63%), *Escherichia coli* (0.63%), *Propionibacterium acnes* (0.75%), *Pseudomonas aeruginosa* (3.0%), *Serratia marcescens* (0.25%), *Staphylococcus aureus* (0.63%), *Trichophyton mentagrophytes* (0.75%) and *Trichophyton rubrum* (0.5%) (Table 2). Methicillin and mupirocin resistant *Staphylococcus aureus* (MRSA) were susceptible to tea tree oil with a MIC of 0.25% and a MBC (minimal bactericidal concentration) of 0.5% [7]. The antimicrobial effects of several major components of tea tree oil have been investigated [8,9]. Terpinen-4-ol was active against all the test organisms, while 1,8-cineol was inactive against the organisms tested.

Tea tree oil has a wide range of applications and is commonly used to treat infectious disorders of the skin and respiratory system. The oil is unusual in that it is active against all three categories of infectious organisms, bacteria, viruses and fungi. Tea tree oil is an effective treatment for many skin conditions such as cold sores, the blisters of shingles and chicken pox, veruccae, warts, acne, large inflamed spots and nappy rash. It is also effective against fungal infections such as ringworm, athlete's foot and thrush. Gynaecological conditions, including vaginal infections such as trichomonal vaginitis, have been successfully treated with tea tree oil. Anaerobic (bacterial) vaginosis is usually treated with oral nitroimidazoles such as metronidazole but there is possible toxicity and long term recurrence is very high. Research has shown that topical treatment with tea tree oil may be more effective because the abnormal bacterial flora was replaced by normal lactobacillus [10].

Many other comparative studies have been carried out between tea tree oil and conventional medications. The topical application of 5% tea tree oil versus 5% benzoyl peroxide has been investigated in the treatment of acne vulgaris which is caused by the microorganism *Propionibacterium acnes* [5]. Both compounds reduced the number of acne lesions and although the action of tea tree oil was slower this may have been due to a suboptimal concentration being used. It also had fewer side effects than the benzoyl peroxide. The use of 10% tea tree oil cream has been compared with 1% tolnaflate and placebo creams in the treatment of tinea pedis or ringworm [11]. This is the commonest form of superficial dermatophyte infection caused by several related fungi *Trichophyton rubrum*, *Trichophyton metagrophytes* and *Epidermophyton floccosum*. The tea tree group and tolnaflate group showed significant improvement in clinical condition, but the tea tree oil did not cure the condition. However, once again the concentration of the oil may have been suboptimal and tolnaflate has a minor skin irritant side effect. The efficacy and tolerability of topical application of 1% clotrimazole solution compared with that of 100% tea tree oil for the treatment of toenail disease (onychomycosis) has been investigated [12]. Both preparations gave essentially identical results in improvement or resolution of the condition.

Table 2. Several of the bacterial and fungal microorganisms against which tea tree oil has been shown to be active [5,6,11].

Microorganism	Description
Aspergillus flavus	fungus which causes skin infection and liver damage from toxins
Aspergillus niger	fungus which causes skin infection
Bacillus typhosus	bacterium
Candida albicans	yeast-like fugus which causes oral and vaginal thrush
Epidermophyton floccosum	fungus which causes tinea pedis
Escherichia coli	bacterium which causes intestinal and urinary tract infection
Propionibacterium acnes	bacterium which causes acne vulgaris
Proteus vulgaris	bacterium which causes kidney infection
Serratia marcescens	bacterium
Pseudomonas aeruginosa	bacterium which infects wounds/burns
Staphylococcus aureus	bacterium which causes skin and respiratory tract infections
Staphylococcus epidermis	bacterium which can cause endocarditis
Tricophyton metagrophytes	fungus which causes tinea pedis
Tricophyton rubrum	fungus which causes tinea pedis

Therapeutic properties of manuka honey

The use of honey for its antibacterial properties was replaced by antibiotics, such as penicillin, and synthetic drugs in the 1940's and 50's. However, honey is now beginning to be widely used as a topical antibacterial agent for treatment of surface infections such as ulcers and bed sores and those resulting from burns, injuries and surgical wounds [13]. The antibacterial activity of honey has been attributed to the high osmolarity, acidity and hydrogen peroxide content. Recently there has been increased interest in the properties of manuka honey because the antibacterial activity of this honey is not only attributable to the hydrogen peroxide content, but is also due to plant derived component(s). The possible importance of plant derived activity is indicated by the finding that wounds in laboratory rats were healed more rapidly by floral honey than by honey from sugar-fed bees.

Comparison of the sensitivity of wound infecting species of bacteria to the antibacterial activity of manuka honey and other honey has been carried out [14]. The microorganisms used were (in order of their sensitivity to manuka honey) *Escherichia coli*, *Staphylococcus aureus*, *Salmonella typhimurium*, *Streptococcus pyogenes*, *Serratia marcescens*, *Proteus mirabilis* and *Pseudomonas aeruginosa* (Table 3). The two species most sensitive to manuka honey (*Eschericia coli* and *Staphylococcus aureus*) were also the least sensitive to the other honey which illustrates the presence of a different type of activity in manuka honey. *Staphylococcus aureus*, which has developed resistance to many antibiotics and has become the predominant agent of wound sepsis in hospitals, is very susceptible to the antibacterial activity of honey, particularly the non-peroxide activity of manuka honey.

A similar study indicated that the non-peroxide antibacterial activity in manuka honey is of particular significance for the therapeutic use of honey. A comparison of the effectiveness of manuka honey with heather honey (which has activity due primarily to hydrogen peroxide) found that whereas *Staphylococcus aureus* and *Pseudomonas aeruginosa* were inhibited by both honeys, the inhibition of *Citrobacter freundii*, *Escherichia coli*, *Proteus mirabilis* and *Streptococcus faecalis* was seen only with manuka honey and not heather honey. The antibacterial activity of unpasteurised honey from 26 New Zealand floral sources was tested against *Staphylococcus aureus* [13]. Both manuka and kanuka honey

had high antibacterial activity while a marked proportion of the activity of manuka honey was due to a substance other than hydrogen peroxide.

More recently manuka honey has been found to be effective against the organism *Helicobacter pylori*. This bacterium is a human gastric pathogen which is responsible for gastric or peptic ulcers and has also been implicated in gastric cancer. *Helicobacter pylori*, isolated from biopsies of gastric ulcers, were sensitive to a 20% (v/v) solution of manuka honey, but were not sensitive to a 40% (v/v) solution of a honey in which the antibacterial activity was primary due to its hydrgen peroxide content [15]. Growth of these bacteria was prevented completely by the presence of a MIC of 5% (v/v) manuka honey.

Table 3. Several of the bacterial microorganisms against which manuka honey has been shown to be active [13,14,15].

Microorganism	Description
Citrobacter freundii	bacterium which causes intestinal infections
Escherichia coli	bacterium which causes intestinal and urinary tract infections
Proteus mirabilis	bacterium which causes bowel infections and infects wounds/bed sores
Pseudomonas aeruginosa	bacterium which causes urinary tract infections and infects wounds/burns
Salmonella typhimurium	bacterium which causes typhoid fever
Serratia marcescens	bacterium
Staphylococcus aureus	bacterium which causes skin and respiratory tract infections
Streptococcus faecalis	bacterium which causes intestinal and urinary tract infections
Streptococcus pyogenes	bacterium which causes skin and respiratory tract infections
Helicobacter pylori	bacterium which causes gastritis or peptic ulcers

Future prospects - manuka oil

Leptospermum species are indigenous to both Australia and New Zealand but have not been commercially exploited until very recently. Countries such as Zaire, East Africa, South Africa and Guatemala extract oil from *Leptospermum citratum* or “lemon scented tea tree” which is an excellent source of citral and citronellal. The oil from *Melaleuca bracteata* or “black tea tree” is extracted commercially in Australia as a source of methyl eugenol which is used as an insect repellent. The oil of manuka, collected from Australia and the Northern, Southern and East Cape regions of New Zealand, has recently been characterised [16]. Oil from the Australian *Leptospermum scoparium* was found to have the highest levels of 1,8-cineol while manuka from the East Cape region of New Zealand had the highest level of the triketone leptospermone.

The essential oil of manuka has recently been tested against a couple of organisms, *Bacillus subtilis* and the dermatophyte *Trichophyton mentagrophytes* [16,17]. Oil distilled from plants collected in the East Cape region of New Zealand showed the highest antimicrobial activity, while Australian tea tree oil showed no activity against these organisms. Manuka oil has only very recently started to be produced commercially from plants growing in the East Cape region of New Zealand. The oil is being marketed as Manex Oil and has been found to have high levels of antiseptic and antifungal activity. Practical trials have shown that it is effective against athlete's foot, ringworm, acne, thrush and some antibiotic resistant organisms.

Lastly, research carried out by the author [18] indicated that several components of manuka inhibited cysteine proteases which can be involved in muscle wasting diseases,

such as muscular dystrophy, viral replication and tumour invasion and metastasis. The screening of New Zealand native plants for enzyme inhibitory activities (Kellam S.J., Tisch M.H. and Walker J.R.L., personal communication) showed that extracts of manuka had variable inhibition of several enzymes including (in order of highest inhibition) trypsin, leucine aminopeptidase, α-glucosidase, β-galactosidase, α-chymotrypsin, papain and α-amylase. Therefore, further research into the therapeutic properties of manuka seems warranted.

About the Author

Anitra Carr has a BSc (Hons) in Biochemistry from the University of Canterbury and a Diploma in Herbal Studies from the Australasian College of Herbal Studies. She is currently a biomedical researcher at the Christchurch School of Medicine and is completing a part-time PhD in Clinical Biochemistry through the University of Otago. She is also the biochemistry tutor for the Canterbury College of Natural Medicine's new Diploma in Herbal Medicine course.

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