

HĀ KĀNUKA

The Bioactivity of Kānuka Oil: Current Knowledge

Dr Andrew Munkacsi and Robyn Ooi

School of Biological Sciences
Te Herenga Waka - Victoria University of Wellington
andrew.munkacsi@vuw.ac.nz

Report Prepared for Kānuka Charitable Trust

MARCH 2026

Contents

Executive Summary

Introduction

What is Kānuka Oil?

Purpose of Review

Chemical Composition of Kānuka Oil

Major Active Compounds

Variation in Composition

Bioactive Properties of Kānuka Oil

Antimicrobial Activity

Anti-inflammatory Effects

Other Bioactivities

Traditional & Modern Applications

Conclusion

References



Executive Summary

Kānuka (*Kunzea spp.*) are a family of taonga plant species long used in traditional medicine by Māori for their antimicrobial, anti-inflammatory, and analgesic properties. While commercial interest has largely focussed on kānuka honey or the essential oil of the similar mānuka tree (*Leptospermum scoparium*), kānuka oil has demonstrated unique and potent bioactivities.

This review builds on a 2022 report by Nigel Perry, 'Kānuka Oil: Current Knowledge and Potential Markers', which was commissioned by Hikurangi Bioactives Limited Partnership, and focused on the chemical profile of kānuka oils. This report consolidates current knowledge about kānuka oil, including their chemical composition, biological activities, therapeutic potential and emerging applications, and provides an update on advances in research since that earlier publication.

Introduction

What is Kānuka Oil?

Frequently confused for the more famous mānuka (*Leptospermum scoparium*) due to morphological similarities and confusion over terminology, the word “kānuka” now generally refers to varieties of the *Kunzea* genus found in New Zealand. The term “tea tree” was commonly used by early explorers for both kānuka and mānuka, and is also used to refer to Australian *Kunzea* species, though it can refer more broadly to non-*Kunzea* genera such as *Melaleuca alternifolia*. While Māori traditionally used “kānuka” and “mānuka” interchangeably, and despite the presence of *Kunzea* species outside of New Zealand, this review will use “kānuka” only when referring to the ten species of *Kunzea* endemic to New Zealand: *K. amathicola*, *K. ericoides*, *K. linearis*, *K. triregensis*, *K. robusta*, *K. salterae*, *K. serotina*, *K. sinclairii*, *K. tenuicaulis*, and *K. toelkenii*².

Although kānuka is frequently harvested together with mānuka, its distinct bioactivities have been observed and used for human health for centuries. Leaves and bark from the kānuka tree have been used in Rongo Māori (traditional healing practices) to treat a range of health concerns, including stomach disorders, inflammation, infection, dermatological concerns, and pain relief^{3,4}. These practices are supported by modern scientific studies that have since shown that kānuka is a powerful antibacterial, antifungal, antioxidant, anti-inflammatory, and spasmolytic agent. Kānuka oil is usually obtained by subjecting the leaves and bark to steam distillation, and it is faster to distil than mānuka oil due to the high level of monoterpenes such as α -pinene that are present in the oil.

Figure 1a: An aerial view of kānuka growing in the Waiapū Valley in Tairāwhiti on the East Coast of Aotearoa New Zealand, 2018. Photo: Josie McClutchie.

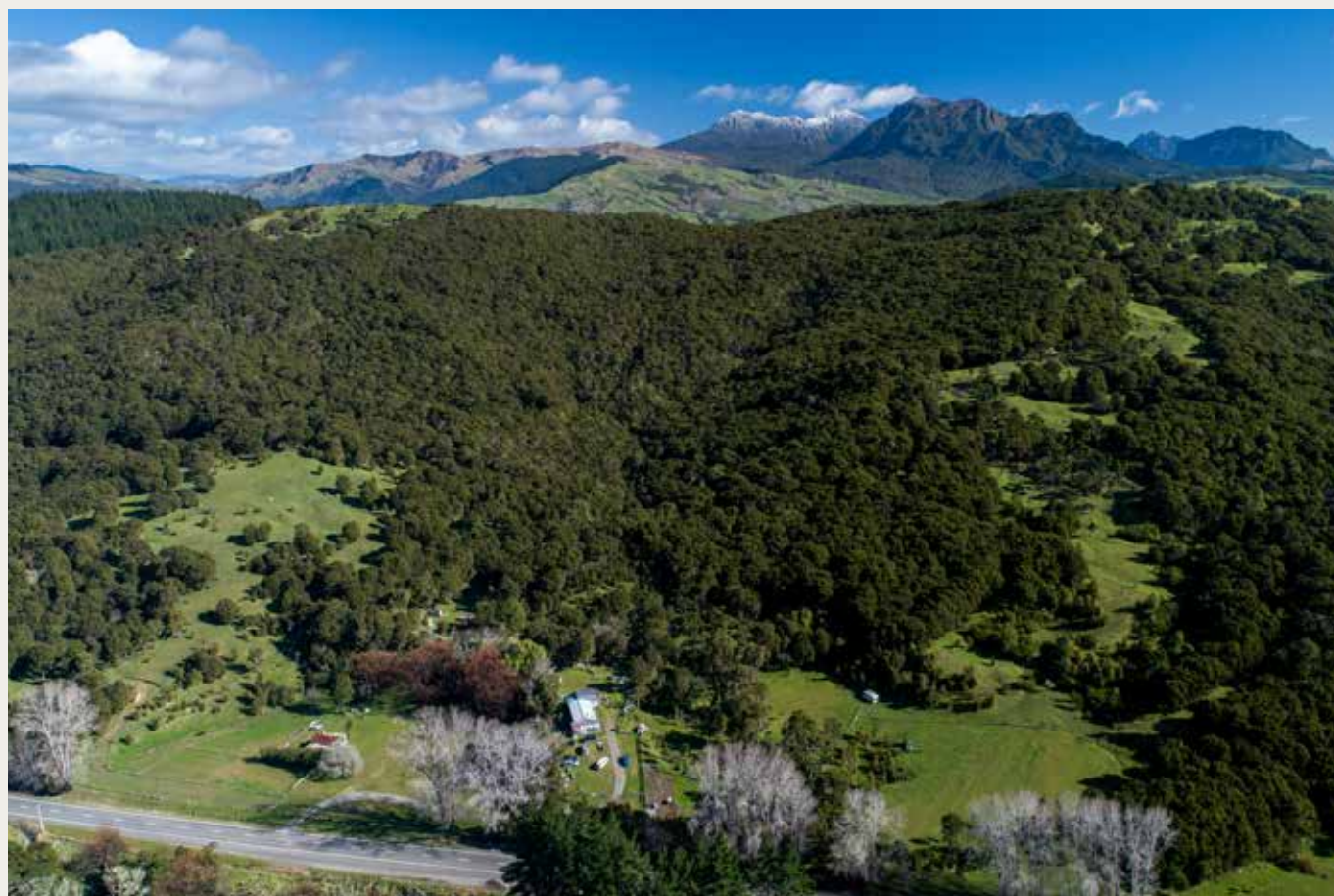


Figure 1b: A close-up view of *Kunzea robusta* in flower. Photo: Peter de Lange



Purpose of Review

Although k nuka honey and Australian tea tree oil have been extensively researched, this review focuses exclusively on the essential oil derived from *Kunzea* species that are endemic to Aotearoa New Zealand and omits studies where the geographical source of the *Kunzea* plant is not explicitly stated as New Zealand. Since the 1950s, there have been many attempts to characterise the chemical makeup of the oil, as well as several *in vitro* studies examining specific bioactivities such as its antimicrobial actions and effects on different cell and tissue types. There have been two randomised controlled trials using k nuka oil as the active ingredient, including a mouthwash to treat radiotherapy-induced mucositis, and to investigate its use in the skin condition eczema^{5,6}. This review aims to bring together studies into k nuka oil's chemical constituents and bioactivity, offering a consolidated perspective on its potential as a natural therapeutic agent.

Chemical Composition of K nuka Oil

Major Active Compounds

Many studies have sought to characterise the chemical composition of k nuka oil, consistently identifying a distinct chemical signature that differentiates it from m nuka oils. The primary difference is high levels of α -pinene, although the percentage varies depending on species and location (Table 1). Despite having a lower abundance of β -triketones than m nuka oil, Bloor et al. (1992) discovered two isomers of a phenolic compound containing a β -triketone group in a 4:1 ratio in extracts of *Kunzea sinclairii* and *Kunzea ericoides*⁷. The minor compound was considered a condensation product of robustaol B and leptospermone, the main β -triketone found in m nuka, which is also found in lesser quantities in k nuka. Bloor's acyl phloroglucinols were found to provide inhibitory effects against viral *Herpes simplex* Type 1 and *Poliovirus* Type 1.

Aside from α -Pinene, other chemical compounds that are regularly found in k nuka oil extracts are β -pinene⁸⁻¹¹, *p*-cymene^{9,10,12-15}, 1,8-cineole^{8,9,11,12,14,16,17}, γ -terpinene^{9-12,14,15}, linalool^{8-12,14}, viridifloro^{11,13,14,18}, leptospermone^{7,10,11}, limonene^{8-11,14,15}, δ - and ϵ -terpinene^{8,10}, aromadendrene^{8-10,15}, and *trans*-calamenene^{10,11,13,15} (Table 1).

Variation in Composition

Studies with different k nuka samples from around New Zealand have shown variability in the chemical composition of k nuka oil between species, geographical source, season of harvest, and method of extraction^{9,10,12,13,19}. Traditionally, plants of the *Kunzea* family have been referred to as "m nuka", with species from the *Leptospermum* family frequently referred to as "kahik toa". The revision by Thompson in 1983 to reclassify *Leptospermum ericoides* and *Leptospermum sinclairii* as *Kunzea ericoides* and the 20th century adoption of the term "k nuka" had the effect of applying a blanket designation that did not take into account the diversity of *Kunzea* species²⁰. Despite growing in similar locations and frequently sharing morphological features, modern classifications and taxonomic definitions proposed by de Lange (2014) have identified many subspecies of the *Kunzea* genus². Trees most frequently attributed to being k nuka include the *Kunzea* species *ericoides*, *robusta*, *linearis*, *sinclairii*, *pauciflora*, *flavescens*, *hirakimata*, the m nuka species *Leptospermum scoparium*, and Australian tea tree *Melaleuca alternifolia*. Many studies have been attributed to just "*Kunzea* sp." or "K nuka oil" without specifying which species is being used. In addition to this taxonomic diversity, the geographical distribution of different subspecies has not yet proven to influence the chemical composition of essential oils, possibly due to a limited number of studies (e.g., the seven studies annotated in Figure 2 together only had five South Island samples and fourteen North Island samples).

Perry et al. (1997) noted that different species from different locales could be differentiated by their comparative levels of α -pinene, *p*-cymene, and γ -terpinene¹⁰. It is possible that k nuka samples will therefore have a distinct profile that distinguishes them from similar trees sourced from Australia and other countries, but confirming this would require further research.

Table 1: Percentage of total mass of the most commonly identified chemical constituents in kākūka oil across various studies employing a variety of kākūka species from different geographical sources. †Source of kākūka oil not stated beyond “provided by Tairāwhiti Pharmaceuticals Ltd”.

Study	Species	Source Location	Constituents (%)						
			α -Pinene	<i>p</i> -Cymene	1,8-Cineole	γ -Terpinene	Linalool	Viridiflorol	Leptospermone
Corbett & Gibson, 1959	<i>Leptospermum ericoides</i>	Whare Flat, Dunedin	52.4	-	3.8	-	0.9	-	-
Perry et al., 1997	<i>Kunzea ericoides</i>	New Zealand	67.6	5.8	4.3	1.6	1.7	2.8	0.4
Porter & Wilkins, 1999	Commercial Kanex oil	Tair whiti	55.51	3.41	3.94	2.53	1.52	7.23	0.0
Maddocks, 2021	Not specified	Great Barrier Island (1)	71.68	0.0	5.95	0.3	2.49	4.11	-
		Great Barrier Island (2)	74.34	0.0	5.58	0.53	2.57	1.06	-
		East Coast	60.12	0.0	5.51	3.63	1.81	3.5	-
		Coromandel	74.08	0.0	6.6	0.28	4.45	2.32	-
		Arapaoa Island	70.64	0.0	4.34	3.72	1.93	1.3	-
		Otago	61.39	5.82	8.99	5.73	2.62	-	-
Fuller et al., 2022	<i>Kunzea amathicola</i>	South Head, Manawatū, Golden Bay	19.91	0.55	5.70	0.30	0.78	7.33	0.0
	<i>Kunzea ericoides</i>	Golden Bay, Hope River, Adele Island	18.33	0.12	1.93	0.14	0.43	3.39	0.12
	<i>Kunzea linearis</i>	Wellington, Waikato, Waitemata, Northland	20.02	0.26	5.81	0.45	0.44	7.25	0.0
	<i>Kunzea robusta</i>	Canterbury, Greymouth, Northland, Pictou, Taranaki, Waikato, Auckland, Dunedin	13.46	0.72	2.34	0.44	1.35	10.07	0.17
	<i>Kunzea salterae</i>	Moutohora, Moutahora	15.04	0.0	0.49	0.11	0.24	6.65	0.37
	<i>Kunzea serotina</i>	Tasman, Canterbury, Marlborough, Taupū, Manawatu	19.11	5.28	2.50	2.62	0.37	7.49	0.0
	<i>Kunzea sinclairii</i>	Great Barrier Island	11.57	0.20	2.29	0.09	0.38	3.27	0.13
	<i>Kunzea tenuicaulis</i>	Taupū, Dunedin	16.80	0.10	0.0	0.12	0.32	10.43	0.15
	<i>Kunzea toelkenii</i>	Thornton	14.07	0.06	0.0	0.12	0.24	5.54	0.46
	<i>Kunzea triregensis</i>	Three Kings	10.15	0.0	0.0	0.41	0.77	6.59	0.0
Lewe et al., 2023	<i>Kunzea robusta</i>	Tair whiti	40.5	15.6	4.3	10.0	1.5	1.9	-
		Taranaki	43.4	8.8	0.7	9.5	1.7	7.6	-
		Taitokerau	52.1	1.7	3.5	2.5	4.3	7.8	-
		Horomaka	46.0	4.4	2.9	10.9	3.9	4.0	-
Kaur et al., 2023	Not specified	Tair whiti†	64.25	3.28	6.6	1.52	2.76	8.0	-
Blockley-Powell et al., 2025	<i>Kunzea robusta</i>	Tair whiti	39.60	5.82	-	9.09	-	-	-
Haira et al., 2025	<i>Kunzea robusta</i>	Tair whiti	46.61	4.43	3.73	4.60	1.62	-	-

Bioactive Properties of K nuka Oil

There have been fifteen studies on the bioactivity of k nuka oil from plants sourced from New Zealand, which investigated seven bioactivities. These

include antibacterial, antifungal, antiviral, anti-inflammatory, anti-Alzheimer's disease, and effects on muscle function (Figure 2).

Figure 2: Abundance of the compounds α -Pinene and p -Cymene from the studies listed in Table 1. Each dot represents the average abundance of the compound from plant samples sourced from either the North or South Island, where the location was identified (n = 14 for North Island and n = 5 for South Island).

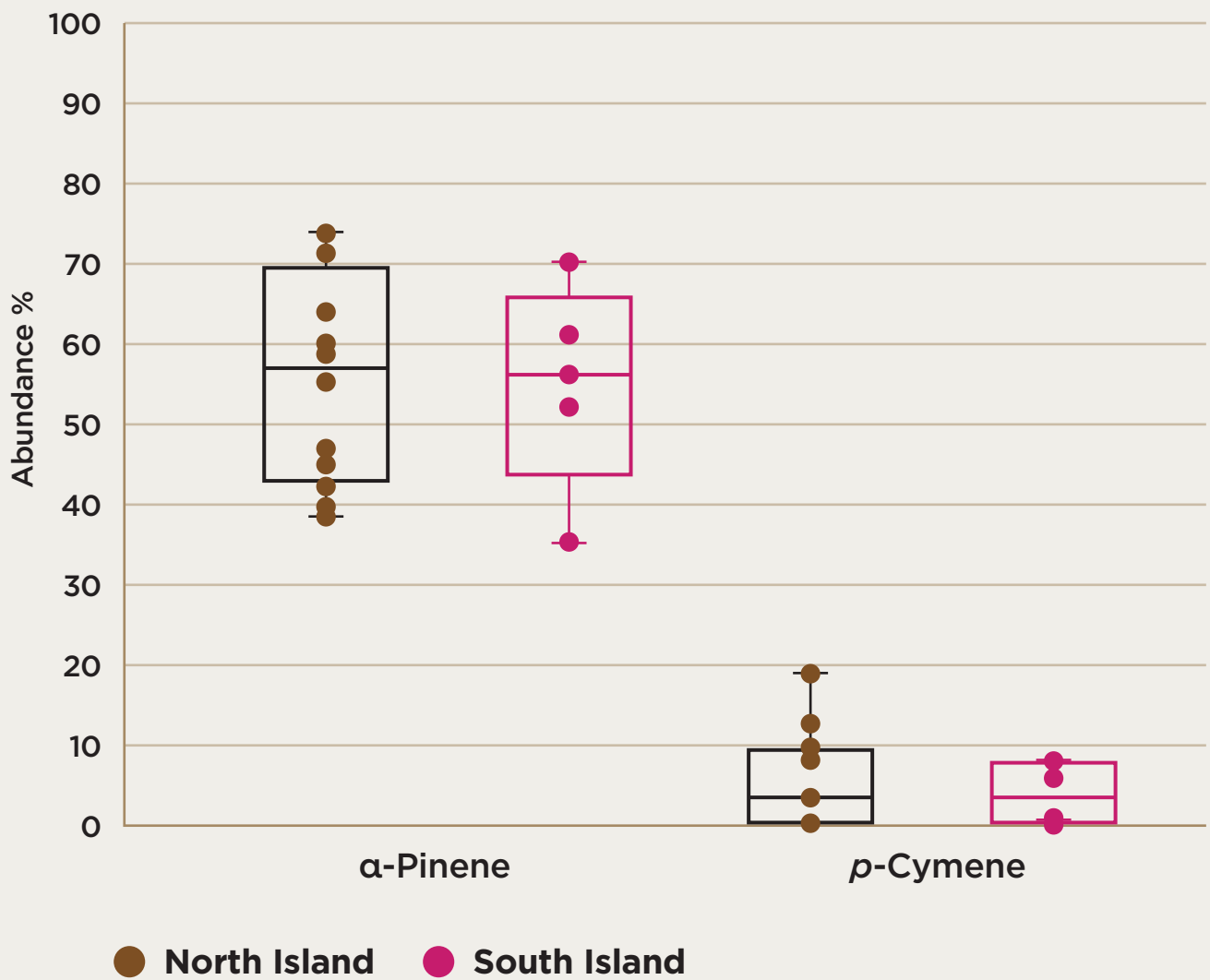
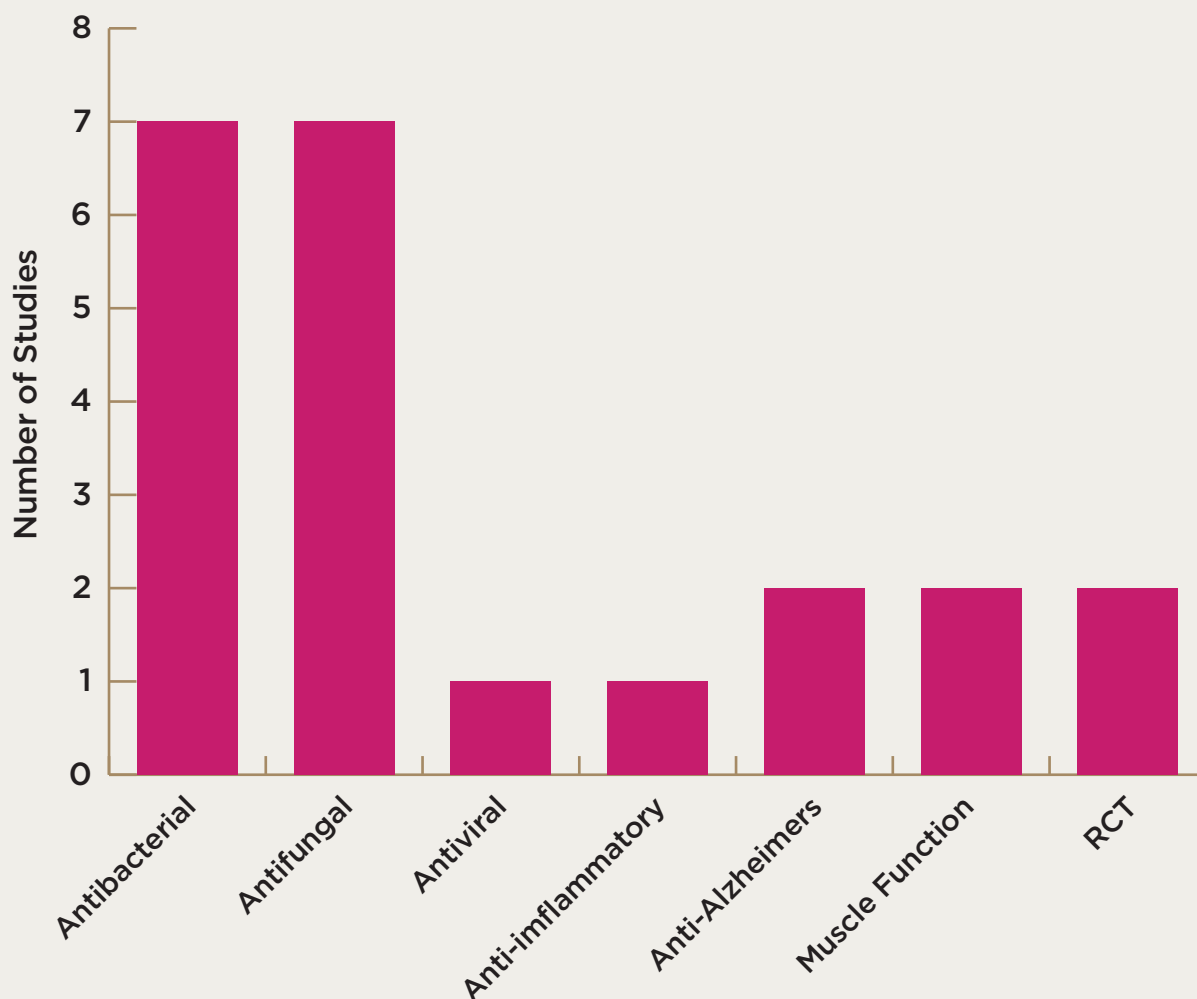


Figure 3: Studies into the bioactivity of extracts from kākānuka in the literature. The 2019 study on the eukaryotic oomycetes *Phytophthora agathidicida* has been included under “Antifungal”. RCT = Randomised Controlled Trial.



Antimicrobial Activity

Traditional uses of kākānuka formulations include antiseptic and wound-care applications^{3,4}. Its benefits in these situations may be attributable to its strong antibacterial actions, which have been supported with *in vitro* susceptibility studies for both gram-positive and gram-negative bacteria. Lis-Balchin et al. (1996) observed inhibitory activity of kākānuka oil against *Staphylococcus aureus*, *Streptococcus faecalis*, *Micrococcus luteus*, *Bacillus subtilis*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Klebsiella pneumoniae*, *Proteus vulgaris*, and *Listeria monocytogenes*²¹. This team further characterised the active compounds in a study in 2000, noting terpinen-4-ol alone had antibacterial activity comparable to the whole oil²². A study by Christoph et al. (2000) highlighted the efficacy of kākānuka oil against gram-positive bacteria²³. Both gram-negative and gram-positive species were effectively inhibited by kākānuka oil investigated

by Chen et al. (2016) after even short exposure periods²⁴. Angane et al. (2023) found kākānuka oil effective against gram-positive bacteria at a lower concentration than against gram-negative bacteria, with *Bacillus cereus* (gram-positive) exhibiting the greatest sensitivity, which the researchers attributed to the absence of the outer lipid membrane in gram-positive bacteria¹¹. Kaur et al. (2023) found that wagyu beef minced with different bacterial cultures had a better response to mānuka oil than kākānuka oil, but that kākānuka oil was effective against the gram-negative *P. aeruginosa* where mānuka was not, potentially indicating a different mechanism of action²⁵. Kākānuka was active against gram-positive *Propionibacterium acnes* and Methicillin-Resistant *Staphylococcus Aureus*, with greater activity against *P. acnes* in a study by Haira et al. (2025) comparing season of harvest and geographic source⁹.

Historically, bark of k nuka was mixed with wood ash by T hoe to treat maihi (dandruff) and p tito, an infection that was probably *Tinea corporis* (ringworm)³. Modern studies have confirmed the antifungal properties of k nuka through in vitro assays demonstrating activity against yeast, dermatophytes, and moulds. Perry et al. (1997) observed mild antifungal activity against *Trichophyton mentagrophytes*, one of the main causative agents of ringworm, with samples from southern New Zealand exhibiting greater effect than northern ones²⁶. K nuka oil was effective against a range of fungal species, with two- to four-fold greater inhibition of growth against *Trichosporon mucoides* and *Malassezia furfur* than the pathogenic yeasts *Candida albicans* and *Candida tropicalis* in a study by Chen et al. (2016)²⁴. Maddocks et al. (2021) tested k nuka oil from different locations in New Zealand against the ringworm-causative fungi *Trichophyton rubrum* and *Microsporum canis*. They found that all oils tested reduced mycelial growth with the samples sourced from Great Barrier Island and the East Coast of the North Island eliciting the greatest effect²⁷. A study into k nuka samples by Haira et al. (2025) collected in different seasons found that k nuka harvested in Spring was more active against *Candida albicans* than samples harvested in Autumn⁹.

Phytophthora agathidicida is another eukaryotic pathogen similar to fungi of the oomycetes class, which causes Kauri Dieback disease, a malady that threatens the survival of the native New Zealand tree²⁸. As oomycetes do not possess the biological targets used by most agricultural fungicides, controlling *Phytophthora* diseases is difficult and limited. An investigation into the effects of k nuka extracts by Lawrence et al. (2019) found that crude extracts of k nuka root and leaf had a lytic effect on *P. agathidicida* zoospores, with leaf extracts reducing germination of the zoospores and inhibiting the growth of mycelia²⁸. Bioactivity-guided fractionation identified flavanones in the active fraction that was responsible for the anti-*Phytophthora* effects.

Anti-inflammatory Effects

M ori frequently created ointments and poultices from the leaves, bark, and seed capsules of k nuka to treat pains, inflammation, and dermatological concerns such as rashes and eczema^{3,4}. Maddocks-Jennings et al. launched the first randomised controlled trial of a k nuka product in 2009, testing a mouthwash made from diluted k nuka oil in patients undergoing radiation treatment for cancer⁵. Using the mouthwash delayed the development of

mucositis and had anti-inflammatory and analgesic effects.

Investigation into a possible mechanism of action for these anti-inflammatory effects by Chen et al. (2016) probed THP-1 macrophage cells' generation of the proinflammatory cytokines, tumour necrosis factor- (TNF-) and interleukin-4 (IL4)²⁴. Both k nuka and m nuka oils reduced the amount of TNF- released by these cells after they were stimulated with lipopolysaccharide, a known irritant from bacteria that induces a T-helper-mediated immune response. As IL4 production was not affected and treatment with the oils did not induce cytotoxicity in the cells, the oils were unlikely to be involved in allergic reactions due to cytokine release, suggesting it would be suitable to use in products without causing skin sensitisation. Because TNF- stimulates Th2 and Th17, which cause eczema lesions, a randomised controlled trial on a cream formulated with 3% k nuka oil to treat eczema was undertaken by Shortt et al. (2022). It showed significant improvement in patients using the cream compared to those using the vehicle control⁶.

Other Bioactivities

In tests by Lis-Balchin & Hart (1998) measuring the tension of guinea pig muscle tissue when stimulated with electrodes, contractions were inhibited when in the presence of k nuka oil²⁹. A follow up study by Lis-Balchin et al. (2000) found that k nuka oil had a spasmolytic action on chic biventer muscle and rat uterine muscle²². Simple spasmolytic actions were seen in smooth muscle treated with -terpineol and terpinen-4-ol, while an initial spasmogenic action followed by a spasmolytic action was observed with - and -terpinene, -pinene, and one of the -pinene enantiomers. 1,8-cineole and p-cymene increased muscle tone, decreasing the force of contractions.

Majid & Silva (2020) screened fifteen native New Zealand tree species for their potential against Alzheimer's disease by measuring their effects on enzymes involved in the formation of the -amyloid plaques associated with disease progression, as well as by analysing the plants' antioxidant activity³⁰. Extracts from the leaves of k nuka displayed excellent activity against the enzymes tested and performed moderately well as free radical scavengers. These researchers further optimised the extraction method of k nuka leaves in a 2021 study that identified ultrasound-assisted extraction as being superior to solvent extraction when creating extracts with high enzyme inhibition and antioxidant activity³¹.

The antioxidant capabilities of k nuka oil extracts have been used to uncover further information about the plant's constituents. Lis-Balchin et al. (2000) saw minor antioxidant activity from α -terpinene and terpinene-4-ol when evaluating the major components found in k nuka oil²². Essien et al. (2020) used free radical scavenging activity and ferric ion reduction assays to measure the yield of bioactive phenolic compounds when extracting k nuka oil under different subcritical water extraction (SWE) conditions, determining that this method had better efficacy than traditional

solvent extraction methods in recovering these compounds³². These findings were supported by Devadass et al. (2025), who evaluated the optimal SWE conditions for recovery of compounds with antioxidant activity³³. A study from Blockley-Powell et al. (2025) also demonstrated the antioxidant activity of k nuka oil as well as synergy with the FDA-approved drug rapamycin¹⁵.

Traditional & Modern Applications

K nuka and m nuka have been used in Rongo M ori for a range of health concerns ranging from gastrointestinal distresses to pain and wound care^{3,4}. Ashes of the k nuka and m nuka were applied directly to hair to treat dandruff and a scalp disease termed p tito, which was probably ringworm (a fungal infection), or mixed with infusions from other plants such as k whai to create a concoction that was rubbed into skin freshly scored with a sharp instrument to treat headaches. The bark of native trees was pounded and then boiled in water to create an infusion that was applied topically to treat muscular pains and rheumatism. Water that had been boiled with m nuka and k nuka was used to bathe eczema, chronic sores, and to disinfect wounds. Many reports from around New Zealand note its emetic and sedative effects when teas made with the leaves are ingested, and it was used to treat stomach ache, diarrhoea, and dysentery. Vapour from the boiled leaves was inhaled to alleviate viral illnesses, headaches, and respiratory complaints such as cough, bronchitis, blocked sinuses, hay fever, and asthma. Today, aromatherapists continue to employ k nuka oil as an inhalant and massage oil^{12,22}.

K nuka oil is abundant in the nutraceuticals industry, featuring prominently in products such as insect repellents, skin balms, and face creams. In 2023 alone, New Zealand exported USD\$2.68M of essential oils, of which a significant amount was from endemic species^{34,35}. Not only does k nuka contribute to the economy via commercialisation of its essential oil, but the plant could play a positive role in regulating local ecology by supporting habitation of threatened native bird species and maintaining soil stability in coastal areas prone to erosion³⁶.

Despite the known issues with collection of k nuka samples involving their taxonomic classification, which was revised in 2014 by de Lange², and the differences in chemical composition associated with different species, their geographical origin, and season of harvest, there are not currently any standards regarding the minimum chemical composition of k nuka oil sold for therapeutic use. Additionally, commercialisation of k nuka-containing products does not require any form of approval, and the advertised bioactive effects of these products may not be acting via any of the bioactivities stated above.

Conclusion

Of the papers reviewed in this article, the majority were antimicrobial studies, with seven antibacterial studies, seven antifungal studies, and one antiviral study (Figure 3). Although there have been relatively few studies into its anti-inflammatory and antioxidant effects, there have been only two randomised controlled trials of products featuring k nuka oil. These studies did not include follow-up on the long-term effects of k nuka oil nor examine whether there were any interactions, either positive or negative, with other drugs. However, Schnitzler et al (2008) noted that 1,8-cineole, one of the main constituents of k nuka oil (Table 1), affects hepatic enzymes of the P-450 cytochrome group¹⁷. The mechanism of action for any of the bioactivities is poorly understood, as few studies have identified which compound present in the oil is the one eliciting its biological effect.

A limitation of this review was not including studies involving *Kunzea* species from outside of New Zealand. There have been several studies using *Kunzea* plants from Australia, Japan, India, and England, and two randomised controlled trials investigating Australian *Kunzea* oil in formulations to treat skin diseases³⁸⁻⁴⁵. While *Kunzea* oil from Australia seems to have a similar chemical composition to k nuka oil, with α -pinene being the primary component, more research would be needed to look at finer ratios of α -pinene and other components to distinguish it from k nuka oil.

Potential future research could include more targeted antimicrobial studies that pinpoint the mechanism of action and active compound, beyond just measurement of growth inhibition by the crude extract. Given the clear effect on chemical composition of k nuka oil by geographic location and *Kunzea* species, identifying the key component responsible for each bioactivity would inform what conditions are ideal for growing and harvesting the plant. As k nuka cultivation is associated with ecological conservation, the commercialisation of k nuka may have a positive effect on the environment. Planting more k nuka will lead to positive ecological effects, increase jobs, and create an industry that would support M ori communities.

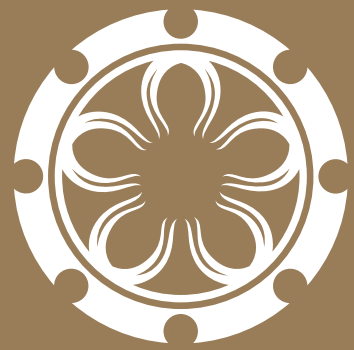
In summary, k nuka oil has had proven to be inhibitory against multiple microbes and could be a valuable anti-inflammatory agent. Its traditional use as a muscle relaxant is supported by evidence of its spasmolytic properties and studies suggest it may work as a potential antioxidant. K nuka's unique bioactivities have been attributed to its high levels of α -pinene, which distinguishes it from m nuka oil, which has higher levels of β -triketones instead. However, in vivo studies and randomised controlled trials have been limited, especially using k nuka oil. Continued investigations into the biological properties of k nuka oil is warranted to fully explore its therapeutic potential.

Identified Problem	Proposed Research and Applications
No regulation on composition of oils marketed as k nuka oil	Study on chemical profiles that identify and distinguish k nuka oil from other countries, and clearly distinguish k nuka from other plant species
Limited knowledge on specific compound of interest for each bioactivity	More in-depth assays exploring the individual constituents of k nuka oil and identification of ideal harvest conditions to maximise yield
Limited knowledge on Mechanism of Action for most bioactivities	Mechanism of Action studies to promote inclusion of k nuka oil for medical and agricultural purposes
Few clinical trials	More clinical trials investigating the use of k nuka oil beyond its efficacy on eczema

References

- (1) Fuller, I. D.; de Lange, P. J.; Burgess, E. J.; Sansom, C. E.; van Klink, J. W.; Perry, N. B. Chemical Diversity of K nuka: Inter- and Intraspecific Variation of Foliage Terpenes and Flavanones of *Kunzea* (Myrtaceae) in Aotearoa/New Zealand. *Phytochemistry* 2022, 196, 113098. <https://doi.org/10.1016/j.phytochem.2022.113098>.
- (2) Lange, P. de. A Revision of the New Zealand *Kunzea ericoides* (Myrtaceae) Complex. *PhytoKeys* 2014, 40, 1-185. <https://doi.org/10.3897/phytokeys.40.7973>.
- (3) Riley, M. *Māori Healing and Herbal*; Viking Sevenses N.Z. LTD: Paraparaumu, New Zealand, 1994.
- (4) Brooker, S. G.; Cambie, R. C.; Cooper, R. C. *New Zealand Medicinal Plants*, 2nd ed.; Heinemann Publishers: Auckland, New Zealand, 1987.
- (5) Maddocks-Jennings, W.; Wilkinson, J. M.; Cavanagh, H. M.; Shillington, D. Evaluating the Effects of the Essential Oils *Leptospermum scoparium* (Manuka) and *Kunzea ericoides* (Kanuka) on Radiotherapy Induced Mucositis: A Randomized, Placebo Controlled Feasibility Study. *Eur. J. Oncol. Nurs.* 2009, 13 (2), 87-93. <https://doi.org/10.1016/j.ejon.2009.01.002>.
- (6) Shortt, N.; Martin, A.; Kerse, K.; Shortt, G.; Vakalalabure, I.; Barker, L.; Singer, J.; Black, B.; Liu, A.; Eathorne, A.; Weatherall, M.; Rademaker, M.; Armour, M.; Beasley, R.; Semprini, A. Efficacy of a 3% K nuka Oil Cream for the Treatment of Moderate-to-Severe Eczema: A Single Blind Randomised Vehicle-Controlled Trial. *eClinicalMedicine* 2022, 51, 101561. <https://doi.org/10.1016/j.eclinm.2022.101561>.
- (7) Bloor, S. J. Antiviral Phloroglucinols from New Zealand *Kunzea* Species. *J. Nat. Prod.* 1992, 55 (1), 43-47. <https://doi.org/10.1021/np50079a006>.
- (8) Corbett, R. E.; Gibson, M. G. C. Extractives from the New Zealand Myrtaceae. V.—The volatile oil of *Leptospermum ericoides*. *J. Sci. Food Agric.* 1959, 10 (3), 198-200. <https://doi.org/10.1002/jsfa.2740100310>.
- (9) Haira, T. H.; Ooi, R. J.; Pay, R. A.; Paenga, B.; Caddie, M.; Skinner, D.; Harcourt, N.; Jackson, M.; Keyzers, R. A.; Munkacsi, A. B. Antimicrobial-Guided Metabolomic Analysis of Essential Oil Derived from the Aotearoa New Zealand Endemic Plant *Kunzea robusta* (K nuka). *Fitoterapia* 2025, 184, 106592. <https://doi.org/10.1016/j.fitote.2025.106592>.
- (10) Perry, N. B.; Van Klink, J. W.; Brennan, N. J.; Harris, W.; Anderson, R. E.; Douglas, M. H.; Smallfield, B. M. Essential Oils from New Zealand Manuka and Kanuka: Chemotaxonomy of *Kunzea*. *Phytochemistry* 1997, 45 (8), 1605-1612. [https://doi.org/10.1016/S0031-9422\(97\)00203-3](https://doi.org/10.1016/S0031-9422(97)00203-3).
- (11) Angane, M.; Swift, S.; Huang, K.; Perera, J.; Chen, X.; Butts, C. A.; Quek, S. Y. Synergistic Antimicrobial Interaction of Plant Essential Oils and Extracts against Foodborne Pathogens. *Food Sci. Nutr.* 2024, 12 (2), 1189-1206. <https://doi.org/10.1002/fsn3.3834>.
- (12) Maddocks, W. Diversity in the Essential Oil of New Zealand Grown K nuka, *Kunzea ericoides* (A. Rich) Joy Thomps. *Am. J. Essent. Oils Nat. Prod.* 2021, 9 (1), 32-38.
- (13) Fuller, I. D.; de Lange, P. J.; Burgess, E. J.; Sansom, C. E.; van Klink, J. W.; Perry, N. B. Chemical Diversity of K nuka: Inter- and Intraspecific Variation of Foliage Terpenes and Flavanones of *Kunzea* (Myrtaceae) in Aotearoa/New Zealand. *Phytochemistry* 2022, 196, 113098. <https://doi.org/10.1016/j.phytochem.2022.113098>.
- (14) Lewe, N.; Young, M.; Vorster, J.; Paenga, B.; Skinner, D.; Harcourt, N.; Lange, P. J.; Haira, T.; Blockley-Powell, S.; Munkacsi, A.; Keyzers, R. Comparison of Chemical Profiles of Kanuka (*Kunzea robusta* de Lange & Toelken, Myrtaceae) Essential Oils. *Phytochem. Lett.* 2023, 56, 50-56. <https://doi.org/10.1016/j.phytol.2023.06.006>.
- (15) Blockley-Powell, S.; Andreassend, S.; Paenga, B.; Skinner, D.; Harcourt, N.; Caddie, M.; Moreno, T.; Tallon, S.; Keyzers, R. A.; Munkacsi, A. B. Indigenous Community-Guided Chemical Genomic Insight into Synergy of Rapamycin with Nerolidol Derived from a Leaf Extract of K nuka (*Kunzea robusta*) in Tair whiti, Aotearoa New Zealand. *Phytomedicine Plus* 2025, 5 (2), 100771. <https://doi.org/10.1016/j.phyplu.2025.100771>.
- (16) Perry, N. B.; Brennan, N. J.; Van Klink, J. W.; Harris, W.; Douglas, M. H.; McGimpsey, J. A.; Smallfield, B. M.; Anderson, R. E. Essential Oils from New Zealand Manuka and Kanuka: Chemotaxonomy of *Leptospermum*. *Phytochemistry* 1997, 44 (8), 1485-1494. [https://doi.org/10.1016/S0031-9422\(96\)00743-1](https://doi.org/10.1016/S0031-9422(96)00743-1).
- (17) Schnitzler, P.; Wiesenhofer, K.; Reichling, J. Comparative Study on the Cytotoxicity of Different Myrtaceae Essential Oils on Cultured Vero and RC-37 Cells. *Pharm.* 2008, 63 (11), 830-835.
- (18) Porter, N. G.; Wilkins, A. L. Chemical, Physical and Antimicrobial Properties of Essential Oils of *Leptospermum scoparium* and *Kunzea ericoides*. *Phytochemistry* 1999, 50 (3), 407-415. [https://doi.org/10.1016/S0031-9422\(98\)00548-2](https://doi.org/10.1016/S0031-9422(98)00548-2).
- (19) Porter, N. G.; Smale, P. E.; Nelson, M. A.; Hay, A. J.; Van Klink, J. W.; Dean, C. M. Variability in Essential Oil Chemistry and Plant Morphology within a *Leptospermum scoparium* Population. *N. Z. J. Bot.* 1998, 36 (1), 125-133. <https://doi.org/10.1080/0028825X.1998.9512551>.
- (20) Thompson, J. Redefinitions and Nomenclatural Changes within the *Leptospermum suballiance* of Myrtaceae. *Telopea* 1983, 2 (4), 379-383. <https://doi.org/10.7751/telopea19834403>.
- (21) Lis-Balchin, M.; Deans, S.; Hart, S. Bioactivity of New Zealand Medicinal Plant Essential Oils. *Acta Hort.* 1996, No. 426, 13-30. <https://doi.org/10.17660/ActaHortic.1996.426.1>.
- (22) Lis-Balchin, M.; Hart, S. L.; Deans, S. G. Pharmacological and Antimicrobial Studies on Different Tea-Tree Oils (*Melaleuca alternifolia*, *Leptospermum scoparium* or Manuka and *Kunzea ericoides* or Kanuka), Originating in Australia and New Zealand. *Phytother. Res.* 2000, 14 (8), 623-629. [https://doi.org/10.1002/1099-1573\(200012\)14:8<623::AID-PTR763>3.0.CO;2-Z](https://doi.org/10.1002/1099-1573(200012)14:8<623::AID-PTR763>3.0.CO;2-Z).

- (23) Christoph, F.; Kaulfers, P.-M.; Stahl-Biskup, E. A Comparative Study of the in Vitro Antimicrobial Activity of Tea Tree Oils s.l. with Special Reference to the Activity of α -Triketones. *Planta Med.* 2000, 66, 556–560. <https://doi.org/10.1055/s-2000-8604>.
- (24) Chen, C.-C.; Yan, S.-H.; Yen, M.-Y.; Wu, P.-F.; Liao, W.-T.; Huang, T.-S.; Wen, Z.-H.; Wang, H.-M. D. Investigations of Kanuka and Manuka Essential Oils for in Vitro Treatment of Disease and Cellular Inflammation Caused by Infectious Microorganisms. *J. Microbiol. Immunol. Infect.* 2016, 49 (1), 104–111. <https://doi.org/10.1016/j.jmii.2013.12.009>.
- (25) Kaur, R.; Kaur, L.; Gupta, T. B.; Bronlund, J. M. nuka Oil vs. Rosemary Oil: Antimicrobial Efficacies in Wagyu and Commercial Beef against Selected Pathogenic Microbes. *Foods* 2023, 12 (6), 1333. <https://doi.org/10.3390/foods12061333>.
- (26) Perry, N. B.; Van Klink, J. W.; Brennan, N. J.; Harris, W.; Anderson, R. E.; Douglas, M. H.; Smallfield, B. M. Essential Oils from New Zealand Manuka and Kanuka: Chemotaxonomy of *Kunzea*. *Phytochemistry* 1997, 45 (8), 1605–1612. [https://doi.org/10.1016/S0031-9422\(97\)00203-3](https://doi.org/10.1016/S0031-9422(97)00203-3).
- (27) Maddocks, W.; Tayagui, A.; Collins, B.; Williams, O.; Garrill, A. Evaluating the Effects of K nuka Essential Oil (*Kunzea ericoides*) Grown in Different Locations in New Zealand on Two Pathogenic Dermatophytes: An *in Vitro* Study. *Am. J. Essent. Oils Nat. Prod.* 2021, 9 (2), 28–33.
- (28) Lawrence, S. A.; Burgess, E. J.; Pairama, C.; Black, A.; Patrick, W. M.; Mitchell, I.; Perry, N. B.; Gerth, M. L. M. tauranga-Guided Screening of New Zealand Native Plants Reveals Flavonoids from K nuka (*Kunzea robusta*) with Anti-Phytophthora Activity. *J. R. Soc. N. Z.* 2019, 49 (sup1), 137–154. <https://doi.org/10.1080/03036758.2019.1648303>.
- (29) Lis-Balchin, M.; Hart, S. L. An Investigation of the Actions of the Essential Oils of Manuka (*Leptospermum scoparium*) and Kanuka (*Kunzea robusta*), Myrtaceae on Guinea-Pig Smooth Muscle. *J. Pharm. Pharmacol.* 1998, 50 (7), 809–811. <https://doi.org/10.1111/j.2042-7158.1998.tb07144.x>.
- (30) Majid, H.; Silva, F. V. M. Inhibition of Enzymes Important for Alzheimer's Disease by Antioxidant Extracts Prepared from 15 New Zealand Medicinal Trees and Bushes. *J. R. Soc. N. Z.* 2020, 50 (4), 538–551. <https://doi.org/10.1080/03036758.2020.1741403>.
- (31) Majid, H.; Silva, F. V. M. Kanuka Bush Leaves for Alzheimer's Disease: Improved Inhibition of α -Secretase Enzyme, Antioxidant Capacity and Yield of Extracts by Ultrasound Assisted Extraction. *Food Bioprod. Process.* 2021, 128, 109–120. <https://doi.org/10.1016/j.fbp.2021.04.018>.
- (32) Essien, S.; Young, B.; Baroutian, S. Subcritical Water Extraction for Selective Recovery of Phenolic Bioactives from K nuka Leaves. *J. Supercrit. Fluids* 2020, 158, 104721. <https://doi.org/10.1016/j.supflu.2019.104721>.
- (33) Devadass, I.; Swift, S.; Sreebhavan, S.; Baroutian, S. Subcritical Water Extraction of K nuka (*Kunzea ericoides*): A Qualitative Analysis of Bioactive Profile Based on Antioxidant Properties. *Mol. Biotechnol.* 2025. <https://doi.org/10.1007/s12033-025-01399-4>.
- (34) *Essential oils, nes in New Zealand Trade*. The Observatory of Economic Complexity. <https://oec.world/en/profile/bilateral-product/essential-oils-nes/reporter/nzl> (accessed 2025-07-21).
- (35) *Stats NZ: Tauranga Aotearoa*. stats.govt.nz/tools/2018-census-ethnic-group-summaries (accessed 2023-06-03).
- (36) Ekanayake, J. C.; Marden, M.; Watson, A. J.; Rowan, D. Tree Roots and Slope Stability: A Comparison Between *Pinus radiata* and K nuka. *N. Z. J. For. Sci.* 1997, 27 (2), 216–233.
- (37) Rolfe, J.; de Lange, P.; Lopez-Ubiria, I.; Vidiella-Salaberry, A.; Paenga, B.; Mulvaney, J.; Harcourt, N.; MacLeod, K.; Whare, T. K nuka Handbook, 2020. <https://www.mpi.govt.nz/dmsdocument/39887-Kanuka-Handbook-FINAL.PDF>.
- (38) Thomas, J.; Narkowicz, C.; Peterson, G. M.; Jacobson, G. A.; Narayana, A. Randomised Controlled Trial of the Treatment of Pastern Dermatitis with a Formulation Containing *Kunzea* Oil. *Vet. Rec.* 2009, 164 (20), 619–623. <https://doi.org/10.1136/vr.164.20.619>.
- (39) Ito, H.; Kasajima, N.; Tokuda, H.; Nishino, H.; Yoshida, T. Dimeric Flavonol Glycoside and Galloylated C-Glucosylchromones from *Kunzea ambigua*. *J. Nat. Prod.* 2004, 67 (3), 411–415. <https://doi.org/10.1021/np030367s>.
- (40) Thomas, J.; Narkowicz, C. K.; Jacobson, G. A.; Peterson, G. M. Safety and Efficacy of *Kunzea* Oil-Containing Formulations for the Management of Psoriasis: A Randomized, Controlled Trial. *J. Clin. Pharm. Ther.* 2015, 40 (5), 566–572. <https://doi.org/10.1111/jcpt.12311>.
- (41) Park, C. G.; Jang, M.; Shin, E.; Kim, J. Myrtaceae Plant Essential Oils and Their α -Triketone Components as Insecticides against *Drosophila suzukii*. *Mol. J. Synth. Chem. Nat. Prod. Chem.* 2017, 22 (7), 1050. <https://doi.org/10.3390/molecules22071050>.
- (42) Khambay, B. P. S.; Beddie, D. G.; Simmonds, M. S. J.; Green, P. W. C. A New Insecticidal Pyranocyclohexenedione from *Kunzea ericifolia*. *J. Nat. Prod.* 1999, 62 (10), 1423–1424. <https://doi.org/10.1021/np9900573>.
- (43) Khambay, B. P. S.; Beddie, D. G.; Hooper, A. M.; Simmonds, M. S. J. Isolation, Characterisation and Synthesis of an Insecticidal Tetramethyltetrahydrochromenedione-Spiro-Bicyclo[3.1.1]Cycloheptane from Two Species of Myrtaceae. *Tetrahedron* 2003, 59 (36), 7131–7133. [https://doi.org/10.1016/S0040-4020\(03\)01095-0](https://doi.org/10.1016/S0040-4020(03)01095-0).
- (44) He, X.; Li, P.; Zhao, S.; Liu, H.; Tang, W.; Xie, J.; Tang, J. *Kunzea ericoides* (Kanuka) Leaf Extracts Show Moisturisation, Antioxidant, and UV Protection Effects in HaCaT Cells and Anti-Melanogenesis Effects in B16F10 Cells. *Appl. Biochem. Biotechnol.* 2024, 196 (12), 8892–8906. <https://doi.org/10.1007/s12010-024-04989-1>.
- (45) Yetukuri, K.; Umashankar, M. S. Development and Optimization of *Kunzea ericoides* Nanoemulgel Using a Quality by Design Approach for Transdermal Anti-Inflammatory Therapy. *Gels* 2025, 11 (6), 400. <https://doi.org/10.3390/gels11060400>.



HĀ KĀNUKA

www.hakanuka.co.nz