



Jill Mulvaney

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With over 25 years of experience, Jill now teaches and consults on all aspects of plant extraction, aroma, and natural flavour, advancing ideas and products that can be utilised across a broad range of industries. Jill leads regular events and workshops that educate people about the exciting possibilities of botanical distillation and plant extraction, and her teaching will be available online soon at The Alembics Lab.

Jill is passionate about the character of plants, the alchemical wonder of distillation, and enjoys sharing her knowledge with others. Jill's formative years, growing up on an isolated farm in Hawkes Bay, her recent teaching partnerships with internationally renowned phytochemists and aromatic distillers in Europe and America, and her experience distilling New Zealand and Australian natives, forms the basis of her deep engagement with the natural world—which remains her greatest inspiration.

JILL MULVANEY

Learning from *Piper excelsum* (Kawakawa)

When the experiential and the scientific come together: My perspective as a distiller and a maker.

I have been distilling *Piper excelsum* (kawakawa) for many years, and the goalposts always seem to be shifting. I don't think it's the kawakawa as much as my own experience and intent each time I work with this plant.

My first memory of distilling *Piper excelsum* was about fifteen years ago at a workshop on the Kapiti Coast. I didn't know much about the plant yet, apart from the botanical name but that's always a good start as correct naming and identification is

key for safety. What I did know: it's a native, has lovely green heart-shaped leaves, a strange peppery taste and smell, and was often used by Rongoā practitioners and herbalists. I also knew that while it had been used for centuries by Māori, at this time I can't remember it being a popular mainstream tea nor were there many *Piper excelsum* products on the shelves, so I was coming into this with curiosity and an open mind.

This first experience was a hydro distillation at the height of summer.

Kawakawa Hydrosol



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Kawakawa

The *Piper excelsum* we used were harvested on the outskirts of a patch of native bush near a stream on the Kapiti Coast on a hot, sunny day. After the distillation I remember everyone being surprised at both the appearance and taste of the resulting hydrosol. It was like mist—cloudy and saturated, and had a strong vegetative, herby-green aroma and taste. On this hot day it was incredibly inviting, so I diluted some and we all had a cold drink. I still remember the clean feeling in my mouth and the peppery, numbing effect.

When distilling at workshops we always engage our audience in an organoleptic discussion—what's

the primary taste, is it bitter, sweet, sour, salty? Does it change over time? What's the sensation in the mouth—dry, wet, harsh, smooth or oily? Then breathe. On the outward breath—what does the aroma remind you of? Can you make an association with the taste and smell? Are you feeling any sensations in your body? In our workshops we are always clear from the outset—we are not here to discuss health issues, and we are not in the business of fixing and prescribing. However, it is natural that this exploration often leads to people sharing what they have used the plant and product for or, invariably, Rongoā practitioners sharing their experiences.

Piper excelsum is used extensively in Rongoā herbal practice to relieve a large array of symptoms. It also plays a significant role in Māori culture and spirituality as well as being a food and medicine. This plant traditionally appears throughout everyday Māori life, there are so many stories about *Piper excelsum*. These experiential and traditional testimonies are valuable for building knowledge and awareness of the plants you're working with, so I always listen with interest. Which is why I would like to share some of my own early personal experiences with *Piper excelsum*.

On the way home from this first *Piper excelsum* distillation (where we had been drinking that refreshing hydrosol), our van broke down. We were stranded on the roadside in the middle of the countryside—at least a better option than on the motorway. It was such a sunny, warm day and I was reminded of my childhood walking down the country roads in summer and the plethora of wild plants that grew there.

As we waited, I lay spreadeagled amongst *Plantago lanceolata* (plantain), *Achillea millefolium* (yarrow), grasses, and daisies from the highly fragrant Asteraceae family. The heat of my body released the volatiles, and I was infused with the aromas of cut grass, (which I now know is from the aromatic molecule coumarin) and the intensity of yarrow (camphoraceous—from a-pinene, and spicy—from borneol).

Once our van was fixed, I had to rouse myself, get up, and get on the road again. I had a hard lump on my shoulder, which had been there for some years. When I sat up, I noticed my shirt felt quite wet and I assumed it was sweat. But once I was in the van I became aware of a hot spot where the lump was—it had opened and spilled its contents. Immediately I could taste and smell *Piper excelsum*. To this day my thoughts are that it was the *Piper excelsum* hydrosol working quietly away, in synergy with the aromatics I was infusing myself with and the heat of the day.

This moment has stayed with me over the years, and I've been mindful when using *Piper excelsum* ever since—she may not be toxic, but she's a powerful force.

That's an example of an experiential effect. For me, that describes a situation where you have tried something without much prior experience or research. So, coming from a naïve state of mind. In this instance, the senses were engaged through distillation, smell, touch, taste and sharing. A relationship grew, and an intuitive understanding began based on these sensory experiences and outcomes. My intuitive understanding was now taking shape and forming ideas—*Piper excelsum* may loosen or unblock, allowing flow in your body. My next step was to see if a similar effect would happen again and if it would happen similarly to others. So, on a physical level, I tried this by using the hydrosol as a compress and adding the hydrosol to water—to drink for stiff muscles, congestion and splinters. I found a change occurred. I have run many workshops over the years at the Auckland Botanic Gardens through all the seasons. *Piper excelsum* was a go-to for our hydro-distillation demonstration as it grows abundantly there, and we had permission from the garden to harvest. We collected from all around our venue where it was springing out with vitality.

Each workshop would bring the same surprise at the misty hydrosol and its smell and taste. We would always taste it on its own, and sometimes I would also mix it with ginger and lemon, as those flavours, aromas and effects seemed to work very well together.

After we have gone through our organoleptic discussion people's curiosity is aroused. Many may have never thought of this common native as a useful plant for health and wellbeing, let alone thought to distil it. Questions are asked and it's my responsibility to be as accurate as possible in answering. We can

share our experiential knowledge, of course, but if we can back that up with current research and analytical data, it makes it much more authentic (and safe). We can also understand why an effect may be happening and look for other applications.

It's at this point that I want to share another experiential story. We were asked to distil a large quantity of *Piper excelsum* hydrosol for a commercial product. We had permission to harvest in a council park, as it suited them to have the trees cut back. As the winter had been unusually warm and extremely wet, the *Piper excelsum* was luxuriant and produced a lot of buds. I spent time with her, harvesting, distilling, tasting and admiring. I was going through a transition at the time and was personally feeling quite stuck, not knowing which way to go. I was greatly comforted and felt supported by being around this plant. I felt a strong impulse to engage by drinking the tea and hydrosol—working on ways we could get together—and moved on to designing a *Piper excelsum* botanical martini (with zero alcohol). Working with *Piper excelsum* on this day led me in new directions, which was what I needed. The recipe has been incredibly successful and one that I use often (you'll find it on The Alembics Lab site, in our blog called 'The

Archive' www.thealembicslab.com). Once I have had these types of experiences with a plant, I delve into the research as well as other people's experiences—the next step is to find as much relevant written information as I can. Like many of our natives, the research on *Piper excelsum* is limited but there are some useful sources. Murdoch Riley's book 'Māori Healing and Herbal – New Zealand Ethnobotanical Sourcebook'¹ is one such text (and one you may already be very familiar with). Riley has collected hundreds of pages of information on the medicinal use of NZ plants which illustrates the extent of Māori knowledge and use gathered over centuries. Riley outlines how *Piper excelsum* is used extensively in Rongoā herbal practice and plays a significant role in Maori culture on a spiritual basis, as well as for food and medicine. The word 'kawa' means bitter, and 'protocol' indicating the plant's cultural significance (kawa or tikanga). It is a taonga (highly prized) plant for Māori including as a luck charm for women trying to get pregnant, at naming ceremonies, and for removing tapu (sacred, spiritual restriction) during the opening of a new meeting house, launching a new canoe or as a symbol of mourning.

Encouragingly, there are also growing numbers of journal artic-

les. From the early (1987) article in Economic Botany journal titled *New Zealand Medicinal Plants* I found that 'medicinal uses of kawakawa by Māori include relieving a range of ailments (eczema, boils, rheumatism, toothache), as a general tonic and for the treatment of various genito-urinary, dermatological, gastrointestinal and respiratory complaints'.² This certainly piqued my interest considering the experience I had with the hard lump on my back. Since the time of that first distillation (when I hadn't encountered many *Piper excelsum* products on the shelves) there's been a surge in commercial interest in *Piper excelsum*. There are a number of products available to buy, in particular teas and tisanes. This commercial interest has the benefit of sparking off more research to ensure the safety (and therefore viability) of these products, and I read several articles with interest, including a 2018 article in the Journal of Ethnopharmacology that contained helpful information on the chemical constituents of the plant.³

Something I was able to do myself was testing—by sending samples to Phytochemia, a leading independent laboratory based in Quebec that specialises in the analysis of plants and natural products. Thankfully, I have collegial relationships with them, and they always look forward to the samples I send—especially if they are NZ natives, as they are so new to them. So (as often as I dare) I send samples for GCMS analysis, as it is a process that lends itself well to the analysis of the volatile molecules which is EOs and hydrosols. Phytochemia's Alexis St-Gelais explains that essential oils are therefore particularly suited to GC analysis, as they are by definition composed almost exclusively of volatile substances.⁴

By volatiles, we are talking about tiny molecules that become gaseous at different temperatures. They mainly consist of terpenes (monoterpenes and sesquiterpenes), esters, alcohols, ketones, phenolics and phenylpropanoids. They are just one of the many secondary plant metabolites



Kawakawa essential oil is denser than water, so unlike most essential oils it will sit underneath the aqueous part of a distillation.

produced by plants to induce flowering, attract pollinators, protect the plant from bacteria and fungi and repel predators.⁵ They are the main components of essential oils. There was yet another benefit that came from that second story I have just related. In distilling such a large amount of *Piper excelsum* for that commercial client, I managed to harvest a very small amount of essential oil. Like many NZ natives, *Piper excelsum* does not usually produce any measurable quantity of essential oil in distillations, but you may see a few drops of the EO collecting on the surface of your hydrosol in a large distillation. It then floats to the bottom (yes, it sinks)—as like *Chrysopogon zizanioides* (vetiver) and *Syzygium aromaticum* (clove) it is denser than water, and then most times it will become re-integrated with the hydrosol. But in this large-scale commercial distillation I managed to get several millilitres of EO. It was a delightful bonus. So now I had both hydrosol and EO to send to the Phytochemia Labs. In 2018 I sent a sample of *Piper excelsum* hydrosol and a tiny 1ml sample of EO to be

tested by GCMS. The classes on both analyses are quite different. The EO classes are mainly terpenes and you can see there are no terpenes in the hydrosol. This is because terpenes have low polarity and are not soluble in water. The classes you see in the hydrosol have a higher polarity so small amounts will be present.

Myristicin is the main constituent in both essential oil and hydrosol. It is present in high percentage concentrations in *Nasturtium officinale* (watercress), *Perilla frutescens* (perilla), *Myristica fragrans* (nutmeg), *Zingiber officinale* (ginger), *Piper chaba* (piper chilli), *Piper sarmentosum* (lolo pepper or wild betel) and *Piper interruptum*. Noticeably all these piper species mentioned are also similar in appearance to *Piper excelsum*.

Myristicin has antioxidant, anti-inflammatory, analgesic, antiproliferative, antimicrobial and insecticidal properties.⁶ Most of these actions I experienced in my naive use of *Piper excelsum* and are present in many writings about *Piper excelsum*. Myristicin also has a reputation for

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RESULTS OF THE GCMS BY PHYTOCHEMIA OF A SAMPLE OF PIPER EXCELSUM HYDROSOL*
Highlighted are the major constituents

IDENTIFICATION	(mg/L) ††	%	Classe
Diacetone alcohol	tr	<0.10	Aliphatic alcohol
(3Z)-Hexenol	0.1	0.15	Aliphatic alcohol
2-Heptanone	tr	<0.10	Aliphatic ketone
2-Heptanol	0.6	0.88	Aliphatic alcohol
1,8-Cineole	6.2	9.11	Monoterpenic ether
2-Heptyl acetate	2.1	3.09	Aliphatic ester
Fenchone	tr	<0.10	Monoterpenic ketone
Linalool	3.8	5.58	Monoterpenic alcohol
Phenylethyl alcohol	tr	<0.10	Simple phenolic
Maltol	tr	<0.10	Aliphatic alcohol
Isophorone	tr	<0.10	Normonoterpenic ketone
Camphor	1.6	2.35	Monoterpenic ketone
Camphene hydrate	0.2	0.29	Monoterpenic alcohol
Isoborneol	0.2	0.29	Monoterpenic alcohol
Borneol	tr	<0.10	Monoterpenic alcohol
δ-Terpineol	0.1	0.15	Monoterpenic alcohol
Menthol	0.1	0.15	Monoterpenic alcohol
Terpinen-4-ol	0.4	0.59	Monoterpenic alcohol
α-Terpineol	5.8	8.52	Monoterpenic alcohol
Methyl salicylate	0.1	0.15	Phenolic ester
Verbenone	0.1	0.15	Monoterpenic ketone
Benzothiazole	tr	<0.10	Thiazole
Ethylmethylmaleimide	tr	<0.10	Succinimide
Carvone	tr	<0.10	Monoterpenic ketone
Phenylethyl acetate	0.1	0.15	Phenolic ester
Geraniol	tr	<0.10	Monoterpenic alcohol
Methyl hydrocinnamate	0.2	0.29	Phenylpropanoid ester
α-Terpinyol acetate	0.1	0.15	Monoterpenic ester
Eugenol	0.2	0.29	Phenylpropanoid
Dihydrocinnamic acid	2.5	3.67	Phenylpropanoid
Methyleugenol	1.7	2.50	Phenylpropanoid
(E)-Cinnamyl acetate	0.3	0.44	Phenylpropanoid ester
Butylated hydroxytoluene (BHT)	0.1	0.15	Synthetic
Myristicin	19.1	28.07	Phenylpropanoid
Elemicin	11.6	17.04	Phenylpropanoid
8-Acetoxy-carvotanacetone	0.3	0.44	Monoterpenic ester
(E)-para-Methoxycinnamyl alcohol	0.1	0.15	Phenylpropanoid
Spathulenol	tr	<0.10	Sesquiterpenic alcohol
Amyl salicylate	tr	<0.10	Phenolic ester
Methoxyeugenol	0.2	0.29	Phenylpropanoid
α-Muurolol	0.1	0.15	Sesquiterpenic alcohol
α-Cadinol	0.1	0.15	Sesquiterpenic alcohol
Lauryl acrylate	tr	<0.10	Synthetic
Irgacure 184	0.1	0.15	Synthetic
Unknown	0.1	0.15	Phenylpropanoid
(E)-Hexylcinnamaldehyde	0.1	0.15	Synthetic
Dibutyl phthalate	0.1	0.15	Synthetic
Unknown	0.1	0.15	Unknown
1-Cinnamoylpiperidine	0.1	0.15	Alkaloid
Unknown	0.1	0.15	Unknown

*When comparing the tables, note that the essential oil constituents are expressed as a percentage, whereas in the hydrosol, it is mg/L.

RESULTS OF THE GCMS BY PHYTOCHEMIA OF A SAMPLE OF PIPER EXCELSUM ESSENTIAL OIL*
Highlighted are the major constituents

IDENTIFICATION	DB-5(mg/L)	DB-Wax(mg/L)	Class
Myristicin	69.29*	68.95	Phenylpropanoid
β-Caryophyllene	1.77*	[1.64]*	Sesquiterpene
α-Terpinyol acetate	1.11*	0.87	Monoterpenic ester
1,8-Cineole	0.31*	0.07	Monoterpenic ether
9-epi-β-Caryophyllene	0.17*	0.04	Sesquiterpene
Isobornyl acetate	0.15*	1.64*	Monoterpenic ester
τ-Cadinol	0.15*	0.07	Sesquiterpenic alcohol
Aromadendrene	0.07*	0.03	Sesquiterpene
δ-Cadinene	[69.29]*	[0.41]*	Sesquiterpene
β-Ylangene	[1.77]*	0.17*	Sesquiterpene
α-Cubebene	[1.11]*	0.28	Sesquiterpene
Limonene	[0.31]*	0.24	Monoterpene
(E)-β-Farnesene	[0.17]*	0.09	Sesquiterpene
Bornyl acetate	[0.15]*	0.25*	Monoterpenic ester
τ-Muurolol	[0.15]*	0.10	Sesquiterpenic alcohol
(Z)-β-Farnesene?	[0.07]*	0.07	Sesquiterpene
Germacrene D	8.44	8.40*	Sesquiterpene
γ-Muurolene	3.82	[3.83]*	Sesquiterpene
Elemicin	2.01	2.32*	Phenylpropanoid
2-Heptyl acetate	1.75	1.75	Aliphatic ester
Bicyclogermacrene	1.73	2.90*	Sesquiterpene
α-Zingiberene	1.12	[2.90]*	Sesquiterpene
allo-Aromadendrene	1.00	[1.06]*	Sesquiterpene
(E)-Nerolidol	0.61	0.62*	Sesquiterpenic alcohol
β-Bisabolene	0.47	0.37	Sesquiterpene
β-Bourbonene	0.40	0.37	Sesquiterpene
Methyleugenol	0.37	0.42	Phenylpropanoid
α-Humulene	0.26	0.23	Sesquiterpene
α-Muurolene	0.24	[2.90]*	Sesquiterpene
α-Muurolol	0.24	0.25	Sesquiterpenic alcohol
Camphene	0.17	0.18	Monoterpene
β-Elemene	0.17	[0.25]*	Sesquiterpene
(E)-Cinnamyl acetate	0.16	0.14	Phenylpropanoid ester
Terpinyl acetate analog	0.15	3.83*	Monoterpenic ester
β-Copaene	0.15	[0.17]*	Sesquiterpene
ar-Curcumene	0.15	0.17	Sesquiterpene
Germacrene D-4-ol	0.14	0.09	Sesquiterpenic alcohol
α-Cadinol	0.14	[2.32]*	Sesquiterpenic alcohol
α-Pinene	0.11	0.12	Aliphatic alcohol
Myrcene	0.11	0.07	Monoterpene
(E)-β-Ocimene	0.11	0.09	Monoterpene
2-Nonyl acetate	0.11		Aliphatic ester
γ-Cadinene	0.11	0.41*	Sesquiterpene
α-Copaene	0.10	0.14	Sesquiterpene
(Z)-β-Ocimene	0.08	0.06	Monoterpene
Isogermacrene D	0.08	1.06*	Sesquiterpene
Viridiflorol	0.07	0.07	Sesquiterpenic alcohol
Linalool	0.06	0.06	Monoterpenic alcohol
γ-Amorphene	0.06	[8.40]*	Sesquiterpene
β-Pinene	0.05	0.06	Monoterpene
Camphor	0.05	0.05	Monoterpenic ketone
α-Terpineol	0.05	0.04	Monoterpenic alcohol
α-Ylangene	0.05	0.10	Sesquiterpene
Globulol	0.05	0.05	Sesquiterpenic alcohol
Spathulenol	0.04	0.16	Sesquiterpenic alcohol
1-epi-Cubenol	0.04	[0.62]*	Sesquiterpenic alcohol
Methyl hydrocinnamate	0.03	0.02	Phenylpropanoid ester
Ledol	0.03		Sesquiterpenic alcohol

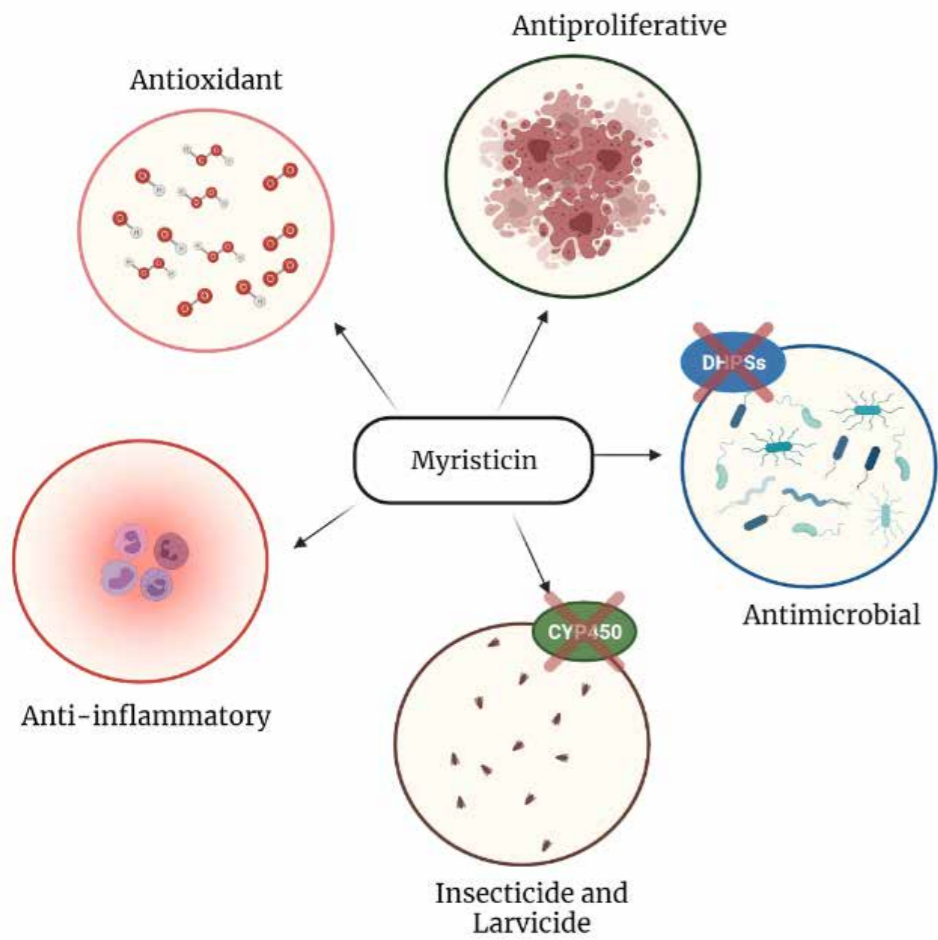


Illustration: Graphical representation of the main biological activities of myristicin

having a psychoactive effect, however it's dose-related and you will be hard-pressed to ingest enough of these plants to experience anything. For instance, eating a whole nutmeg would be more than challenging let alone four or five. However, it's important to be aware when a constituent of a plant has psychoactive properties.

However, there's a lot more going on in *Piper excelsum* than just myristicin and it has been noted that myristicin often works in synergy with other constituents. You can see the complexity of the essential oil and hydrosol by the sheer number of minor constituents which all play out in the synergy of the plant.

I'm not a trained medical herbalist,

I'm just curious about the plants I work with when I am distilling and making products. But now when I make a *Piper excelsum* tea, I add some hydrosol to replace these complex volatiles that will be compromised by the infusion's heat and loss through vapour. I can't get the terpenes back (as they are not water soluble) and the EO yield is so low that I only have a few precious millilitres in my collection, but I can replace all the water-soluble ones that are present in a hydrosol. It's just one of the many ways I use this hydrosol, which features often in my work at The Alembics Lab. In fact, *Piper excelsum* hydrosol is one of my favoured drinks. 15mls poured over ice and topped up with soda, garnished with a slice of lemon and a thin slice of ginger—is really quite

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special, just like the tree. As a product it's an easy introduction to the world of distilling, and I encourage you to try it yourself. Eventually you may even find yourself with that valuable little bonus of a couple of drops of essential oil to do with what you will. And being so rare, you'll treasure it, like I do.

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