Essential Oils: A new idea for postharvest disease control.

By Jenny Jobling

There is increasing public concern over the level of pesticide residues in food. This concern has encouraged researchers to look for other solutions to synthetic pesticides. Recently there has been considerable interest in GRAS (generally regarded as safe) compounds. Naturally occurring biologically active compounds from plants are an examples of GRAS compounds. These plant extracts are generally assumed to be more acceptable and less hazardous than synthetic compounds. This means that essential oils that are registered food grade materials, could be used as alternative anti-fungal and anti-bacterial treatments for fresh produce. The potential for these types of plant extracts is considerable. It is a resource that has not been fully explored. Megan Szczerbanik from the University of Western Sydney, Hawkesbury and Robyn McConchie from the University of Sydney are currently working with Sydney Postharvest Laboratory looking at the use of essential oils for the control of postharvest pathogens.

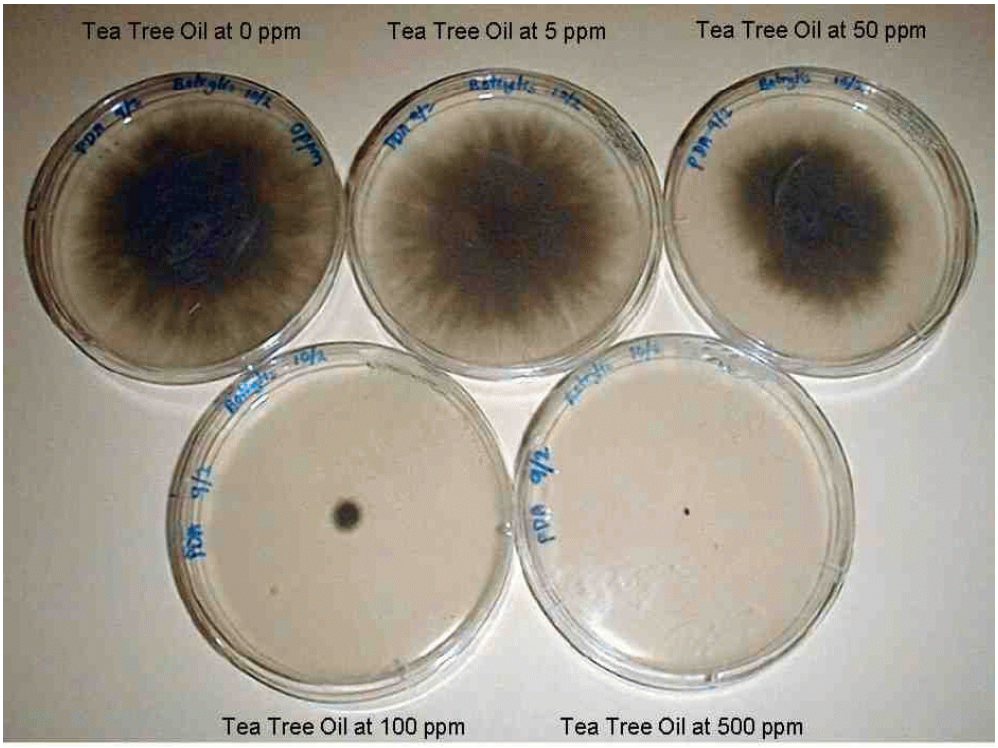
Essential oils are made up of many different volatile compounds and the make up of the oil quite often varies between species. It seems that the anti-fungal and anti-microbial effects are the result of many compounds acting synergistically. These means that the individual components by themselves are not as effective.

Quite a lot of preliminary work has been done to demonstrate the potential of essential oils for use against postharvest pathogens. One group of researchers tested the antifungal activity of a range of essential oils against *Botrytis cinerea*. Botrytis is the main postharvest pathogen of fresh grapes. Their work showed that essential oils from red thyme (*Thymus zygis*), clove buds (*Eugenia caryophyllata*) and cinnamon leaf (*Cinnamomum zeylanicum*) prevented the growth of *Botrytis cinerea*. Other researchers have shown that the essential oil of *Monarda citrodora* and *Melaleuca alternifolia* also exhibit antifungal activity against a wide range of common postharvest pathogens.

We have looked at the effect of tea tree oil as a vapour on the growth of Botrytis from grapes (Table 1). Tea tree oil has antibacterial and antifungal properties that have secured it a place in the commercial pharmaceutical market. We wanted to determine if these properties may also be useful for the postharvest control of fungi on grapes. Our work showed that concentrations of between 100 and 500 ppm were able to prevent the growth of this fungi when it was grown in the laboratory.

Table 1: The effect of Tea Tree oil on the growth of Botrytis sp.

Concentration of oil (ppm)	Percentage reduction in colony size (%)
0	0
5	5
50	40
100	80
500	100



The effect of different concentrations of Tea tree Oil on Botrytis sp.

Bacteria can also cause postharvest rots, particularly in vegetables. Most work on anti-bacterial compounds has been on the medicinal application rather than for use on fruit and vegetables. However recent work has shown that cedar, eucalyptus, thyme and camomile oils were antagonistic against the food spoilage pathogens *Bacillus cereus*, *Clostridium botulinum* and *Listeria monocytongenes*. More work needs to be done to see if these oils can also stop the growth of bacteria that cause postharvest rots.

Essential oils are not as broad spectrum as synthetic pesticides, but their effectiveness can be improved by using them in conjunction with carefully designed packaging. The presence of free moisture in a package provides the ideal environment for the growth of many postharvest pathogens. Our preliminary research showed that mushrooms exposed to eucalyptus oil and packaged in a paper bag inside a plastic bag had a better overall appearance than those mushrooms not exposed to essential oils. The mushrooms stayed whiter and their weight loss was reduced. The total bacterial count on the surface of the mushrooms also showed that the eucalyptus oil vapour had reduced the growth of the bacteria that caused the browning of mushrooms.

Most of the research to date has been done testing the growth of fungi in the laboratory under ideal conditions. The difficulty may be to apply the oils effectively under commercial conditions. Essential oils are often fungistatic rather than fungicidal. This means that they stop the growth of the fungi while it is exposed to the oil, but once the oil is removed the fungi can continue to grow. Sydney Postharvest Laboratory is currently trying to develop a method for applying the oils as a vapour at a low concentration during storage of fresh produce. Application of the oil as a vapour at a continuous, low concentration should prevent tainting of the product. Thin skinned products, not surprisingly are more prone to tainting than those with thicker skins.

This work highlights the potential for using essential oils for postharvest disease control of fresh fruit and vegetables. Essential oils

which have been registered as Food Additives are much easier to register for postharvest use than new synthetic pesticides. Application of these oils via the vapour phase should also make their use more cost effective than dipping. We are continuing our work in an effort to determine the optimum concentration of oil for maximum control of the pathogens with acceptable levels of tainting of the product.

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