

Antibacterial Potential of Australian Berringa Honey

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The therapeutic properties of honey have been described for centuries and honey is traditionally used by many different cultures around the world. To date a number of key properties of honey have been described and supported in the scientific literature including the antimicrobial and the immune stimulatory activities of honey. The antibacterial activity of honey is well characterised and attempts have been made to isolate the components responsible for the impressive activity which has been described both *in vitro* and *in vivo*. A large number of *in vitro* studies have assessed the antimicrobial activity of honey from a variety of sources. Various honeys have been shown to inhibit growth of microbes including important clinical wound isolates including *Pseudomonas aeruginosa* (Mullai & Menon 2007) and *Helicobacter pylori* (Ali *et al.* 1991) and antibiotic resistant strains including MRSA (Maeda *et al.* 2008) (Cooper, Molan, & Harding 1999). Variation in activity has been observed between honey types and is dependent on microbial species tested and honey source. In general most *in vitro* studies found honey samples to be broadly antibacterial and antifungal. The physico-chemical properties of honey make it naturally inhibitory to the growth of many micro-organisms, largely associated with the low availability of water molecules and its low pH, usually below pH4. In addition a number of components / molecules have been identified in honeys which have direct antimicrobial activity, including flavonoids and phenolic compounds. Flavonoids are a class of molecules ubiquitously found in photosynthesising plants, they are also found in honey and propolis (Yao *et al.* 2004). Flavonoid molecules have been demonstrated to inhibit the growth of a range of bacteria including MRSA, *E.coli*, *Salmonella sp*, *Klebsiella sp* and *Enterobacter sp*. The mechanisms of action have been investigated and range from inhibition of nucleic acid synthesis and inhibition of energy metabolism to inhibition of membrane function dependent on molecular structure of flavonoid molecules, however whether activity is bactericidal or bacterostatic in nature remains unclear (Cushnie & Lamb 2005). Phenolic compounds have also been isolated from honey (Dimitrova, Gevrenova, & Anklam 2007; Wahdan 1998). The antibacterial activity of phenolic compounds has been appreciated for many years and these compounds are commonly found in antiseptic solutions. Phenolic compounds have antioxidant properties and are thought to inhibit microbial growth by disruption cell membrane function. The presence of glucose oxidase in honey is well documented, this enzyme leads to the generation of hydrogen peroxide which inhibits microbes. Activity of the enzyme is increased upon dilution and can be inhibited by heating the honey to denature the enzyme or can be counteracted by enzymes such as catalase. Manuka honey has long been associated with a non-peroxide antibacterial activity which has been assessed and quoted as Unique Manuka Factor (UMF) (Allen, Molan, & Reid 1991). The search for this elusive factor appears to be over with the recent isolation of a substance in manuka honey which gives rise to the non-peroxide antibacterial activity of honey (Adams *et al.* 2008). The active component appears to be methylglyoxal, with levels detected in honey correlating to UMF or non-peroxide antibacterial activity (Mavric *et al.* 2008). MG is a natural product

which is synthesised by green photosynthesising plants. The production of this substance and its metabolites in plants are affected by environmental conditions such as salinity, drought and cold stresses (Adams *et al.* 2008) and also by key detoxification / regulatory glyoxylase enzyme pathways (Yadav *et al.* 2008). The levels of MG in plants can be significantly affected (2-3 fold enhancement) by the conditions under which plants are grown (Yadav *et al.* 2005). The levels of MG in manuka honey are thought to be higher than in many other honeys due to the marginal conditions in which the manuka plants (*Leptospermum scoparium*) grow (Adams *et al.* 2008).

Australian Berringa honey is produced from a very similar floral source to manuka honey; the *Leptospermum polygalifolium* plant which grows uncultivated from the south coast of New South Wales to Cape York in Northern Queensland. This variety of honey, (formerly known as Jellybush honey), has been shown to possess antimicrobial activity and immune stimulatory activity (Lusby *et al.* 2005; Tonks *et al.* 2003). Recent laboratory surveys have indicated that Berringa honeys possess a wide range of antimicrobial activities dependent on region of collection and vary in their non-hydrogen peroxide activity. Interestingly, the levels of MG present in Berringa honey samples were found to be equivalent or higher than that previously described for Manuka honey (Mavric *et al.* 2008). Whilst all honeys are not created equal in terms of their antimicrobial activity, the high antibacterial activity and MG levels observed in some Berringa honey indicate its potential as an antibacterial agent.

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