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THE RHEOLOGICAL & MELLISOPALYNOLOGICAL PROPERTIES OF HONEY AND HOW THEY CAN BE USED TO IDENTIFY THE MAJOR PLANT NECTAR SOURCE USED IN PRODUCING THE HONEY

INTRODUCTION

The rheological properties [(1)] of most honey types can be described as Newtonian. This means that even if the amount of shear applied to the sample by the viscometer is increased the viscosity remains constant. The overall viscosity measured is dependent on the composition of the honey (sugar content, moisture content etc) and the temperature of measurement. Since the temperature of the measurement is fixed by the analytical procedure the composition is the key factor.

Certain types of honey exhibit non-Newtonian characteristics. These are known as ***thixotropy*** and ***shear thinning*** and the two main types of honey that exhibit these effects are those produced from ***Leptospermum spp***. (including manuka honey) and ***Calluna vulgaris*** (heather honey). When the shear rate of the viscometer is increased on these honeys the viscosity observed is reduced significantly with time. If the samples are allowed to "re-set" a repeat measurement will follow the same profile as the initial measurement. The term ***Apparent Viscosity*** is used to describe the rheological properties of such honey. These honeys contain significant amounts of protein, which is attributed to the different rheological properties compared with other honey.

The phenomenon of thixotropy or shear thinning can be observed simply by stirring the sample with a spoon. Hence, a good quality manuka sample with moisture content of 17-18% will be gelatinous with very little mobility. If the sample is stirred vigorously for a couple of minutes it will become free flowing and can be easily transferred to a second vessel. If the sample is allowed to stand for an extended period it will re-set to its previous condition. If however, the moisture content increases above 21% or the thixotropic honey is mixed with even small amounts of Newtonian type honey, manual visual assessment becomes difficult if not impossible.

Key Words

1 Rheology is the study of the flow of matter, primarily in the liquid state, but also as 'soft solids'. It includes measurements such as Viscosity

2 Melliosopalynology is a branch of palynology that deals with the analysis of bee pollen loads usually by microscopy. Palynology is defined as the "study of dust" or "particles that are strewn". A classic palynologist analyses particulate samples collected from the air, water, or from deposits including sediments of any age

RHEOLOGICAL MEASUREMENTS

The sample is prepared in the prescribed manner. The spindle is immersed in the sample and the automatic program on the Rheometer is initiated. The program allows the spindle to increase its rpm over predefined time intervals. The resulting data is sent directly to a data collection system.

The software allows for the automatic generation of a logarithmic graph of the type

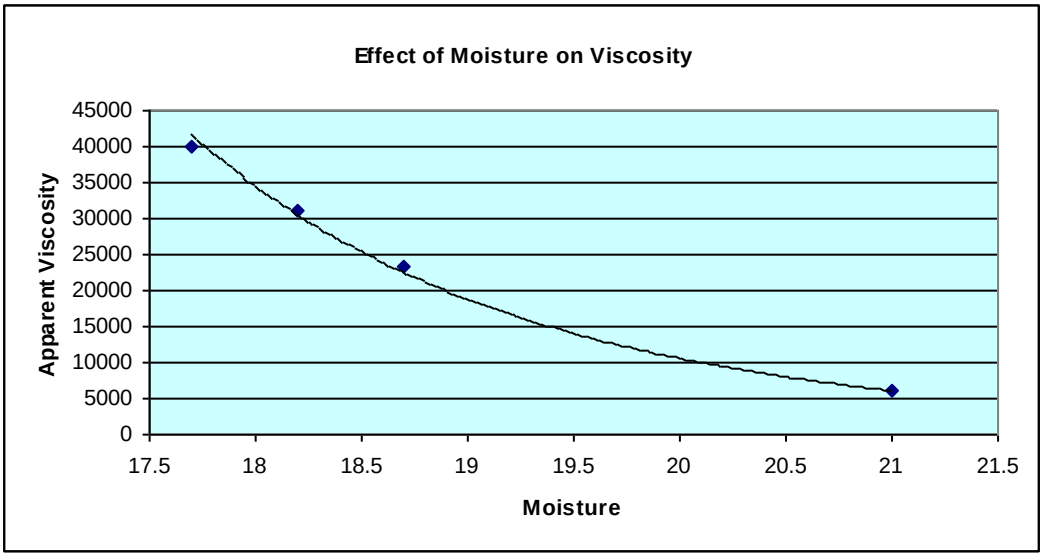
$$y = m^{-x} + c$$

Where

y	=	Viscosity/Apparent viscosity
m	=	Shear Rate
x	=	Slope or Viscosity Index

VISCOSITY & MOISTURE

As previously mentioned, moisture has a profound effect on the viscosity of a sample (see Graph 1)



GRAPH 1 Effect of Moisture on Viscosity – Manuka Honey

The viscosity value observed reduces quickly and the viscosity index collapses above 20% moisture. It is desirable to standardise the moisture level in a honey sample to a fixed value for consistent routine measurements.

MANUKA AND KANUKA HONEY

The technique of mellisopalynology (pollen analysis) is the most widely used technique for determining the floral and geographical origin of a honey.

Manuka (***Leptospermum scoparium***) and kanuka (***Kunzea ericoides)*** are two types of shrub/bush growing together in New Zealand and their flowering times overlap. The pollen from these two plants is virtually indistinguishable even to the most experienced pollen analyst. Until recently the plants were thought to be species related.

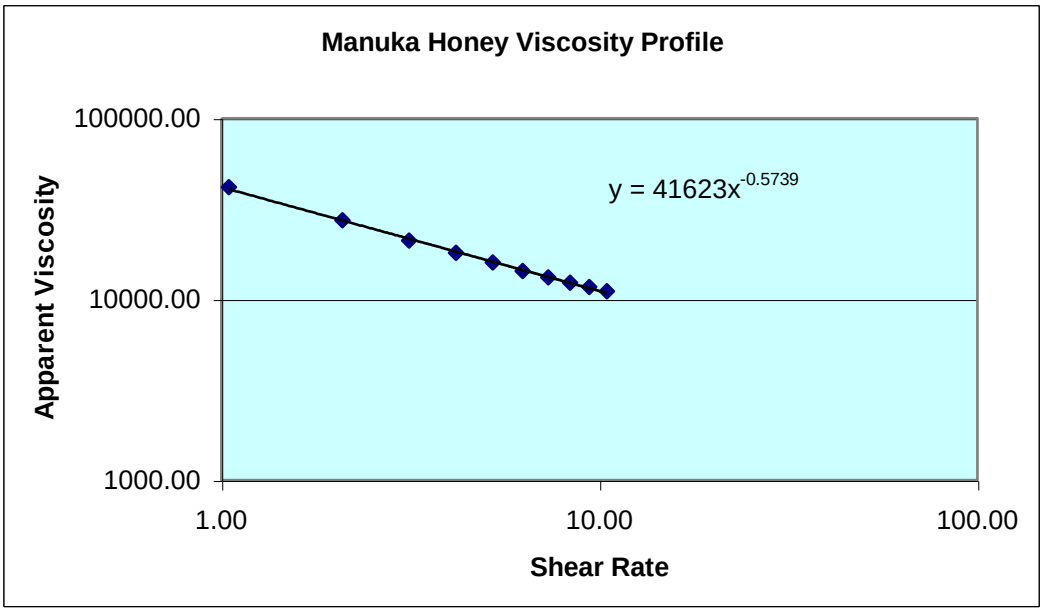
Manuka honey is a sought after honey which demands a premium price due to its unique medicinal qualities whereas kanuka is a sweet culinary honey.

Table 1 shows typical pollen results that might be obtained from a manuka or kanuka honey.

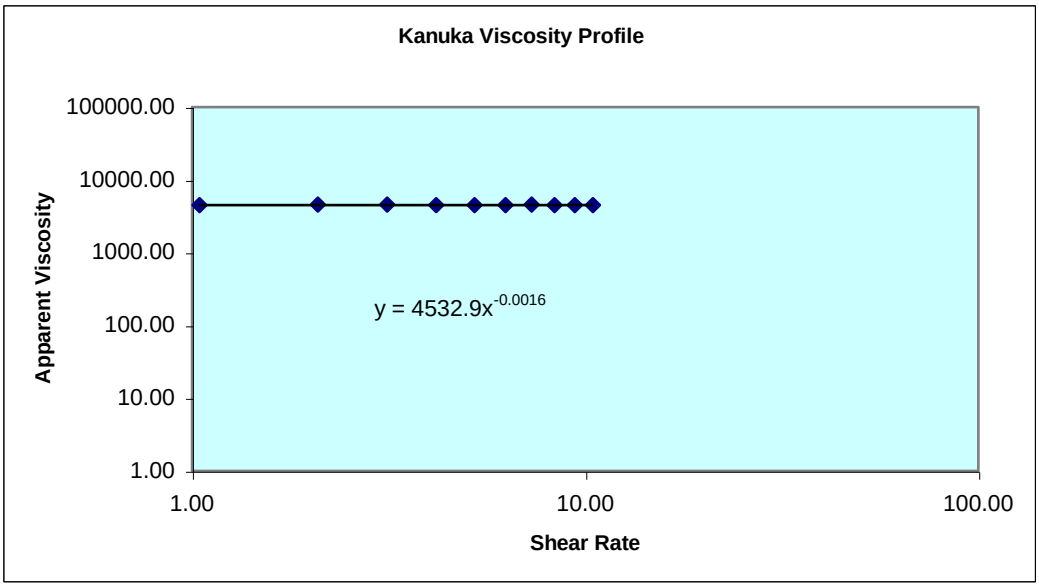
Pollen Type	%
Actinidia chinensis	**1**
Apiacea	**4**
***Weinmannia* spp.**	**1**
***Lotus* spp.**	**15**
Trifolium repens	**3**
***Leptospermum/Kunzea* type**	**70**
Knightia excelsa	**1**
***Ranunculus* spp.**	**1**
***Rubus* spp.**	**p**
Scrophulariacae	**1**

TABLE 1 Typical Pollen Results for a Manuka/Kanuka honey

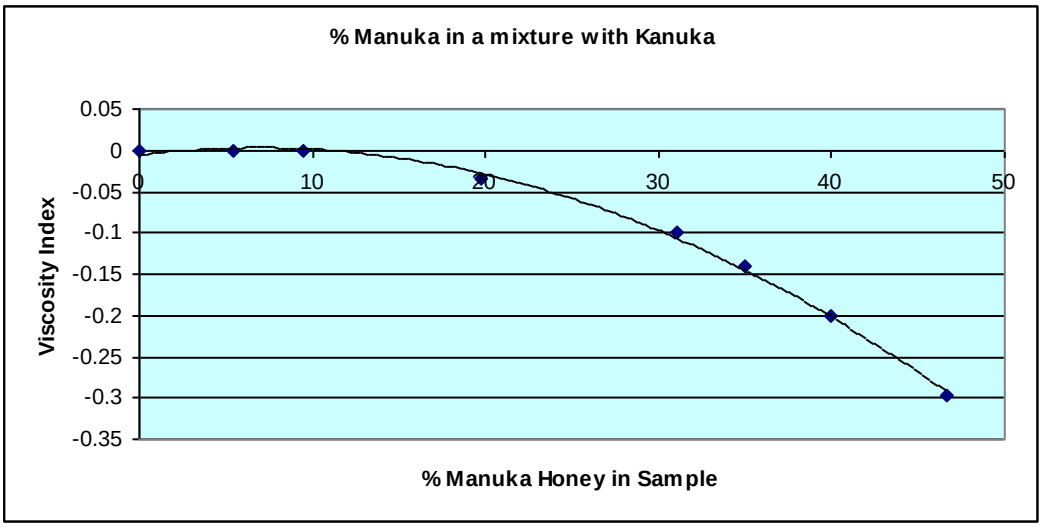
Because the pollen analyst cannot tell the difference between the manuka and kanuka pollens, the proportion of the 70% pollen attributable to either species cannot be defined. If however, rheological measurements are made on a given sample it can be deduced that the sample is predominantly manuka (Graph 2) or kanuka (Graph 3) or a mixture of the two plant species (graph 4).



GRAPH 2 Viscosity profile of manuka honey with pollen content > 70% manuka pollen



GRAPH 3 Viscosity profile of kanuka honey with pollen content > 70% Kanuka pollen



GRAPH 4 Viscosity profile of mono-floral manuka honey mixed with kanuka honey

Summary

A mono-floral manuka honey (>70% ***L. scoparium*** pollen) will have a viscosity of 35,000 - 40,000 cPs and a viscosity index more negative than - 0.500 (Graph 2).

A Newtonian honey such as kanuka will have a viscosity between 3000 - 9000 cPs and a viscosity index close to zero (Graph 3).

The composition of mixtures of Newtonian and manuka honey can be estimated using suitable reference standards (Graph 4).

LEPTOSPERMUM SPECIES

Manuka **(*Leptospermum scoparium)*** is the only species of ***Leptospermum*** that grows in New Zealand.

There are at least 75 species of ***Leptospermum*** that grow in Australia. These include ***Leptospermum polygalifoilum***. This is better known as Jellybush honey. It has similar rheological characteristics to manuka (Graph 5) and like kanuka its pollen is indistinguishable from manuka.

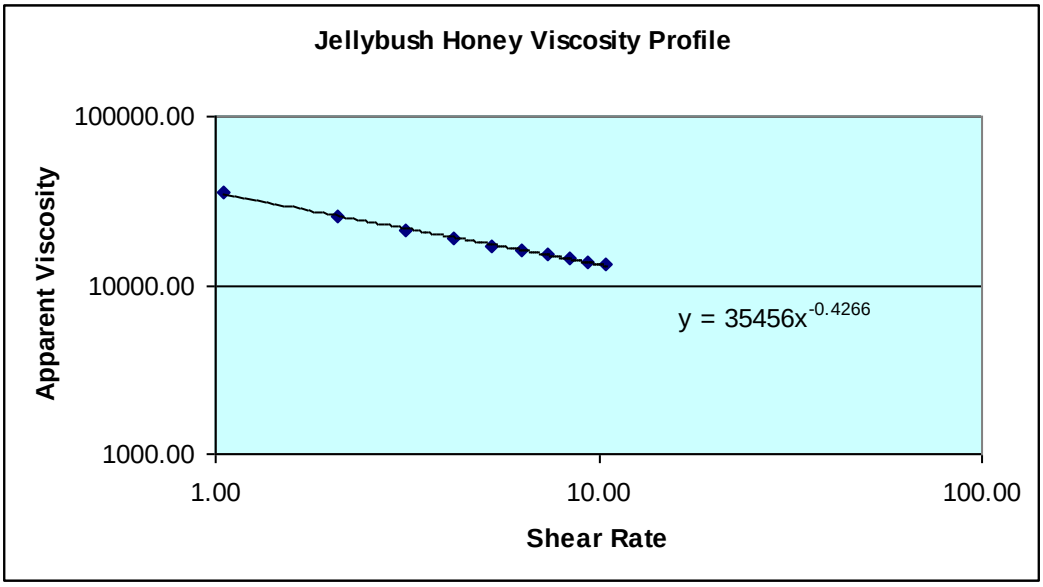
Jellybush honey also has similar Non Peroxide Activity (NPA) to manuka and has been shown to contain significant amounts of methylglyoxal.

Table 2 shows a typical pollen analysis for Jellybush honey

Pollen Type	%
Casuarinaceae	**1**
Baccharis halimfolia	**1**
Boronia rosmarinifolia	**2**
Cruciferae	**2**
Eucalyptus	**4**
***Leptospermum* spp.**	**79**
Lotus corniculatus	**2**
Plantago type	**1**
Proteaceae	**4**
***Trifolium* type**	**2**

TABLE 2 Typical Pollen Results for Jellybush honey

Because the rheological properties and mellisopalynological properties of jellybush honey are very similar to manuka, the problem becomes how to distinguish between them.



GRAPH 5 Viscosity profile of Jellybush honey

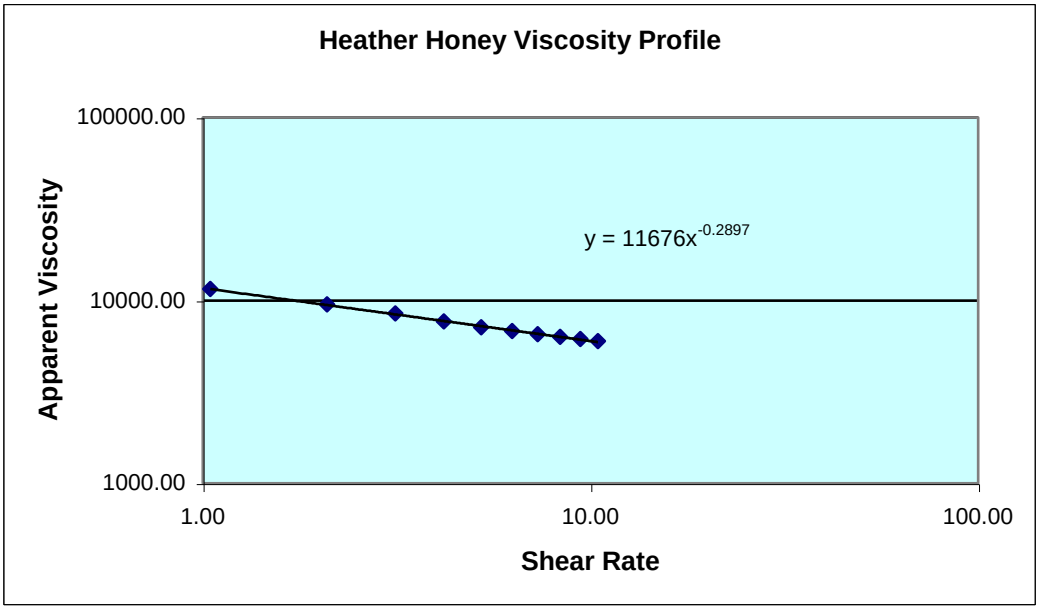
The Viscosity Index is lower than would be expected for a mono-floral manuka at -0.423 but a considerable amount of effort would be needed to confirm that this was representative of this type of honey (or indeed other types of ***Leptospermum***).

In short, an experienced pollen analyst should be able to detect the presence of small amounts of pollen that are native to Australia and not found in New Zealand. Thus by inference there is a mechanism for distinguishing between the two.

HEATHER HONEY

The only other honey that is known to show significant non-Newtonian character is heather honey. This is also known as ling honey and it is found in New Zealand. The non-Newtonian characteristics of this honey are less pronounced than honey from ***Leptospermum*** species.

The main pollen associated with Scottish heather is ***Calluna vulgaris***. This pollen is easily distinguishable from the ***Leptospermum*** species. Further work is on going at Minerva to see if there is a correlation between the amount of ***C. vulgaris*** pollen and the Apparent Viscosity of this type of honey.



GRAPH 6 Viscosity profile of Heather honey

ACKNOWLEDGEMENTS

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