TECHNICAL SUMMARY

FORECASTING THE CHANGE IN 3-IN-1 RESULTS FOR MĀNUKA HONEY

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The mānuka 3-in-1 test is one of the most common lab tests used by NZ honey producers. It is cheap, fast, and provides really useful information about the grade of the honey in the sample.

As many of us know, a unique feature of mānuka honey is how it changes over time. The mānuka 3-in-1 test is very much affected by these changes. These days it's common not only to receive test results for a honey sample, but also a forecast of how those results will change in future.

Laboratories have developed mathematical models that forecast how 3-in-1 results for mānuka honey will change, usually based on the results of samples that have been stored in controlled conditions.

This article focuses on changes in honey following harvest, leading up until when the honey is processed into a packed product to be sold to end customers. In a future article, we will discuss the importance of the ratio of DHA (dihydroxyacetone) and MG (methylglyoxal) in honey as a way of quickly assessing mānuka honey.

For those wanting more detail about the tests included in the mānuka 3-in-1 suite, please see the article published in the journal in February 2019 (Howse, 2019).

How mānuka 3-in-1 results change over time

For the first 12–24 months after harvest, DHA reduces and MG increases.

The DHA and MG concentrations in honey are related to each other. DHA is present in mānuka honey because it is in the mānuka nectar collected by bees. There is no MG in mānuka nectar—this forms in the honey over time, from the DHA. If there is a lot more DHA in honey than MG, then there is a lot of potential for the MG concentration in the honey to grow.

Initially (at harvest) the amount of the DHA in honey will often be 10 times higher (or more) than the MG concentration. So, in the early months after honey is harvested, as the DHA converts into MG, the DHA concentration goes down and the MG concentration goes up.

After 12–18 months the rate of increase in MG will slow until it reaches a peak.

The MG formed in mānuka honey also tends to disappear over time. While there is a lot of DHA in the honey, MG will be forming faster than it is disappearing—so the concentration of MG in the honey will increase. Over time the concentration of DHA in the honey reduces, and so the rate MG is forming will also reduce. When the rate that MG forming is the same as the rate it is disappearing, the honey is at its peak or maximum MG concentration.

Over time, the MG concentration will reduce from its peak.

Once the MG concentration has peaked, MG will be disappearing from the honey at a greater rate than the remaining DHA can

WHAT IS INCLUDED IN THE MĀNUKA 3-IN-1 TEST

The mānuka 3-in-1 suite includes 3 tests which are important for honey producers and processors:

- DHA (dihydroxyacetone): a naturally occurring compound found in mānuka nectar.
- MG (methylglyoxal): a compound formed from DHA in honey, which is very bioactive, and is believed to be largely responsible for the antimicrobial properties of mānuka honey. The MG concentration is very important when valuing honey.
- HMF (hydroxymethylfurfural): a result of sugars in the honey caramelising, HMF is an important indicator of the degree to which honey has been exposed to heat during its lifetime. The international CODEX standard states that HMF of honey should not exceed 40 mg/kg, and honey processors will usually want to make sure their honey will meet this specification during its labelled shelf life.

As well as these test results, a laboratory will usually calculate and report a non-peroxide activity (NPA) value for the honey using an equation which is based on the MG concentration in the honey. This is the same calculation used to calculate a UMF Grade for honey, although the UMF grading system also has a series of additional requirements.

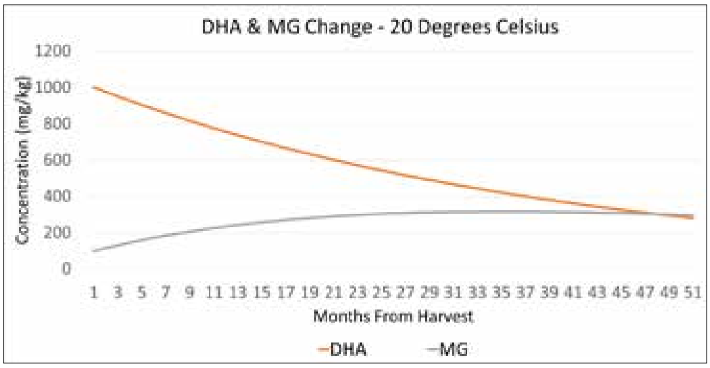

Figure 1. Change in DHA and MG at 20 degrees Celsius.

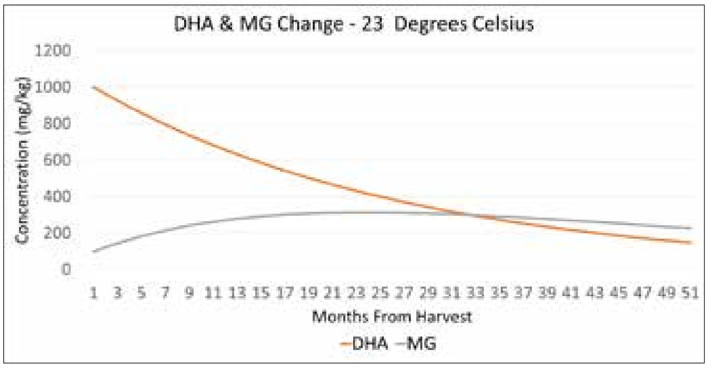

Figure 2. Change in DHA and MG at 23 degrees Celsius.

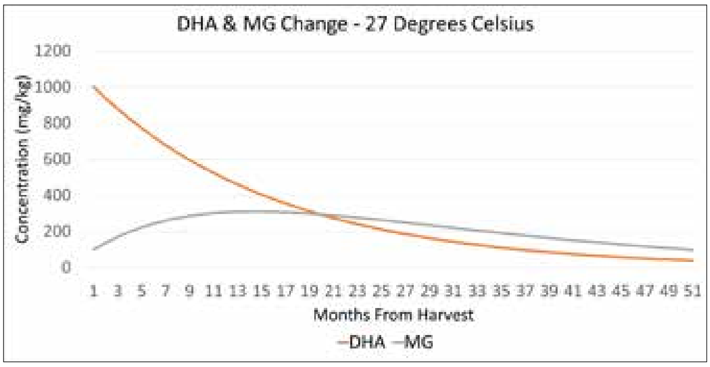

Figure 3. Change in DHA and MG at 27 degrees Celsius.

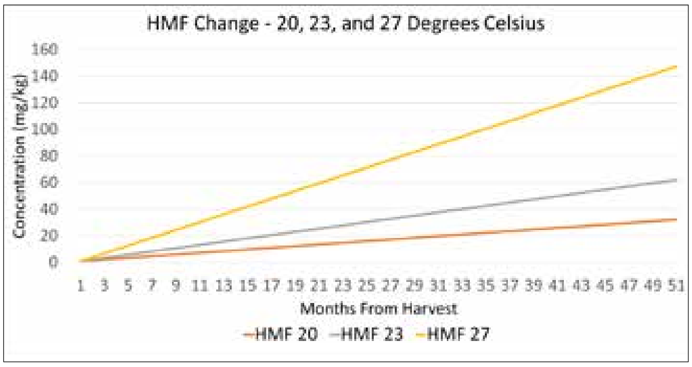

Figure 4. Change in HMF at 20, 23 and 27 degrees Celsius.

support. The concentration of the MG in the honey will start to reduce, slowly at first, but with time will fall away to low levels.

HMF concentration increases over time.

The other test in the mānuka 3-in-1 suite is HMF (hydroxymethylfurfural), which forms as sugars caramelise with exposure to heat. HMF concentrations only ever increase, and for honey producers is important not to exceed the CODEX threshold of 40 mg/kg of HMF.

Changes in mānuka honey in picture form, and key learnings

The series of graphs in Figure 1 to Figure 4 show how a fictitious mānuka honey sample with 1000 mg/kg of DHA, 100 mg/kg of MG, and 1 mg/kg of HMF at harvest, will change over time. Three different storage temperatures are assumed (20, 23, and 27 degrees Celsius). The results contained here have been calculated using Analytica Laboratories' forecasting model.

Some key learnings from these graphs are as follows:

Storage temperature is very important.

Storing honey at a higher temperature will result in faster changes in that honey. In particular, DHA will convert to MG more quickly, and HMF will increase more quickly. If we assume that this honey is at its best for processing when it is at 85% of its maximum MG (about 270 mg/kg of MG), then it will reach this point after 16 months stored at 20 degrees (HMF of 11 mg/kg); or 11 months stored at 23 degrees (HMF of 14 mg/kg); or 7 months stored at 27 degrees (HMF of 21 mg/kg).

The MG concentration in honey only grows quickly for a time.

The MG concentration in the honey increases quickly while there is a lot of DHA in the honey. Over time, as the DHA concentration decreases, so does the rate of MG growth. As an example, the honey stored at 23 degrees Celsius (Figure 2) saw MG concentration increase by 115 mg/kg in the first 6 months, 65 mg/kg in the next 6 months, and 30 mg/kg in the 6 months following that.

The MG concentration in honey does decline after its peak.

There is sometimes a belief that mānuka honey is like red wine and the older it is, the better it gets. While it does improve in grade for a time after harvest, this only lasts so long before the MG concentration starts to reduce. As mentioned above, the warmer the storage temperature, the sooner this will happen.

The optimum time for processing and packing mānuka honey

Generally, processors will want to pack mānuka honey well before it has reached its maximum MG concentration, so it has the ability to retain its grade for a reasonable shelf life. Each processor has their own criteria for this. They may also have an ability to blend different drums of honey to meet the specification they have for a particular customer or market.

However, it is important for honey producers to talk with their buyers about what they need to be able to produce a packed product that will meet consumer requirements. In my experience, honey processors prefer to pack mānuka honey with between two and three times as much DHA in the honey as MG, and with an HMF which is as low as possible (but certainly less than 30 mg/kg).

When using forecast results to decide how long to store honey before offering it for sale, it is worth discussing these factors with your potential buyers.

Reference

Howse, S (2019, February). DHA and MGO: the most common testing in mānuka honey. *The New Zealand BeeKeeper*, *27*(1), 10–13.