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NEW ZEALAND

Diastase Activity in Honey Stomachs of New Zealand Bees

Unique Findings and Their Significance

Mānuka honey (*Leptospermum scoparium*) is a unique product created by honeybees (*Apis mellifera*) that collect nectar from mānuka flowers native to New Zealand. One distinguishing feature of this honey is its high content of dihydroxyacetone (DHA), a precursor to methylglyoxal (MGO)—a key bioactive component. Mānuka nectar has a more complex and bioactive-rich composition compared to other floral nectars. Diastase activity (α-amylase) plays a crucial role in transforming nectar into honey by breaking down complex carbohydrates and is an essential indicator of honey quality.

This study analyzed enzymatic activity not only in mānuka honey as the final product but also during the primary processing of nectar by bees in their honey stomachs. It provides new insights into the physiological characteristics of New Zealand bees and the unique qualities of mānuka honey.

METHODS

Conducted in 2023, the study involved 15 mānuka honey samples from three locations in Taranaki, with five samples from each site. From each location, 30 worker bees were sampled, and their honey stomach contents analyzed. Diastase activity was measured using the Phadebas method, with three technical replicates per sample (see figures 1 & 2).

RESULTS

In unsealed honey, diastase activity ranged from 6.2 to 30.6 DN. (see figure 3) Variability among samples can be attributed to environmental factors such as mānuka vegetation density, seasonal conditions, and resource availability. However, diastase activity in honey stomachs was significantly higher than in unsealed honey—a novel finding. Enzyme concentrations in honey stomachs were 16 times greater than the standard for honey, highlighting bees' exceptional enzymatic capacity during nectar processing (see figure 4).

Figure 1, Materials & Methods - Nine fresh honey samples were collected across three hive sites (three samples per site) in the Taranaki Region. These sites were Post Office 1, Garvins 1 and Post Office 8.



- Post Office 1**
- 1A honey taken from uncapped honey from top honey box above the excluder.
 - 1B honey taken from uncapped honey from top honey box.
 - 1C honey taken from uncapped honey from top honey box.
- Garvins 1**
- 2A honey taken from uncapped honey from top honey box.
 - 2B (1) honey taken from uncapped portion of frame in top box.
 - 2B (2) honey taken from capped portion of same frame in top box.
 - 2C honey sample taken from uncapped honey from top honey box.
- Post Office 8**
- 3A honey taken from uncapped honey from top honey box.
 - 3B honey taken from uncapped honey from a part drawn foundation frame in top honey box.
 - 3C honey taken from uncapped honey from a part drawn foundation frame in top honey box.
- No Honeybees were collected from this hive.
- Honeybees were taken from this hive for honey stomach sampling.

Figure 2, Honey Stomach Samples

Each Honeybee sample consisted of approximately 350-450 individual forager bees. The honey stomachs from these bees were extracted and collected in airtight 50mL tubes. 5mL of honey stomach content was extracted from each sample, which was the required amount for diastase testing.

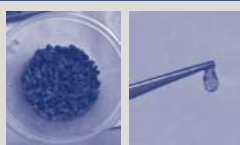
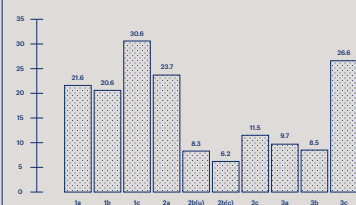
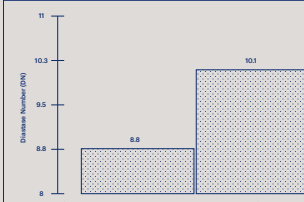


Figure 3, Fresh Honey Diastase Test Results



- We can see that there is a lot of variation in the DN across all of the samples. The sample with the highest DN is sample 1C (30.6DN), while the lowest DN was observed in sample 2B(2) (6.2DN).
- Samples 1A-1C were collected from the same hive and are all uncapped samples. We see a difference in the DN between 1B and 1C even though these samples were collected from the same honey box. Sample 1A also differs from the other two samples from this hive but is somewhat similar to sample 1B.
- Samples 2A-2C were taken from the same hive at the hive site Garvins 1. Sample 2B(1) is uncapped honey, while 2B(2) is capped honey. The rest of the samples obtained are uncapped honey. Sample 2A has the highest diastase result (23.7), while the other three samples all had low results (6.2, 8.3 and 11.5). We can see that there is a difference between the capped and uncapped samples collected from the same frame. We expected to see a lower DN value in the capped sample since enzyme activity will deplete as the honey ripens.
- Samples 3A-3C were taken from the same hive at the hive location Post Office 8. All samples from this site are uncapped honey. The highest diastase activity from the samples at this location is 3C (26.6), while the other samples results are considered low (8.3 and 9.7).

Figure 4, Honey Stomach Content Diastase Test Results



- The DN of both samples are considered low but the samples were diluted 16X more than normal honey to produce a readable result, indicating that honey stomach content is very potent/concentrated. At full concentration, we could assume that these read in at 140.8DN for Garvins 1, and 161.6 for Post Office 8.
- The two hive sites that these samples were collected from are 800m away from each other in a straight line, therefore it is likely that these two hives are collecting Mānuka nectar from the same trees. The DN values of honey stomach content from Post Office 8 (10.1DN) is higher than that at Garvins 1 (8.8DN).
- This difference in DN could be due to further manipulation by the bees at Post Office 8, and/or due to hive related causes such as the genetics of the bees or health and age of the hive.

CONCLUSION

Diastase activity in honey stomachs ranged from 140.8 DN to 161.6 DN, indicating bees' adaptation to mānuka nectar, rich in complex sugars and DHA.

The unique composition of mānuka nectar may have driven evolutionary enhancements in New Zealand bees' enzymatic systems.

High enzymatic activity suggests a healthy physiological state for bees, even under intensive commercial beekeeping. Proper management and ecosystem preservation are critical for maintaining healthy colonies in New Zealand.

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Key Findings

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- High enzymatic activity suggests a healthy physiological state for bees, even under intensive commercial beekeeping. Proper management and ecosystem preservation are critical for maintaining healthy colonies in New Zealand.