

RESEARCH

# AOAC C4 SUGAR TESTS: THE FINAL FRONTIER?

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Recent honey adulteration scandals in Australia around addition of C3 rice and beet syrups used to stretch honey yields remind us that the honey industry is only as good as its lowest common denominator. If we play the game well, we all win. If some of us go 'rogue', then the entire industry will suffer. It only takes a few rotten apples ...

Which brings us back to those pesky C4 sugar tests, which are still hindering our best and highest bioactive mānuka honeys from being exported to key overseas markets.

### New Zealand's own sugar adulteration scandal

Back in 2000, Dr Karyne Rogers at GNS Science noted some anomalous C4 sugar test fails in mānuka honey. At the time, Barry Foster and Binnie Brown were producing some high-quality organic mānuka honey for export. As was their usual practice, they didn't feed sugar to their bees, yet their honey was failing the C4 sugar test, suggesting it was adulterated. Karyne remembers being very puzzled, re-running the samples several times and still not understanding the reason. Her comment to Barry was, "maybe your bees are snacking on a neighbouring sugar source!"

Only a few years later, in 2008, honey exports were hitting the wall at entry ports around the world as shipment after shipment of mānuka honey failed the C4 sugar test. What was happening in New Zealand? We were accused of being a bunch of crooks and sugar feeding to make money out of the mānuka 'goldrush'. Accusations flew, and the industry was getting a poor reputation for blatant sugar adulteration (a bit like Australia at the moment).

In 2010, the Ministry for Primary Industries stepped in. Along with the Bee Products

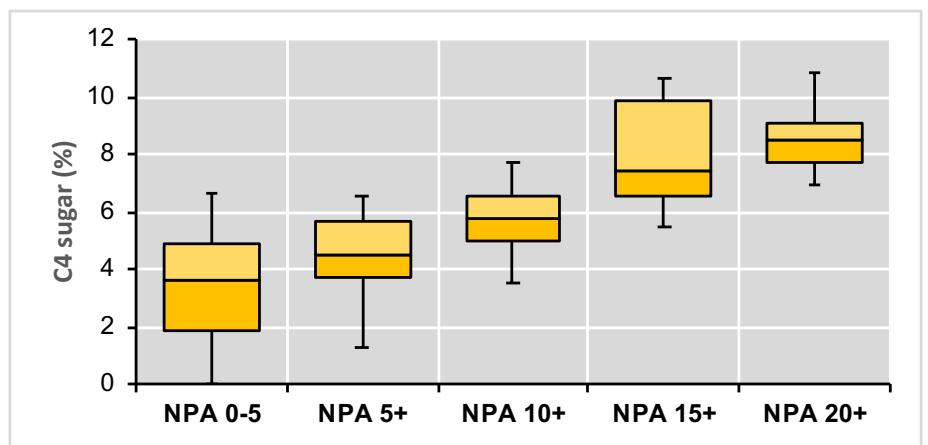


Figure 1. Relationship between the NPA level and C4 sugars in mānuka honey.

Standards Council, Honey Packers and Exporters, AGMARDT and several honey companies, Karyne was funded to find out why New Zealand mānuka honey was failing the C4 sugar test.

Her research found that while a very small margin of honey did have some C4 sugar residues (<1%), almost all the higher-activity mānuka honeys falsely failed the test. Kinetic (heating and maturation) studies with Megan Grainger and Marilyn Manley-Harris at the University of Waikato and beekeeper Kevin Gibbs showed that C4 sugars 'increased' in honey during aging, and were accelerated by heating, even though no C4 sugar had been used.

Further work, funded by the UMF® Honey Association and undertaken at Analytica Laboratories (by Terry Braggins and Anatoly Chernyshev), confirmed these findings. A more recent study by Jacob Jaine, from Analytica, of a large test dataset showed a strong relationship between C4 sugar and NPA level in mānuka honey (Figure 1). The higher the NPA value, the greater chance the honey will fail the C4 sugar test.

### So where does this leave the New Zealand honey industry?

Some people have suggested redesigning a new test for C4 sugars. A range of complex (and costly) sugar tests exist, but the AOAC 998.12 C4 sugar adulteration test is still the globally accepted test for Codex. Laboratories around the world are set up to do the test and it is unlikely that a new test would supersede the existing test in the near future. Therefore, as the AOAC 998.12 test has no issues for most floral honeys, a modification of the existing test interpretation, along with evidence of why the test needs to have specific exceptions for mānuka honey, needs to be ratified.

Karyne successfully amended the C4 sugar test in 2012, but it only acknowledged that some unusual varieties of honey were prone to failing the test. It was not possible to specify mānuka, or clarify the test acceptance limits, as there was no definition of mānuka honey at the time. This amendment has eased the rejection of some 'failed' mānuka honey into Canada and Europe, but it was never fully accepted, so China and other international

continued...



markets continue to reject mānuka honey which tests falsely with high C4 sugars.

**What are the financial implications for the honey industry?**

Testing at both GNS Science and Analytica has shown that around 30% of all honey tested will fail this sugar test, especially as mānuka is our key export honey. This costs the industry millions in lost revenue every year, so it is surely a future investment by the industry to get an exception inserted into the C4 sugar test for high activity mānuka honey. Moreover, our highest activity (and most expensive) mānuka honeys are precluded from international sale.

**What are we doing about the problem?**

Now that a robust mānuka definition is available, this C4 sugar test is one of the few barriers to export for our best mānuka honey. Criteria is urgently needed to modify the AOAC 998.12 interpretation around New Zealand mānuka honey. A recent meeting was held with Apiculture New Zealand (Karin Kos and Tony Wright) along with Karyne Rogers (GNS Science) and Terry Braggins (Analytica) to look providing a resolution and amendment for the AOAC method to free up trade barriers into foreign markets.

The scoping team agreed on several future research initiatives:

- 1. undertake further research to better understand the mechanisms that are causing the AOAC C4 sugar test to fail unadulterated mānuka honey

- 2. engage with industry to seek funding to develop the mechanism and the criteria (including caps of the levels) for allowable 'C4 sugars' for mānuka
- 3. consult with industry to ensure our criteria are robust (undertake an investigation on historical and recent honey datasets to check that only genuine, unadulterated mānuka honey will meet the criteria)
- 4. engage with the international community to promote our findings including Codex, AOAC and the International Honey Commission, but specifically target China to ensure that ratification will be accepted there. (This might need government-level intervention for China.)

- 5. consult with the international community (including testing laboratories) in case there are other special varieties which have false positive fails.

We are now seeking input, feedback and funding to take this collaborative project forward and would welcome offers of support directly to Karin Kos at Apiculture New Zealand via e-mail: info@apinz.org.nz.

Both Karyne and Terry are recognised internationally for their honey science and will jointly lead this project to achieve the necessary C4 testing amendments, along with industry and government endorsement.

*[Editor's note: this is the first of two articles on C4 sugars.]*



# CORRIGENDUM TO SEPTEMBER ARTICLE

An article released by Analytica Laboratories entitled 'Test Results for Packed Mānuka Honey: Part 2' (published in the September 2018 edition of *The New Zealand BeeKeeper*) was found to contain an error relating to Figure 1. In this figure, the upper limit of 400 mg/kg for 3-PLA in multifloral mānuka was not applied during the classification process. As a result, the height of the "not mānuka" and "multifloral mānuka" bars were displayed incorrectly. A corrected version of Figure 1 is shown to the right.

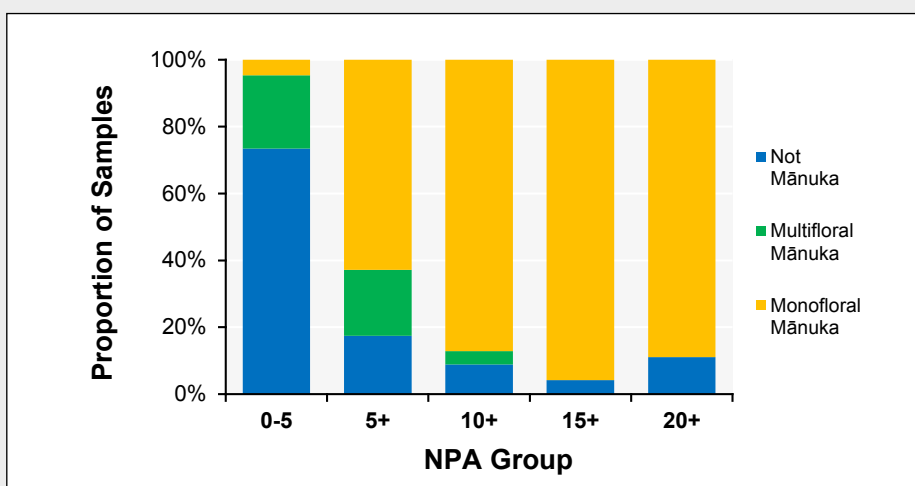


Figure 1b. Proportion of packed samples are their respective MPI floral classifications, broken up according to grade.