Fact Sheet

Southern Cross University Research
Bee Research & Extension Lab

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Crystallisation In Honey

What is honey & Why Does It Crystallise?

Honey bees collect nectar from flowers and turn this into honey in the hive. This honey is stored in the hive for the bees to eat during times when there is not much nectar available. The composition of honey varies from one floral source to another. Generally, honey is made up of different types of sugars including fructose (around 44%), glucose (around 25%) and sucrose (around 3%).

Given the right conditions, such as low temperatures, high moisture content and honey with lots of particles in it and high glucose content, honey can crystalise.

What is crystallisation?

Honey crystallisation is a **natural process** where small sugar crystals begin to form in liquid honey, and gradually turn the liquid honey into a solid.

Crystallisation does not spoil honey, and it is safe to eat.

Honey is mostly made of sugar and water. The sugar is dissolved in the water, but there's not enough water to keep the sugar dissolved forever. So there's a good chance that the two ingredients will eventually separate, resulting in the formation of sugar crystals. The size and texture of the crystals depends mostly on the floral source the honey is from.

Factors affecting crystallisation

Sugar content

The ratio of sugar to water in the honey affects crystallisation.
Honey that has a higher in sugar content will crystallise quicker because it's more difficult for the water to keep holding it. Honey contains different types of sugars, and honey with a high glucose content tends to crystallize more quickly. A high glucose content and a low water content facilitate faster crystallization

Temperature

Cooler temperatures can accelerate crystallisation and the optimal temperature for honey crystallization is around 14°C (57°F). Cooler conditions promote the formation of stable crystal structures within the honey. When honey is stored in containers that left on the ground, they can be exposed to temperature changes that can accelerate crystallization.

Particles in honey

Raw honey often crystallises faster than processed honey because it contains particles of pollen and beeswax. These particles encourage crystallisation, as they provide tiny physical structures for sugar crystals to form on. Particles can also be present in honey due to such things as beekeepers harvesting frames with brood and pollen, harvesting in windy conditions when there’s dust in the air, placing supers on the ground, and using extracting hardware that hasn’t been cleaned down properly. These particles can be filtered out from honey by straining the honey through a honey filter. Many beekeepers heat their honey for an easier flow through the filter, however this heating can also destroy many of the naturally occurring desirable components, such as enzymes, flavonoids, polyphenols and microbial compounds.

Honey in crystallised form (left) and in liquid form (right)
Note the cloudy appearance and visible crystals in the jar on the left.

Ways to reduce crystallisation

It is important to emphasise that **crystallisation does not mean that honey has spoiled.**

Crystallised honey can be a sign of a natural raw product from the bees which has distinctive characteristics and nutritional benefits. Opportunity exists to educate consumers around this fact, and you could consider writing this on your label and in your marketing.

However, for some consumers, crystals in honey are not desirable. If you want to reduce the crystallisation in honey to increase sales to customers, you may want to consider some of the following techniques.

- All natural and raw honeys will eventually crystalise, given enough time. Always look for capped honey to extract. Look for at least 90% capped cells on frames of honey.
- A quick test is to shake the honey frame horizontally. No drips = good.
- Do not extract honey frames containing brood.

- Let the honey sit in a settling tank for at least 48hrs so that the bubbles and particles can float to the surface. Pour the honey out of the bottom of the settling tank.
- Filter the honey before bottling to remove unwanted particles like wax or bee parts.
- Consider warming your honey (never over 45˚C)
- Bottle or jar the honey as soon as possible after extracting to avoid it crystallising in bulk storage containers. Once honey has crystallised in a bucket or other large container it can be very difficult to remove into a jar.

Filtering the particles from honey can help discourage crystallisation

Heating Honey

Honey can be carefully heated after extraction to reduce crystallisation occurring, or to return crystallised honey to its liquid form.

It is very important not to heat at too high a temperature and for too long a time, as this will affect colour, flavour and lower the quality of the honey.

Honey should not be heated higher than 45 degrees Celsius, and for no longer than 14 hours.

Honey should never be heated on a direct heat source or open flame. To warm honey it can be placed in food grade containers and placed in a hot water bath (ensure no moisture can get in).

If a large amount of honey has crystallised in a bucket or holding tank, it can be warmed with a warming box. This can be made by constructing a large sealed box and using a heat source such as a light bulb or electric blanket. The bucket of crystallised honey is placed inside and the heat source gently warms the honey at a consistently low

temperature over a few days.
In place of a box, an old fridge, a stack of bee boxes, or an old drinks cooler can be used. There are many videos and sites online showing various ways to do this.

A low temperature must be used, and care must be taken to use a low temperature and to monitor carefully to make sure the honey does not get too hot.

Heating honey above 45 degrees Celsius for longer than 14 hours will begin to destroy the beneficial enzymes in honey and will increase the undesirable compound hydroxy-methyl furfural (HMF) content.

You will need a thermometer to monitor the temperature of your honey. Consider keeping notes in a logbook including information on temperature checks and start and finish times.

Indications of damage to honey due to excessive heat include:

- Loss of aroma
- Darkened colour
- Undesirable flavour
- Reduction in enzyme activity
- Increase of undesirable compound HMF (hydroxy-methyl furfural)

HMF is a quality and processing marker, which indicates storage conditions, the age of honey or heating as part of processing. The world standards for honey (CODEX) stipulates that HMF must be less than 80mg/kg for tropical honeys.

Communication To Customers

It is helpful to provide information to customers about the crystallisation process on labels. Considerations for labels include:

- Crystallisation is not an indicator of poor-quality honey
- Crystallisation can be an indicator of a natural raw product with desirable characteristics and high nutritional benefits
- Gently heating the jar in a saucepan of warm water with the lid off will bring the honey back to liquid form
- Don’t overheat, boil, or put honey in a microwave as this will destroy health benefits of the honey

Crystallisation Do’s & Don'ts

Do	Don’t
If working a nectar flow that produces honey which is prone to crystallisation, closely monitor frames and harvest quickly after cells are capped	Don’t give your bees access to nectar flows that will crystallise in the hive
Make sure at least 90% of each honey frame is capped before taking from the hive	Don’t take honey frames that aren’t at least 90% capped
Extract in a clean, dry space during dry weather	Don’t extract honey frames or extract during wet and windy weather
Use a settling tank, and let the honey settle for 48hrs to allow the bubbles and some particles to rise to the top, and filter all honey after settling.	Don’t extract honey frames containing brood
If possible, bottle your honey directly after extraction to avoid crystallisation in bulk storage containers	Don’t store honey containers directly on concrete or paved floors as these can become cold and increase crystallisation
Do warm honey gently to de-crystallise, but closely monitor its temperature using a thermometer during heating to avoid spoiling the honey	Don’t heat honey over 45C (113F)
Do educate your customers about crystallised honey through proper labelling and signage.	Don’t believe that crystallised honey is spoiled.

Sources and further readings

Dyce, E.J.: Crystallization of honey. J. econ. Ent. 24, 597-602 (1931b) und Dyce, E.J.: Fermentation and crystallization of honey. Bull. Cornell agric. Exp. Sta. No. 528 (1931a)).

Bhandari, B., D´Arcy, B., Kelly, C.: Rheology and crystallization of honey: present status. International Journal of food properties, 2 (3), 217-226 (1999)

Austin, G.H.: Maintaining high quality in liquid and recrystallized honey. Can. BeeJournal 61 (1), 10-12, 20-23 (1953)

Assil, H.I. et al. 1991. Crystal control in processed liquid honey. Journal of Food Science 56(4):1034.

Binnie, B.: Processing Honey: A Closer Look. Bee Culture Magazine March 27, 2018

McGee, H. 1984.”On Food and Cooking: The science and lore of the kitchen. ”Macmillan Publishing Company, New York.

Townsend, G.F. Processing and storing liquid honey. Chpt. 9 in “Honey.”