



## Love you, Honey

### How can honey be solid or runny?

Stock items	Consumables
Bin bags	Set honey
Plastic plates	Runny honey
Plastic spoons	Bread
Glucose molecular model	
Fructose molecular model	
Sucrose molecular model	

### Presenting ideas

Open the two jars of honey and put a decent dollop of each on separate plates. Then, apply a liberal amount of honey to a slice of bread. Invite your *edible explorer* to try both types of honey.

- What's on the plates?
- What do you think honey is made from?
- How do you think honey is made?
- Why is some honey very pale and some is very dark?
- What makes some honey set or runny?
- What's happened to the honey on the bread? Why do you think this has happened?

### What's the chemistry?

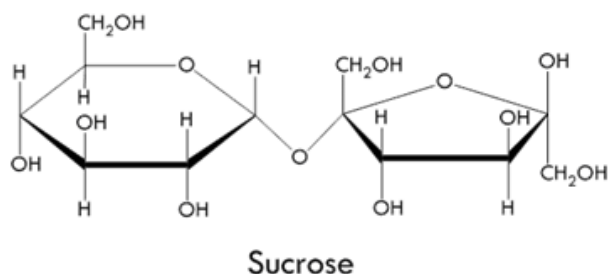
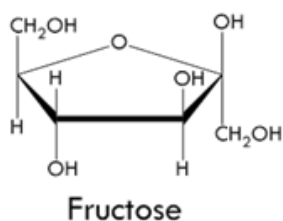
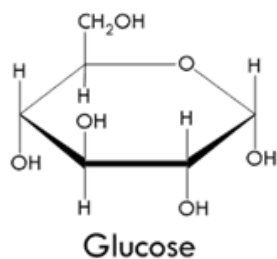
Bees are the middle-men between nectar and honey. Worker bees collect nectar, which is predominately sucrose; the same chemical you might sweeten your tea or coffee with. They store this disaccharide (double sugar) in their honey stomach and secrete enzymes from their salivary gland such as invertase which break it down into monosaccharides (single sugars) called glucose and fructose and amylase which breaks starch into smaller units. Glucose and fructose are structural isomers – they possess the same chemical formula.

Once inside the hive, the worker bees regurgitate the sugary solution and transfer it to processor bees to finish breaking it down further. These smaller sugars are much sweeter than larger sugars.

It's then deposited into the combs where the bees fan their wings over it to reduce the water content by evaporation to roughly 17 %. The consistency changes and over a couple of days of manic wing-fanning, the watery sugar has been transformed into the gloopy syrup we know as honey and there are hundreds of different types.



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The colour of honey is one of the most important quality criteria for consumers, ranging from almost colourless to a really dark brown, with flavours varying from incredibly subtle to distinctly bold. Generally, paler honeys are milder in taste and it all depends on where the bees buzzed. The colour depends mainly on the content of plant pigments, arising from the huge array of flowers the bees have been collecting their nectar from. But the exact amounts of proteins, carbohydrates, amino acids, vitamins, minerals, antioxidants and water along with the shape and size of the sugar crystals can also influence colour too.

Bees could technically produce any colour honey you wanted. A few years ago, bees foraging by a waste plant started to produce blue/green honey. Their food source was traced back to a sugary solution used to make M&Ms, which was being processed at the waste plant. Sadly, the new colour never caught on.

Your jar of honey will have a best before date, but in reality honey never goes off. The low water content means bacteria find honey too hostile to grow in and they'll soon become dehydrated – the honey literally sucks the water out of the bacteria! Have you noticed if you leave a slice of bread for a few minutes dolloped with generous topping of honey, it starts to become concave? Bread contains about 40 % water and it's drawn out and into the honey by osmosis. Removing the water makes the bread shrink, but only on the side in contact with the honey and your bread will bend. It doesn't work if you apply butter to your bread first, as that acts as a barrier.

Honey also has a pH between 3.5 and 5.5 because, amongst others, formic acid, citric acid and gluconic acid are present. The enzyme glucose oxidase catalyses the conversion of glucose to gluconolactone, which yields gluconic acid and hydrogen peroxide – all these compounds aren't favoured by bacteria.

The overabundance of sugar makes honey unstable. It contains 30 – 44 % fructose and 25 – 40 % glucose and is a supersaturated solution. This leads to glucose, with its lower solubility, precipitating out and forming crystals over time. Fructose is more soluble in water so will remain as a liquid. Honey naturally higher in glucose will crystallise more rapidly and nectar from sunflowers, dandelions, lavender and oilseed rape will crystallise quicker. Honey higher in fructose collected from cranberry, sage and acacia can stay as a liquid for years. The presence of pollen grains or tiny pieces of beeswax act as seed crystals and this will encourage crystallisation too.

## Jo's Top Tips



You don't have to buy expensive honey for this. Most supermarkets do budget versions of runny and set honey.

Unless you're feeling flush, I wouldn't splash out on manuka honey. It's derived from the manuka tree (*Leptospermum scoparium*), which is grown throughout New Zealand and eastern Australia. It contains chemicals which supposedly boost its antibacterial and antioxidant abilities. Celebrities are said to slather it on their bodies, drink it and smear their faces in it. But there's no hard scientific evidence to prove its efficacy. So it appears the difference between manuka honey and the normal stuff is just the price tag.

Make friends with an apiarist! Your local friendly beekeeper may be only too willing to give you some used combs you can use as props.



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