Cheesy Chemistry

What distinct flavours can you detect in cheese?

Stock items	Consumables
Bin bags	Cottage cheese
Plastic plates	Cheddar
Plastic spoons	Gorgonzola
Plastic tubs with lids	Access to a fridge
Cocktail sticks	
Plastic knife	

Presenting ideas

Chop up the cheddar and gorgonzola into similar-sized cubes on the plastic plates. If they're going to get eaten straight away, then leave them on the plates. If not, put them in labelled plastic tubs, with lids on and pop them in the fridge. Invite your *edible explorer* to eat some cottage cheese on a clean spoon.

- How would you describe the taste?
- How would you describe the texture?
- Do you know how it's made?
- How is it related to other cheeses, like cheddar or gorgonzola?

Invite your *edible explorer* to eat a piece of cheddar cheese, which they can pick up with a cocktail stick. Ask them to chew it well.

- Does it taste sweet, sour, bitter, salty or savoury?
- Can you describe any other flavours you can taste? Does the taste remind you of other foods?

Invite your *edible explorer* to eat a piece of gorgonzola, which they can pick up with a cocktail stick. Ask them to chew it well.

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- Can you describe any other flavours you can taste? Does the taste remind you of other foods?

What's the chemistry?

Milk is primarily water. Suspended in the water are solids; mainly proteins called casein and whey. To make cheese, you have to separate these two proteins. If the milk is not heated (unpasteurised), bacteria naturally present will start to turn it sour.

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Usually the milk is pasteurised, where it's heated to remove unwanted bacteria. Bacteria which gives cheese distinctive flavours such as *Streptococci* and *Lactobacilli* are then added, along with the enzyme rennet and the mixture is processed at 30-40 ºC for a couple of hours. During this time, the natural sugar in the milk called lactose is fermented into lactic acid, reducing the pH and the rennet helps to coagulate the casein protein, forming curds. Curds have the consistency of a rubbery gel and they're allowed to set for an hour or two before the liquid whey is separated by cutting the curds into small pieces and draining the whey away.

What you're left with is cottage cheese. These drained cheese curds have a soft consistency, with some of the whey still present. Cottage cheese tastes slightly sharp due to the pH change but is fairly tasteless as it hasn't had the time for the volatile flavours to develop.

Some cheeses have additional bacteria injected into them or brushed onto their surface to mature into distinctive tastes. Others are warmed to release more whey, making them firmer and less rubbery. Softer cheeses ripen faster by the action of bacteria as they contain more water. That's why hard cheeses such as parmesan can last for weeks in your fridge – it contains less water which bacteria find difficult to survive in. The longer you leave a cheese before eating it, the more lactose is converted into lactic acid so older cheeses tend to have a sharper taste.

In cheddar, the curds are mixed with salt before the whey is drained and this makes it a difficult breeding ground for bacteria. Extra-mature cheddar is much stronger in flavour than mild cheddar and needs to be matured for over a year. During this time, the proteins are chopped up into amino acids, which break down further to produce all the different flavour chemicals. Cheddar contains up to 500 compounds at detectable thresholds.

Try some cheddar and see if you can detect furaneol and homofuraneol (caramel), δ-dodecalactone (peach/coconut), butanedione (buttery), ethanoic acid (sharp, vinegar), (Z)-4-heptenal (creamy, biscuit) and methional (boiled potato).

Gorgonzola and other blue cheeses get their distinctive taste from a class of chemicals called methyl ketones. In gorgonzola, 2-heptanone and 2-nonanone impart 'blue cheese' notes. But try some gorgonzola to see if you can also taste 1-octen-3-ol (mushroom), 2-heptanol (fresh, lemongrass), ethyl hexanoate (apple), ethyl butanoate (pineapple), 2-nonanol (waxy) and 4-methylanisole *(*mothballs).

It's amazing to think that all the flavour molecules found in cheese derive from just three starting materials – lipids in the milk fat, lactose (a sugar) and casein (a protein).

Jo's Top Tips

Keep all cheeses in the fridge when you're not using them. It will minimise bacterial growth and gorgonzola gets even more stinky than usual when warm!

If you're a cheese fan like me, why not branch out and test your sense of taste…

- Can you taste methanethiol in camembert? It smells of cabbages.
- Can you taste 3-methylindole in swiss cheese? In low concentrations it's rather sweet; you'll find it in orange blossom and jasmine, but in higher concentrations it stinks of manure!
- Can you taste ethyl octanoate in pecorino? It's a taste associated with oranges and apricots.
- Can you taste phenylethanoic acid in gruyere? It gives a sweet, honey, malty, vanilla-like taste.

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