The ‘not-so-swee t’ smell of mastitis

Mastitis pathogens can be identifi ed faster using ‘aromatic’ analysis

It sounds futuristic – identifying mastitis pathogens by ‘smelling’ milk. But while studying for his doctorate, Kasper Hettinga, a researcher at the Dutch Wageningen Institute, discovered that each individual mastitis pathogen gives off specific aromatic substances.

What do you do when you think food is past its sell-by date? The chances are that you will smell it. A carton of milk that is well over its sell-by date gives off a smell that is different from fresh milk. This principle also applies in the food industry, where it is the most normal thing in the world to work with instruments that smell food. In the field of medicine, too, there are techniques for identifying specific diseases from the air we breathe out.

But what about measuring the quality of milk by its smell? Five years ago, when Kasper Hettinga began research for his doctorate, this was still unexplored territory. As a doctoral student at the Dutch Wageningen University in the faculty of product development and quality, he has learned a lot in recent years. “Initially, the idea was mainly to investigate deviations in the quality of farm milk. For example, the dairy industry was interested what the smell of the milk tells you about hygiene on the farm or the addition of odd feedstuffs to the diet,” he says.

Orange peel

Dr Hettinga began his research by identifying the pattern of aromatic substances in ‘normal’ milk. It soon became apparent from this that milk contains relatively few aromatic substances. “Good quality milk contains only seven different aromatic substances, whereas in cheese you find more than 100.”

He then examined the patterns in milk that failed to meet the standards, for example from cows who had consumed foodstuffs other than their normal feed. “Using the aromatic pattern, it was an easy matter to show that cows had eaten oranges.” He did not succeed with all foodstuffs, however. “With onions and cabbage, measuring with an instrument didn’t work, though I could smell the onions in the milk myself. With onions, sulphur compounds play a major role and people can smell them very well. The instrument is much better at identifying other smells. For example, milk always contains a minute amount of acetone. No human can smell it, but the instrument detects it easily.”

Using the smell of milk to meansure hygiene on the farm turned out not to be an option. However, Dr Hettinga was certainly able to detect lingering milk fever, as well as residues of cleaning agents. The instrument was also able to measure the degree to which fat was broken down and could smell the presence of large numbers of bacteria.

Aromatic substances

During his studies, Dr Hettinga shifted the focus from the tank milk to individual cows with infected udders. “Identifying mastitis pathogens by means of aromatic substances in the milk may be a quicker alternative to culturing milk.”

The researcher collected 50 samples from cows with mastitis. “The aromatic substances in the milk samples exhibited a specific pattern, and that pattern was unique to the bacterium contained in the sample,“ he explains.

With the aid of special software a computer was able to predict, on the basis of the pattern of the aromatic substances, which bacterium was responsible for the mastitis. Dr Hettinga says he can identify the five most common mastitis-causing pathogens based on the smell of the milk. “In terms of their incidence, these bacteria are by far the most frequent. Other mastitis pathogens are less common.”

In order to be able to measure the smell, he first stores the samples for four to eight hours at 37ºC. “Then we know for sure that bacteria are growing sufficiently well. The bacteria feed on fat and lactose. We measure the waste products produced by the bacteria. Then we continue to warm the milk in a sealed container so that the aromatic substances evaporate. We extract these substances from the air and transfer them to a device that allows us to see a pattern.”

Faster results

The aromatic profiles are easily distinguishable, according to Dr Hettinga. “You can recognise between 80% and 90% of the patterns with the naked eye. But the process is also a good candidate for automation, involving fewer people than bacteriological investigations. For this reason the costs per sample are significantly lower than for the current methods used in bacteriological testing.”

The speed of the method is another advantage. ‘If you have to culture a sample, as you do in bacteriological investigations, it takes a few days before you get a result. Analysing aromatics is significantly faster.”

He believes that analysis of aromatic substances may also be applied in other fields. “We are currently looking at butyric acid bacteria. We have the first positive indications that we can provide information based on the smell of the milk. Testing for salmonella or listeria could also be of interest.”

Inge van Drie

Theo Lam: “Not ready yet, but promising”

As a fellow researcher, Theo Lam of the Dutch animal health organisation is closely involved in Dr Hettinga’s studies. “So far it all looks very promising. If we know which bacteria are present in a sample, we can demonstrate this brilliantly by analysing the aromatic substances.”

According to Mr Lam, the method is not yet ready for practical application. “Analysing aromatic substances is not going to replace bacteriological testing. For example, we don’t yet know whether we can distinguish penicillin-resistant S aureus strains from strains that are sensitive to penicillin.”

But in the long term, he certainly thinks there will be opportunities. “Analysing aromatic substances will make testing for mastitis quicker and increase the quality of testing. This makes bacteriological testing simpler. We are now backing requests for follow-up studies.”