FACTS ON FATS

The role of fats in the composition of taste

'Fats as the carrier of taste ' - many people will think here immediately of the few drops of olive oil mixed in a salad or the small amount of cream added to a soup. Fats are indeed important for the way in which the taste of a product is perceived, whether the fats are visible or invisible. It is then logical that reducing the amount of fat or changing the fatty acid composition has consequences for the taste. This applies both to the 'own' taste of a product as well as to the taste that is based on added flavouring. Because of the complexity of taste it is not easy to put forward general rules for how to develop a product with a different fatty acid composition while maintaining the taste. For the optimum result it will mostly be necessary to find custommade solutions.

THE FOLLOWING HAVE ALSO BEEN PUBLISHED IN THIS SERIES:

- What is fat?
- Functions of fats in food
- Consumer knowledge about fats
- Claims about fats

Taste, smell and the way in which a taste is perceived

Taste and smell go together - these two are bound almost inseparably to each other. This is evident from descriptions of the words 'flavour and flavouring', which as well as 'characteristic taste' also mean 'a substance that provides the smell and taste to food products'. The way in which taste is perceived is thus formed by a combination of tasting and smelling. People can distinguish tastes through the tongue and the cavity of the mouth and smells through the olfactory receptors in the nose.

Smells that are present in the air obviously reach the olfactory receptors through the nose. Smelling products awakens an expectation and triggers signals that prepare the body for taking in food. When you eat something aromatic substances are released during chewing and these proceed through the back of the throat to the olfactory receptors in the nose. This is called 'retronasal smelling'.

PHOTO: NIZO food research, Ede

In the first instance tastes are identified with the tongue. This is covered with a large number of papillae. Each papilla contains a number of receptors that allow people to perceive the different tastes. A number of receptors spread over the whole of the tongue are available for each taste. Four different tastes have been distinguished from of old: sweet, sour, salt and bitter. More recently it has been found that people have a fifth receptor that is sensitive to glutamate. This taste is called 'umami', which comes from Japanese and means 'meatiness' or 'spicy'. A good Dutch translation is hartig or savoury. It increases the amount of saliva produced and enhances many other flavours as well as salt and sweet tastes. It is therefore for a good reason that such compounds are called taste enhancers.

Testing with test panels

The perception of taste takes place in the subconscious part of the brain which makes it very difficult to talk about taste. This is in contrast to how we see colours, for example, which does take place in the conscious part of the brain, close to the language centre. This is why most people can talk about colours easily, where this is much harder for tastes. Therefore, it can be useful to carry out taste testing using trained testers. These testers have learned how to put into words what they are perceiving. Trained testers are better able to separate the perception of taste as well as possible from other circumstances. Environmental factors after all play a major part in the perception of taste. On a cheerful sunny day people can taste things differently than on a sombre rainy day. A beer or a glass of wine when on holiday often tastes better than when at home after a stressful working day. Therefore, it is important that as much as possible taste tests are carried out under the same conditions.

Changes in fats - same taste

Changing the fats in a product while keeping the taste the same is a complex process that is dependent on many factors. Both lowering the fat content and changing the fatty acid composition has consequences for the perception of the flavour at three levels:

1. the product composition
2. the release of aromatic substances in the mouth
3. the interactions between taste, smell and texture

How this takes place is described in the paragraphs below and where possible practical advise is also given.

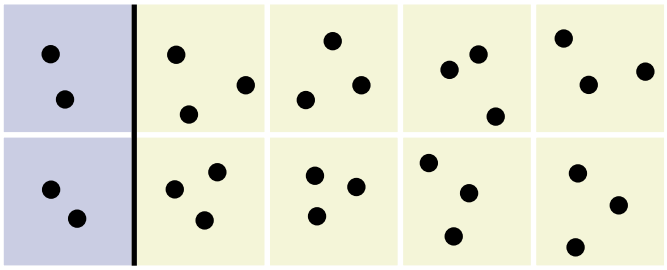
Level 1: Composition of the product

Reduction of fat

An aim shared by many product developers is to reduce the fat content of a product without at the same time changing the perception of the taste. Consider a product that consists of 20% water and 80% oil. There is a certain quantity of flavouring in this product and the consumer is used to this particular taste and its strength. A 'light' variant of this product may consist of 80% water and 20% oil. Using the same flavouring in the same quantity will result in this product having a very different taste. Flavourings generally consist of a complex mixture of flavour compounds. Many of these flavour compounds dissolve better in oil than in water.

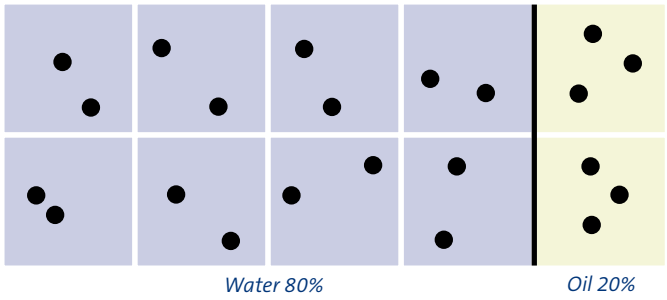
If you lower the fat content there is less of such a flavouring required to keep the taste the same (see the diagrams below). You might actually expect exactly the reverse to be the case.

A particular flavour component dissolves better in oil than in water:



In this example the total quantity of the flavouring component used in this product is 28 units

Only 22 units of this flavouring component are needed for the same taste effect in the equivalent light product:



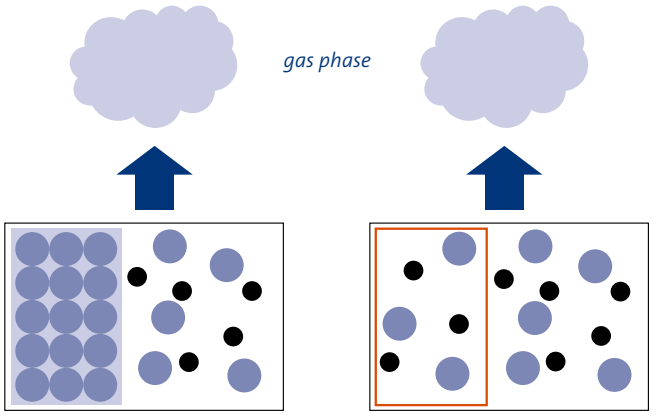
This is because given the way in which the flavouring component dissolves in oil compared with water there will always be present a number of 2 units in the waterparts and a number of 3 units in the oil parts. The taste effect of both emulsions is now the same.

But the reverse is true in the case of a flavour compound from the particular flavouring dissolving better in water than in oil. Then there actually will be more of that flavour compound necessary if the fat content is reduced. So if the fat content is reduced it is necessary to alter the composition of the flavouring in order to retain the same taste because of a change of the nature of the emulsion. Thus when determining the taste it is necessary in the first instance to consider the nature of the emulsion, or in other words the composition of the product.

If the fat content of a product is lowered the emulsion is changed and therefore also the composition of the product. In order to keep the taste the same it is then necessary to add more of one particular flavouring component while adding less of another. This means that a completely different flavouring is required with a different composition, that will have a different application level, and possibly a different colour. If the flavouring is formed during the preparation of the product, as with cheese, then this even means a different production process.

Fatty acid composition

The composition of the product is also of real importance when improving the fatty acid composition. If liquid fats (oils, unsaturated fatty acids) are added to a product at the cost of solid fats (saturated fatty acids) the flavour compounds dissolve better in the whole product so that the concentration drops. This means that it is necessary to add more flavouring in order to compensate for this drop. Flavour compounds dissolve badly in a solid, much less than in a liquid because the flavour molecules do not disperse so easily in the crystal lattice of the solid fat (see the diagram below). A solid fat is a substance in which the droplets of oil are much closer to each other than in a liquid fat. Once again the product composition therefore has consequences for the taste.



Solid and liquid, flavouring: 5 units

Completely liquid, flavouring: 8 units

Both situations give the same effect in the gas phase.

The flavour molecules are represented by the black dots. The oil droplets, containing the triglycerides, are represented by the blue dots.*

The product composition is also of real importance for the final taste in the case of an improvement in the fatty acid composition (addition of liquid fat). The flavour compound dissolves more easily in a liquid than in a solid.
An example of this is an ice lolly. It is sometimes possible to suck the sugared water with the flavour (the liquid) out of the ice lolly leaving a tasteless and often colourless piece of ice (the solid) behind.

Level 2: The release of aromatic substances in the mouth

The product composition is in fact simply the starting point. A dynamic aspect, namely what happens with the product when it is in the mouth, is then introduced as a secondary issue. Processes that are of influence on the concentration of the flavouring in the air space above the product, the so-called 'gas phase' or 'headspace', occur during chewing in the mouth. The gas phase is shown in the above diagram by depicting the oil droplets further apart than when in a liquid. How easily the flavouring escapes into the gas phase is of importance when chewing in the mouth. This gas phase goes with the air breathed in to the nose and in this way determines the smell of a product. How the flavouring moves from the solid or liquid phase of the product itself to the gas phase is also called 'release' of the flavour. This is a dynamic process that depends on various factors that play a role in the mouth, such as an increase in the temperature, the addition of water (saliva), possible 'flipping' of the emulsion (from water in oil to oil in water) and melting or breaking up of the product.

The acidity (pH) in the mouth also influences the concentration of the flavouring in the headspace. A low pH naturally already in itself gives an acid taste, but can also increase the vapour pressure of a flavouring so that it will be observed more strongly. However, this applies only to flavour components that are themselves acids. In contrast a high pH will actually lower the vapour pressure of an acid flavour component so that the perception of the flavouring will decrease.

Level 3: Interaction between smell and taste

The processes in the mouth influence the amount of flavour in the gas phase and thereby determine the smell of a product. As well as this, it is also a fact that taste and smell influence each other, as may texture and smell, and texture and taste. For instance, it appears that we always perceive the smell of viscose products less intensely than those of a thinner liquid. This is true even if the chemical consequences as described above have been corrected for. This has everything to do with how people integrate the information they are getting from smell, taste and the feeling in the mouth while eating. This integration takes place in the brain. These aspects also differ for different fats.

The processes in the mouth influence the amount of flavour in the gas phase and thereby determine the smell of a product. As well as this, it is also a fact that taste and smell influence each other, and tastes also mutually affect each other. An example of this is a product such as cola: although this is very acid this will hardly be tasted, because it is also very sweet.

** Triglycerides are fat molecules that are composed from glycerol and 3 fatty acids. More about this can be found in the FACTS ON FATS factsheet 'What is fat'.*

The objective of the Product Board for Margarine, Fats and Oils (MVO) as knowledge centre is to disseminate reliable and balanced information about the role of fats in a healthy diet. This information complies with the policy of the Dutch government and the Dietary Guidelines (in Dutch: Richtlijnen Goede Voeding) from the Netherlands Health Council. It is also the objective of the Product Board to stimulate an improvement in the fatty acid composition of food.

Fact on Fats is a initiative of
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Product case: cake with healthy fats

There are good examples of cakes with more unsaturated fatty acids on the market. These cakes are not soggier, despite the addition of liquid fats. This is also important because if the dough were to contain more moisture, the cake would have a different softness and crumb structure, and it would be less brown because of different baking characteristics. And all these factors have their own influence on the taste and also have an effect on each other. So to bake a good cake is certainly not easy but it can be done. Fortunately, we increasingly know better how to do this.

This factsheet is based on information provided by NIZO Food Research, with thanks to Peter de Kok, Principal flavour scientist at NIZO.