HEALTH PLUS™ CONCEPT

... A HEALTHY SOLUTION IN CHEESE

Marketing information

Life style and eating habits
Health and well-being remains a key trend in the cheese market. Even though the taste of full fat cheese is preferred, consumers have developed an increased awareness of a healthy lifestyle, asking for a new standard in the cheese industry.

The potential growth in low fat cheese is significant. Figure 1 shows the amount of product launches within the worldwide cheese market. It is clear that the low fat segment is an enduring trend and established itself as a new standard. There are many opportunities within this segment for further product differentiation. In particular positioning low fat cheese as a premium product by improving flavour and texture.

Health conscious consumers
CSK has developed the Health Plus™ concept especially for the group of consumers who want to reduce fat in their diets and therefore choose to eat cheese less frequently, use smaller portions or substitute with other foods. A substantial percentage of this group would increase their cheese consumption if low fat cheese would be offered without compromising on flavour, texture or meltability. In respond to this, CSK applied its expertise in developing a strong health concept for the cheese market.

Proposition of the Health Plus™ concept
CSK has conducted a major research study to determine the attributes, which are needed for developing low fat cheese with an appealing flavour, texture and functionality. This study has resulted in the Health Plus™ concept, which is targeted at low fat cheese variants, which are both natural (coated) and foil ripened. The Health Plus™ concept stands for:

- low fat cheese with different appealing flavour and texture profiles;
- suitable for traditional yellow cheese with high moisture content, like Dutch, Continental or Cheddar cheese types;
- specific adjunct cultures with flavour and texture improving properties;
- excellent low fat cheese, matching full fat cheese to the highest extend;
- a balanced and more intense cheese flavour without bitter off flavour;
- more smooth and less rubbery texture;
- reduced ripening time.

Technological information

Impact of fat reduction on cheese
Removing part of the fat from cheese may negatively affect the flavour, texture and functionality. Many low fat cheeses tend to have a flat and non-characteristic flavour, more translucency, poorer melting and baking properties and more rubbery and gummy texture and mouth feel.

The amount of fat is responsible for a significant contribution to the cheese flavour. Besides this, the fat phase of the cheese mass is an important carrier of flavour compounds, mainly produced by the aromatic strains of the starter culture. Fat is also responsible for the richness and mouth feel of cheese. In low fat cheese the balance of fat, protein, moisture and salt is changed. This results in deficiencies in milk fat derived flavour compounds generated from interaction of degradation products of lipolysis and proteolysis. The rate of development of uncharacteristic flavours increases with a decreased fat content of cheese. Low fat cheese is therefore also more susceptible for the formation of bitter off flavour.

Besides, the texture of low fat cheese is perceived as more rubbery and less cohesive. Cheese is considered as a material that consists of a hydrated protein matrix with interspersed fat particles. The greater the amount of fat in relation to protein, the more interruptions there are in the protein matrix and increased interference of long-range interactions between proteins. Likewise, an absence of fat allows protein interactions to be very extensive resulting in a rubbery texture.
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Flavour improvement

Low fat cheese has been characterised as having a lack of flavour and often contains undesirable flavours, including bitterness. These differences in flavour relate to the different balance of flavour-contributing compounds. As the biochemical processes are altered low fat cheese has an entirely different flavour profile. In particular, there is a distinct change in the aroma compound profile in low fat cheese. By using specific adjunct cultures with the desired characteristics, the same volatiles can be replicated in low fat cheese, which are normally developed in full fat cheese.

In the research study CSK has focussed on raising flavour compounds like diacetyl, which is well known as the key aroma compound of butter, and aromatic compounds from the proteolysis with use of specific starter and adjunct cultures. These cultures contain selected strains, which are used for cheese ripening to develop specific flavours with different organoleptic characteristics. They modify the cheese flavour towards an intense and full cheese flavour with more mature or sweet flavour notes.

As a result of the research study it can be concluded that specific types of starter cultures in combination with different adjunct cultures result in a rise of the diacetyl content of cheese.

In figure 2 the amount of diacetyl in a reference cheese (with index 10) and different adjunct cultures are presented. Diacetyl is perceived as a strong “creamy” flavour. Thus, resulting in a more creamy cheese with a reduced fat content.

To improve the overall flavour intensity of low fat even further, a more ripened flavour in cheese is often desired. Adjunct cultures may strongly improve the taste of cheese as shown in figure 3. In this figure the effect of adjunct cultures on the flavour attributes in low fat cheese is presented. In the central vertical axis the score of the neutral reference low fat cheese is presented, scores to the left represent a lower score and scores to the right represent a higher score.

Figure 3 shows that some adjunct cultures (like Adj I) introduce more sweetness and reduce bitterness, where Adj III give less sweetness than the reference and a higher score on bitterness. This is why CSK spends so much effort in a careful selection of most suitable adjunct cultures for low fat cheese.
**Bitterness prevention**

Low fat cheese is more susceptible for the formation of bitter taste, due to the raised water content. CSK has developed a range of adjunct cultures, which have strong debittering properties. Bitter taste is related to the lysis of lactic acid bacteria, which play a crucial role during proteolysis in cheese. Bacterial lysis ensures the involvement of intracellular starter enzymes in the formation of cheese flavour. In figure 4 the release of proteolytic enzymes is schematically shown. The lack of lysis during cheese ripening may result in an accumulation of degradation products of casein in the cheese matrix. The unbalanced proteolytic system is caused by faster formation than degradation of bitter peptides. This results in the taste deviation bitter. To avoid this, the suitability of lysis sensitive strains as debittering cultures have been evaluated.

In extensive laboratory tests the degradation of a bitter substrate, the C-terminal part of β-casein, has been determined. By incubation of selected lactococci with this bitter substrate an indication of the debittering capacity of such strains could be given. Strains with a high degradation rate of the bitter C-peptide, were strains with a high sensitivity to lysis and therefore very suitable as debittering culture. These strains do not contain protease activity at all, so they supply a net activity of peptidase activity, which is important for avoiding accumulation of bitter peptides in cheese.

The selected strains of mesophilic lactococci and thermophilic lactobacilli, with the special ability of reducing bitter-tasting peptides, have been organoleptically evaluated in Gouda cheese subsequently. In figure 5. the results of the taste deviation bitter in the sensory evaluation is shown.

Other causes of bitterness are the amount of rennet, pH of the cheese milk, cooking temperature and ripening temperature.

CSK has gained much experience in the reduction of bitterness with use of adjunct cultures in cheese types like naturally ripened and foil ripened Gouda, Cheddar and Maasdam.

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*Figure 4. Release of proteolytic enzymes (G. Buist 1998)*

*Figure 5. Organoleptic evaluation of Gouda cheese with addition of a mesophilic and thermophilic debittering culture*
Texture improvement

Melting milk fat in the protein-fat matrix gives a smooth and pleasant mouth feel during consumption. The milk fat plays a key role in the texture of cheese. If the fat reduction is not corrected, the cheese will become very tough, rubbery, less smooth and meltable. Corrections can be found in raising the moisture content of the cheese to make the texture softer. Another possibility can be found in modification or partly breakdown of the proteins during ripening with the use of certain adjunct cultures. This will result in a more soft texture due to the more intense proteolysis. Measuring the force/gradient (N/mm) of cheese samples shows the effect of changes on the texture of the low fat cheese samples. The tougher a cheese, the higher the gradient needed to cut it. In figure 6 the results are shown of measurements on 20° Gouda cheese and 48° Gouda cheese that had been ripened in coating at 13 °C. As shown below, the gradient is significantly increasing in low fat cheese with the same composition for water and fat content. From left to the right the gradient is measured respectively from the centre of the cheese to the rind.

Besides, the flexibility of the protein and fat matrix can be improved with the introduction of certain types of additional polysaccharides (EPS). This EPS is a compound produced by certain lactic acid bacteria. The conducted studies show that with the right selection of EPS forming strains (i.e. *Streptococcus thermophilus* strains) the texture will become softer, resulting in a decreasing gradient. With addition of potential acidifying strains, the right balance has to be found between EPS formation and (very) limited contribution to acidification. In figure 7 this effect is shown.

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**Health Plus™ cultures**

CSK has developed specific cultures with flavour and texture improving properties, which have been selected from an extensive research study. These cultures are part of the following culture ranges:

**L range**: thermophilic cultures with debittering and flavour- and texture improving properties;

**S range**: EPS forming cultures with texture improving properties.

**Assisting customers**

Based on your specific request, recipes and technology, our experts can provide you with further advice on the use of the Health Plus™ cultures starting with your desired product concept. They will give optimal support on:

- translating customer needs into required functionality and suitable product concepts;
- improving existing product ranges or production processes;
- selecting and implementing the right ingredients.

Cheese tastings based on the Health Plus™ prototypes can be supported by our consultancy and product management.

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