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Discussion

Discussion session on food emulsions and foams

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1. Introduction

In this session, we covered the textural requirements related to food emulsions and foams. The discussion was focussed on products such as sauces, mayonnaise, dairy products, desserts, margarine, cheese, whipped cream, ice-cream, bavarois, aerated desserts and mousses. Typical for the systems discussed is the presence of an interface with high surface tension between a dispersed phase (for emulsions usually mainly triglycerides that sometimes contain oil-soluble flavours and for foams usually air) and an aqueous continuous liquid that may be gelled.

The stability of these systems is crucial for processing, storage and handling. They should be very stable both after processing and on the shelf. Heat treatment (often causing protein denaturation and accelerating destabilizing processes) and freeze thaw cycles (related to concentration of the emulsion and components dissolved in the continuous liquid by the formation of ice-crystals) are notorious for causing problems with shelf life. On the other hand, methods to improve shelf life could lead to a loss in handling properties and taste. To date, it is not well known which structural and functional aspects of emulsions (static and dynamic) are relevant for this.

Because of the large diversity of products within the group, of food emulsions and foams, a division was made into three main types of systems within this group namely liquid emulsion, foams and emulsion-filled gels. These systems were addressed in separate rounds of discussion.

2. Results of the discussion session on food emulsions and foams

In the following, we present the question together with the main results from the discussion sessions, organised under the headings Sensorial behaviour and Challenges for research.

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3. Liquid emulsions

Liquid emulsions are the most general of the three types of systems and therefore many aspects that are important for these systems are also important for foams and emulsion-filled gels. Typical examples of liquid emulsions are milk, cream, sauces and mayonnaise. The subject was introduced by Doug Goff and Hugo Weenen (see Box 1). The discussion on this group of systems was initiated by the question: "which are the physico-chemical properties behind mouth-feel and flavor of emulsions?"

4. Sensorial behaviour

It is generally accepted that the viscosity enhancement and lubrication by the droplets plays an important role in oral sensory perception. Parameters in this are volume fraction of the droplets, the droplet size distribution, droplet surface/volume ratio, droplet deformability, the rheology of the dispersed and continuous phases and the connectivity between the emulsion droplets. Although it was generally thought that certain instability is needed for a favourable perception, not much is known about the importance of structural changes (instability) during mastication. Examples of possible processes are mixing with saliva (possibly affecting the state of droplet aggregation and interfacial properties), adherence of droplets to the mucosa, coalescence (either between droplets or hetero-coalescence with the mucosa), and heating to body temperature (which may change the rheological properties of the continuous liquid and melt solid fat in the droplets. These processes may lead to changes of the rheological properties of the emulsion, a coarsening of the structure, release of fat, the formation of a coating on the mucosa, changes in lubrication, and the release of fat-soluble flavours.

Not much is known about how the consumer perceives these properties and changes; which are the physiological interactions, what is the structure of the receptors, and what is the importance of time-intensity relations? How are these perceptions interpreted by the brain, and what is the role of education and culture in this?

Box 1 Which physico-chemical properties do we need to know, to better understand the sensory perception of emulsions?

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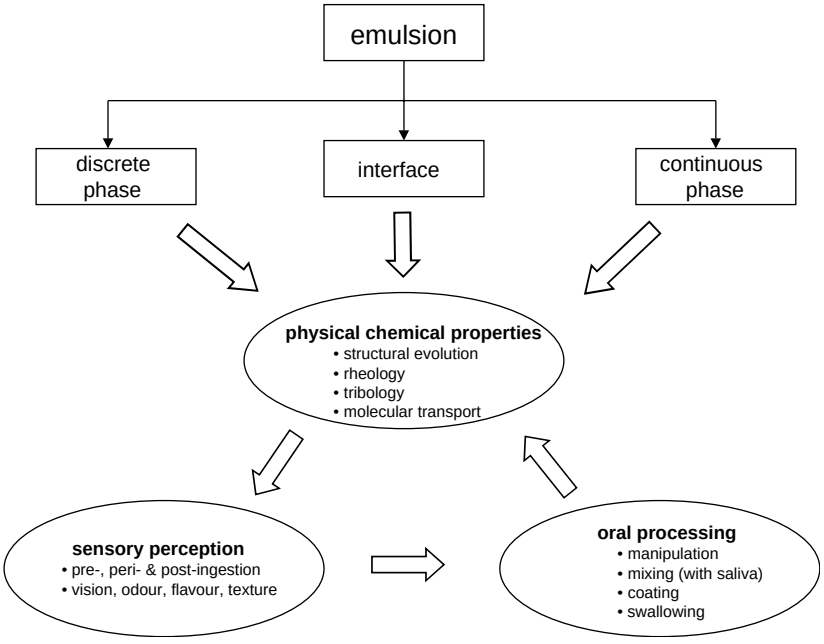
A great deal of research on emulsions has focussed on stability issues, phenomena such as flocculation, coalescence, creaming, sedimentation, and the emulsion attributes that lead to instability are, for the most part, well understood. Stability is also perhaps the primary goal of product development work related to emulsions. But how those attributes affect texture or mouthfeel of emulsions, and how changes due to instability might affect texture, is less well understood. It would pose a serious dilemma to the food technologist to learn that the attributes leading to optimal emulsion stability were not those leading to optimal texture. We can divide emulsion attributes into factors associated with the discrete phase (phase volume, droplet size distribution), those associated with the adsorbed layer (composition, quantity) and those associated with the continuous phase (viscosity, solution composition and properties). Of these, we know that droplet size distribution and composition of the adsorbed layer are very important stability issues. But the effect these have on texture is almost unknown. Flavour partitioning between the discrete and continuous phases, although not important for stability, must also play a role in flavour perception of the emulsion.



An example of the gap between knowledge regarding emulsion property and texture interrelationships can be found in milk and dairy products. For example, we know there is a large difference in texture between skim milk and 1% fat milk, but we do not fully understand how these fat globules can interact with the mouth at such a low concentration. We do not fully understand the relationship between droplet size distribution in homogenized milk (a controllable parameter) and creaminess. We do not fully understand the relationship between quantity of adsorbed protein in homogenized milk (a controllable parameter) and creaminess perception. Clearly, in the case of emulsions specifically but all foods generally, more knowledge is needed of the interactions between food constituents and the mouth before texture of foods can be fully understood.

To understand the relations between the physicochemical properties of an emulsion and sensory perception, we have to know what happens in the mouth. While flavour release under static conditions is mainly determined by molecular diffusion, under eating conditions flavour release is primarily controlled by the rate of surface renewal (de Roos, 2000). A model for the textural aspects for creaminess includes the sensory sub-attributes thick, smooth and slippery, which can be related to, and predicted from shear stress and frictional forces (Kokini, 1987). However up until