

Impact of fat and sugar on the physical and sensorial properties of different food matrices

Carla Arancibia Aguilar

SUMMARY

The impact of fat and sugar on the structural, physical and sensory properties of food, and its consequent acceptance by consumers, can be modified by the characteristics of each food matrix, the composition and structure of ingredients, as well as interactions between them. When designing new healthier foods, one must recognize and understand how these components affect the product's characteristics, and also the impact their reduction or elimination may have on final product quality. Within this context, the thesis reported here was performed on different kinds of semi-solid food matrices (milk-based, water/oil emulsions and protein-based) and focused on three topics: a) to analyze the effects of matrix composition modifications on physical and structural characteristics; b) to make connections between these changes, in-mouth release of odorous and sapid stimuli, and the perception of flavour, sweetness and texture; c) explore the use of new methods to investigate consumer perceptions and facilitate sensory quality optimization for new product development.

In the first part, the influence of fat content and the addition of different concentrations of two thickeners with different structure (carboxymethyl cellulose and starch) on the structure and physical properties of dairy desserts and of water/oil emulsions; was studied. The influence of protein and thickener content of soy desserts was also studied. Findings indicated that fat and protein content, as well as hydrocolloid type and concentration, modified the physical and structural characteristics of the different studied matrices. In dairy matrices, colour was mainly related to fat content, whereas flow behaviour depended mostly upon the type of hydrocolloid, and viscoelasticity on the concentration of this ingredient. In water/oil emulsions, both starch and CMC concentrations had a significant effect on flow behaviour, which was also influenced by the concentration of fat droplets. However, fat content was the most influential factor on viscoelasticity in CMC emulsions, while thickener concentration exerted the greatest influence on this parameter in starch emulsions. These differences were closely related to the variations observed in microstructure and particle-size distribution of the samples. In soy desserts, protein-CMC and protein-starch interactions had significant effect on all rheological parameter values, while the effects exerted by both hydrocolloids on flow behaviour and viscoelasticity, depended on protein concentration.

Two studies were conducted to analyze the effect that changes in composition, structure and rheological behaviour had on sensory characteristics in the different food matrices. One was performed on dairy desserts and the other on emulsions, both citrus flavoured. A study was made to assess the effect of composition (fat content, thickener type and concentration) on flavour release and sensory perception of lemon flavour, sweetness and texture. The *in vivo* release of volatiles responsible for flavour was qualitatively similar in both food matrix types. Fat content clearly affected the release of the most lipophilic volatile (linalool) but not the most hydrophilic (*cis*-3-hexen-1-ol). Reducing fat content influenced not only the intensity of odour and flavour, but also qualitatively changed the sensations perceived by varying the sequence in which volatiles were released from the matrix, in function on the polarity of each. In both types of matrices, volatiles were released at higher rates in starch-containing products than in those containing CMC. In dairy desserts, perceived citrus-flavour intensity depended only on

fat content, whereas in emulsions, intensity depended mainly on hydrocolloid type. Regardless of fat content and thickener concentration, samples with starch were perceived as sweeter than those with CMC. This would suggest that the structural differences between CMC (polymer) and starch (globular) influenced the way in which each matrix acts during processing in the oral cavity, changing the release of sucrose molecules from the matrix and their subsequent contact with taste receptors. Besides the impact on flavour and sweetness, both fat content and hydrocolloid type significantly influenced perceived texture in both types of food matrix.

It is not easy to obtain information from consumers that can provide valid and practical information to develop new products or to improve their acceptability. Thus, the third part of this thesis explored the possibility of combining certain methodologies to obtain information about how consumers perceive and describe differences between samples (Repertory Grid Method + Free-Choice Profiling + Generalized Procrustes Analysis), and also how information on their individual preferences can be used to help identify changes in product acceptance, and thus facilitate its reformulation (Response Surface Methodology + *Just About Right* scales). The first work was designed to determine the extent to which a consumer group was able to perceive and describe colour and textural differences in a series of milk-beverage samples with different compositions, and which differed in optical and rheological properties. This methodology was useful, not only to check that consumers were able to detect these differences, but that they could also identify them; moreover, it provided preliminary information on the relative importance of each difference. In the second research, the relationship between acceptability and composition variables of a high-protein soy dessert was studied. Product acceptability was optimized for overall consumer population consulted, and for two subgroups with different preference criteria. While changes in sample composition did not clearly influence its acceptance for one of these subgroups, for the other one these changes satisfactorily explained the differences in acceptance detected between samples. The information obtained with the JAR scales identified the attributes that should be modified to obtain more acceptable soy-based desserts.