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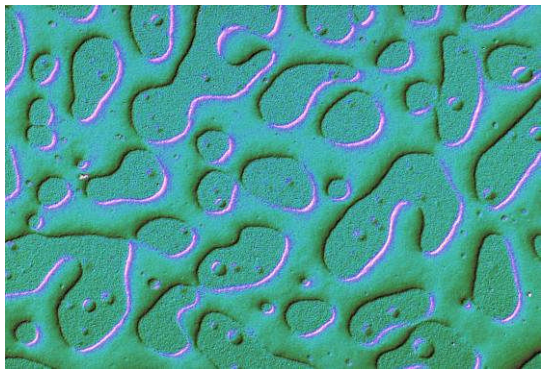
Understanding the perception of creaminess in dairy foods



Key external stakeholders:

Food and food ingredient manufacturers; dairy industry.

Practical implications for stakeholders:

- High pressure processing enhances the creaminess of yoghurts and produces low-fat yoghurts as creamy, or *even creamier,* than their conventionally produced full-fat counterparts.
- A better understanding of the relationship between product structure and creaminess perception, based on composition and processing has been developed.

The results of this work have led to further funding from Enterprise Ireland under the Commercialisation Fund and Teagasc researchers are currently developing a new platform technology for manufacturing size controlled protein particles, specifically to be used as novel fat replacer ingredients. Access to such an energy efficient and innovative food processing technology will benefit dairy and food ingredient companies greatly. It will allow them to produce higher quality, low fat dairy-based products with enhanced nutrition at significantly lower production costs.

Main results:

- High pressure milk processing (microfluidization) was shown to significantly improve the creaminess of low fat yoghurts
- The development of a new dynamic imaging technique for assessing product quality
- A predictive model for creaminess based on composition, rheology and microstructure
- Increased understanding of how microstructure can be controlled to enhance creaminess
- Demonstration that fat release from food matrices can be controlled by pH and emulsifier type

Opportunity / Benefit:

There is an opportunity for dairy food ingredient manufacturers to partner with Teagasc to investigate the true potential of such high quality low fat dairy based ingredients using this novel approach. Expressions of interest from relevant companies are welcome.

Collaborating Institutions:

University College Cork

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1. Project background:

Creaminess is a desirable attribute associated with foods of high quality, but which often contain moderate to high fat contents. Fat-reduction, although desirable for health reasons, remains a technological challenge, given the consumer preference for full-fat counterparts made from natural ingredients. Little is known of the role of processing and food structure on creaminess.

2. Questions addressed by the project:

- What effect has composition and processing on food structure and its relationship with creaminess?
- Will an increased understanding of the relationship between product structure and creaminess perception help in developing innovative reduced fat foods?

3. The experimental studies:

- Pilot scale yoghurts containing 0 %, 1.5 % or 3.5 % fat were produced using high temperature short time (HTST) pasteurizer and either conventional homogenized or microfluidized using the new Biofunctional Food Engineering facilities.
- Production of yoghurts varying pressure, fat content, and homogenization type.
- Standardized operating procedures were established for the production of samples to be given to trained sensory panelists who developed comprehensive creaminess lexicon.
- Full descriptive sensory profiles and rheological characterization of yoghurts obtained.
- Full microstructural characterization of products using light, confocal and scanning electron microscopy facilities of the National Food Imaging Centre.
- To develop new imaging techniques characterise fat release during large-scale deformation of filled protein gels containing polysaccharides or sunflower oil.
- Develop predictive model for creaminess based on multivariate data analysis of composition, rheology, microstructure and sensory data.

4. Main results:

- Significant differences were observed in all major sensory descriptors associated with creaminess and confirmed that microfluidisation greatly improves creaminess in yoghurt.
- 1.5 % fat yoghurts made with microfluidized milk were actually creamier than full fat (3.5 %) yoghurts.
- Microfluidization of milk created protein-fat “nanoclusters” which were associated with improved rheological and sensory properties.
- A new technique for monitoring food material fracture properties was developed. A microtensile stage attached to a confocal microscope was used to characterize the fracture behavior and subsequent release of emulsified fat in a protein gel.
- Results indicate that fat mobility (and release) can be controlled by pH and emulsifier type. This suggests that new low fat products can be developed with controlled fat release in the mouth.
- Results of polysaccharide filled gel work led to a new Enterprise Ireland Proof of Concept project (POC-2009-0260) to develop a new protein fat replacer based on phase separation phenomena.
- A Predictive model for creaminess based on composition and rheology has been completed produced from conventionally homogenized milk.

5. Opportunity/Benefit:

Based on the successful findings of this project which allowed increased understanding of the perception of creaminess in dairy foods, the researchers identified the potential to develop superior quality innovative low fat dairy ingredients and foods in the future using novel food processing technologies developed herein.

This led to successful funding through Enterprise Ireland Commercialisation fund (POC-2009-0260) entitled “*A calcium rich, high fibre fat mimetic formed by kinetic trapping - a novel, energy-efficient food processing*

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technology (Kintrap)" in 2009 which focused on using the natural phase separation based novel, energy-efficient food processing technology to develop nano/microparticles of whey protein as novel protein fat replacers for the dairy industry. It would be hoped that novel Intellectual Property generated through the Enterprise Ireland funded project could be commercialized by Irish and possibly multinational dairy and food ingredient companies through licensing of these novel technologies for specific applications in food industry.

6. Dissemination:

This work has been presented at several conferences, including at the 14th World Congress of Food Science and Technology (China) and as an invited keynote presentation for the International Dairy Federation Microstructure Symposium, Norway.

Main publications:

Ciron, C.I.E, Kelly, A.L. and Auty, M.A.E. (2010) Comparison of the effects of high-pressure microfluidization and conventional homogenization of milk on particle size, water retention and texture of non-fat and low-fat yoghurts. *International Dairy Journal*, 20: 314 – 320.

Abhyankar. A.R., Mulvihill, D.M., Fenelon, M.A. and Auty, M.A.E. (2010) Microstructural characterisation of beta lactoglobulin-konjac glucomannan systems: effect of NaCl concentration and heating conditions. *Food Hydrocolloids*, 24: 18-26.

Ciron, C.I.E, Kelly, A.L., Auty, M.A.E. (2011) Effect of microfluidization of heat-treated milk on rheological and sensory properties of reduced-fat yoghurt. *Food Hydrocolloids*, 25: 1470-1476.

Popular publication:

Auty, M.A.E. 2006. Why do we like creamy foods? TResearch Vol 1 No. 1, Teagasc, p18 - 19.

7. Compiled by: Dr Mark A.E. Auty and Dr Mark Fenelon

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