SENSORY, RHEOLOGICAL AND MICROSTRUCTURAL CHARACTERISTICS OF MODEL EMULSIFIED DAIRY SYSTEMS

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ABSTRACT

Texture is an important sensory property of foods. It is sensed mostly in the mouth during the process of mastication and is an indicator of food quality. To enable faster and cheaper prediction of textural characteristics, extensive research has been done to establish instrumental techniques to produce data that correlates well with the sensory appraisal of texture. In this study, model emulsified dairy systems, represented by processed cheese analogues, were characterised using sensory, microstructural and rheological techniques. Correlation between instrumental and sensory textural data was investigated.

A range of experimental cheeses with differing textural attributes was produced by modifications to the moisture content of the products and the mixing speed during manufacture. Twelve experimental cheeses were used in a partial response surface design in four experimental blocks. These cheeses were subjected to compositional analysis. Two weeks after manufacture, the cheeses were texturally evaluated using a trained sensory panel and quantitative descriptive analysis (sensory), confocal laser scanning microscopy and image analysis (microstructure) and fundamental physical tests including frequency sweep, creep compliance and compression to 70% (rheology). Sensory-instrumental correlations included the chemical data and were performed using pairwise correlation, stepwise regression, principal component analysis and canonical correlation analysis.

Significant differences in moisture, total protein, fat content and pH were found between the experimental cheeses, as expected by the formulation changes. The confocal micrographs showed that fat globule size decreased with decreasing moisture content, but little effect was found for mixing speed. Reduction of the globule size resulted in cheeses that were firmer, better emulsified and stickier.

Sensory evaluation of the cheeses in the mouth was not used in this study because of oral fatigue. Instead, seven hand evaluated attributes were selected from a sensory profiling session. Fracturability, rubberiness and

greasiness proved not to be good sensory attributes to discriminate between these cheeses. Significant differences between the cheeses were found for firmness, curdiness and stickiness. Cheeses with lower moisture content were, in general, firmer, more curdy and less sticky than cheeses with higher moisture content.

Frequency sweep, creep compliance and compression to fracture were all useful tests for providing rheological discrimination between the experimental cheeses. Cheeses with lower moisture content showed higher values of storage and loss moduli, Young's modulus, peak stress and work in compression as well as lower values for compliance. These results provide an indication that these cheeses are firmer, better emulsified and more stable products than those with higher moisture content.

Pairwise correlation was used to correlate the microstructural results to the sensory, chemical and rheological data. It was shown that the area occupied by the protein matrix in the micrographs correlates significantly with most chemical and rheological parameters as well as those sensory attributes that adequately discriminated between the experimental cheeses. Microstructural information was insufficient for use in regression analysis.

Stepwise regression analysis was a useful technique for generating simple models to fit the sensory scores with rheological and chemical data. The regression equations for firmness, stickiness and curdiness produced R-square values above 85%, indicating good predictive ability. Principal component analysis was used to tackle the problem of multicollinearity of the predictive parameters. However, combining those instrumental parameters that were not independent from each other did not improve the quality of the correlation coefficients obtained. Firmness in compression and curdiness were the only two sensory attributes satisfactorily modelled using the first rheological principal component, with R-squares of 88.4% and 90.0%, respectively.

Canonical correlation analysis proved to be a useful statistical tool for maximising the correlation between individual sensory textural attributes and instrumental data. Similarly to the stepwise regression analysis,

fracturability, rubberiness and greasiness could not be satisfactorily modelled. In general, firmness (compression and cutting), stickiness and curdiness were very satisfactorily modelled using only the results from the frequency sweep and creep compliance tests. Compression test data appeared not to lead to any improvement in the correlation coefficients.

Overall, the present study showed that sensory, microstructural and rheological characteristics of the processed cheese analogues investigated do correlate. It is possible to generate predictive models for some individual hand evaluated sensory attributes using chemical and instrumental (rheological) parameters. Prediction using microstructural information has yet to be verified.

"The public sees only the accomplished trick;
they have no conception of the tortuous, demanding
preliminary self-training that was
necessary to conquer that fear."

"The secrets of Houdini" (J.C.Cannell)

To J.

For the love and support,

for the beauty and joy brought into my life,

for the infinite patience

and for making a better me.

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