INVESTIGATION ON THE **TEXTURE OF CREAM CHEESE WITH DIFFERENT METHODS**

Ottília Bara-Herczegh, József Csanádi, Sándor Barakonyi
University of Szeged Faculty of Engineering, Department of Food Engineering
H-6724 Szeged, Mars sq. 7, Hungary
e-mail: otti@mk.u-szeged.hu

ABSTRACT

Rheological characterization of cheeses, especially processed cheeses is very important, because the quality is determined mainly by the texture properties, and the technology and the storage conditions have significant impact on the required texture. Rheological and texture properties are mainly affected by the chemical composition and the type and quantity of the processing conditions. After production the structure is going through of major changes during cooling period and the storage, so a description of knowledge well-defined circumstances, using the parameters may provide useful additional information to the qualification. The structure formation of the final product is also useful feed-back information for the manufacturer.

Different type the Sole-Mizo Co. produced processed cheeses (nature and ham flavoured) were investigated by sensory and rheological methods (texture analyses and flow behaviour). The gross composition and the quality according to the sensory test met with the requirements, their quality were located in good and excellent category. The texture of samples was studied by Texture Analyser QTS 25. The nature cheeses were investigated in the total shelf-life according to a programme, the ham flavoured samples only during a shorter period. We determined the hardness value dependence versus shelf-life. The hardness can be a useful parameter in the qualification of cream cheese. The flow behaviour of ham favoured samples was investigated by viscometer at different temperature. The apparent viscosity changed with the temperature. Flow curves showed a same character as the typical non-Newtonian pseudo plastic fluids. It was created a consistency index (as a rheological parameter) and its changes can be associated whit with temperature induced changes in the structure of processed cheeses.

1. INTRODUCTION

Processed cheese products are characterized essentially by special raw materials and technology. They have versatile forms, appearance and taste with very long shelf-life. Rheological characterization of cheese in general and particularly of processed cheese is important as a means of determining body and texture for quality and identity as well as a means of studying its structure as a function of composition, processing techniques and storage conditions (Konstance & Holsinger, 1992). The texture of processed cheese is affected by many factors. These include the quality of the raw cheese to be processed, emulsifying salts, water, temperature, agitation, duration of processing, addition of dairy or non-dairy ingredients, etc (Caric & Kalab, 1993; Chambre & Daurelles, 2000).

The objective of the present work was to study the textural and viscoelastic properties of cream cheeses - produced by SOLE-MIZO holding - in the shelf life of the products. The aim of investigating textural properties was to get data about the texture parameters, to get information on their changes and choose those parameters, which can give more information about the quality of the product. The aim of the investigation of the flowing properties of the product during heat treatment by rotational viscometer was to collect data to optimize the processing conditions, and to characterize the product. The grading of the samples was by chemical composition and by the quantitative descriptive test of the Hungarian Standard.

We would like to inform you the results of the two series of experiment that investigated the texture and the flowing properties of cream cheese during storage.

In the *first series of experiment* the textural parameters of nature cream cheese were determined by texture analyzer QTS-25 in the shelf life of the product, according to a program (9 times). At the same time the product was qualified according to the sensory test (MSZ 12288-1989).
In the *second series of experiment* we applied the results of the first study. The texture and flow properties were investigated on samples of hammy cream cheese in seven days after production according to a program. At the same time the product was graded according to the sensory test (MSZ 12288-1989).

2. MATERIALS AND METHODS

Two types of cream cheese samples (nature and hammy) were purchased from SOLE-MIZO Dairy Company. The nature samples were taken from 3-3 mixture of two different production lots. The hammy samples were taken from 3 mixture of one production lot.

Determination of textural parameters

The textural parameters were determined with a QTS 25 Texture Profile Analyzer (CNS Farnell England). The samples were analyzed 5 times on the different part of it. From each product three pieces were analyzed. 15 parallel measurements were made for each product at the same age.

Testing parameters: Probe: 7 mm ∅ metal cylinder; Type of test: penetration; Speed of probe: 30 mm/min; Trigger: 5.0 g; Depth of penetration: 5.00 mm; Number of cycles: 1; Temperature of sample: 15±1°C. *Mechanical parameters investigated.* Fracture Force, Hardness, Modulus, Adhesive Force, Adhesiveness, Area, Work Done to Hardness.
Texture analyses of nature samples: The samples were analysed 9 times after production (on the 1., 3., 5., 12., 26., 56.,86., 116., 130. days) in the self-life of the product.
Texture analyses of hammy samples: The samples were analysed 5 times after production in the first week of the storage (on the 1., 2., 3., 6., 7. days).

Determination of viscosity with rotational viscosimeter

The flowing properties of hammy cream cheese samples were investigated the next day after production with Haake R6 rotational viscosimeter. The viscosity was determined as a function of shear rate at different temperature according to a program in three parallel measurements. *Testing parameters:* Spindle: R7; Rate of shear: 5, 10, 20, 30, 50, 60 rpm; temperature of the sample:35°C, 65°C, 75°C, 85°C. Determined parameter: Viscosity mPas.

Sensory Test

The quantitative descriptive test of the Hungarian Standard (MSZ 12288-1989) (20 scores, with weighted factors) was applied for the samples. The nature samples were analyzed on the 5th, 12th, 56th, 116th and 130th day of storage, as the self-life of the products relatively long, 120 days. The hammy samples were analyzed on the 7th day after production.

3. RESULTS AND DISCUSSION

Grading the samples

The gross composition of the samples (fat-, dry-matter, fat in the dry matter content, pH value) was determined by the factory. The composition of the samples was uniform. All data fulfilled the approval requirements (table 1).

Table 1. Gross composition of the samples

Component	Fat content m/m%	Dry matter m/m%	pH	Fat in the dry matter m/m%
Average ± deviation	*24.13±0.25*	*43.4±0.35*	*5.73±0.05*	*55.59±0.72*
Standard value	23-25	43-46	5.6-5.8	53-59

The sensory tests were evaluated according to the standard (MSZ 12292-87). The nature samples met the requirements. They had good and excellent quality in the total shelf-life. The grade of the hammy samples had excellent quality.

Evaluation of Textural Parameters

The texture parameters of processed cheese were determined with a penetration test by QTS 25 Texture Analyzer. Seven parameters were investigated: Fracture Force, Hardness, Modulus, Adhesive Force, Adhesiveness, Area, Work Done to Hardness. According to Cock (1994) a parameter is reproducible if average variation coefficient is smaller than 40%. Six parameters, except Fracture Force, fit to this category with variation coefficients between 20 and 35%. The selected parameters correlated significantly with hardness. We chose it as well defined, easily interpretable parameter. The hardness and the age of the samples are correlated with each other according to an exponential function. So the hardness (Y) and the logarithm of the age (X) have connection with a linear equation. At nature samples Y= 13.5 Ln(X) + 91.28 / r = 0.977 /. At hammy: Y= 315 Ln(X) + 201.71 / r = 0.960 / .

Evaluation of viscosity

The viscosity of hammy samples was determined with rotational viscosimeter to get information about the flow properties. The apparent viscosity (η) is changing with the speed of spindle, which correlates with the gradient of shear rate ($d\gamma/dt$).

The apparent viscosity is decreasing with the increase of shear rate. An exponential function can fit for the measured data. As the temperature increases, the rate of viscosity decrease is growing. The observation is based on the composition of the processed cheese (protein, fat, wet and emulsifying salts). The unfolded hydrated protein molecules have random orientation and reduced mobility, resulting to highly viscous solutions. These solutions display pseudoplastic flow properties, which indicate that their viscosity decreases as soon as the shear rate increases. This behavior can be explained by the progressive rotation and orientation of the macromolecules in the direction of flow (Damodaran, 1997). Increasing moisture content and temperature (thermal energy) increases the protein molecules mobility for rotation, thus the solutions exhibit less shear dependent behavior. A linear function was established between the logarithm of apparent viscosity and the logarithm of shear rate. log Y=b*log x+log a Where Y= apparent viscosity, x= shear rate. The data of linear regressions of different product mixtures are in the Table 2.

Table 2. Parameters of linear regression (log apparent viscosity versus log shear rate)

Temperature	t=35°C			t=65°C		
Mixture	**b**	**log a**	**R2**	**b**	**log a**	**R2**
1	*0.8757*	*1.8016*	*0.9934*	*0.8616*	*1.7702*	*0.9996*
2	*0.7928*	*3.0425*	*0.8143*	*0.7459*	*2.9224*	*0.997*
3	*1.0762*	*3.2192*	*0.9969*	*0.842*	*2.9952*	*0.993*
Temperature	t=75°C			t=85°C		
Mixture	**b**	**log a**	**R2**	**b**	**log a**	**R2**
1	*0.8097*	*1.6396*	*0.9993*	*0.8846*	*1.5756*	*0.9998*
2	*0.7314*	*2.7962*	*0.9993*	*0.6321*	*2.718*	*0.9867*
3	*0.7337*	*2.746*	*0.9329*	*0.8741*	*2.6676*	*0.9982*

According to Dimitreli & Thomareis (2004) the value of *log a* depends on the composition of cheese (protein and wet content) and the temperature. This parameter (*a*) is related to the consistency of cheese (consistency index). When the temperature and moisture content are increased, consistency index is reduced indicating that processed cheese is less viscous. The selected parameter (*log a*) has a relationship with the temperature by linear regression (fig. 1). The tendency is similar to that of Dimitreli & Thomareis (2004)

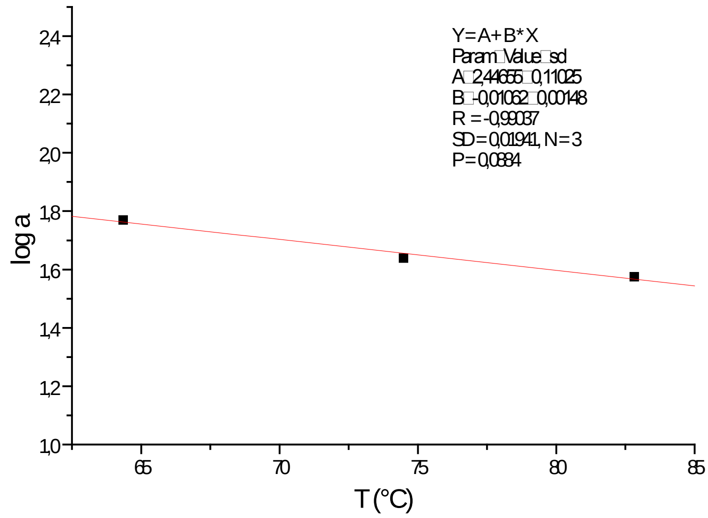

Fig. 1. : Log a as a function m of temperature, linear regression (1. mixture)

4. CONCLUSIONS

The hardness value determined by Texture Analyses and the relationship with the age of the product can be useful information to the description or qualification of the product. The apparent viscosity as a function of temperature of the processed cheese is characteristic for the pseudoplastic fluid. The consistency index was found from the evaluation of flow curves. It is related with the composition and rheological properties of the samples.

REFERENCES

1. Caric, M., & Kalab, M. (1993). Processed cheese products. In P. F.Fox (Ed.), Cheese: chemistry, physic and microbiology (Vol. 2, pp 467–505). London: Chapman & Hall.
2. Chambre, M., & Daurelles, J. (2000). Processed cheese. In A. Eck, & J.C. Gillis (Eds.), Cheesemaking: from science to quality assurance (pp. 641–657). Lavoisier Publishing Inc.
3. Cock, P (1994): Starch compositions texture- design of pasta cocktail snacks. *Food Ingredients europe '94*, Conference Proceedings, pp. 101- 105
4. Damodaran, S. (1997). Food proteins: an overview. In S. Damodaran & A. Paraf (Eds.), Food proteins and their applications (pp. 1–24). New York, Basel, Hong Kong: Marcel Dekker, Inc.
5. Dimitreli, G. & Thomareis, A.S. (2004): Effect of temperature and chemical composition on processed cheese apparent viscosity *Journal of Food Engineering* 64, 265–271.
6. Konstance, R. P., & Holsinger, V. H. (1992). Development of rheological test methods for cheese. *Food Technology*, 46(1), 105–109.
7. MSZ 12292- 87 (1987) „Sensory Analyses of Milk and Milk product" Standard
8. MSZ 12288-1989 (1989) „Processed Cheese" Standard