INFLUENCE OF PLASTICISATION CONDITIONS ON THE TEXTURE OF CASCAVAL CHEESE

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Abstract. *The aim of this study was the determination of mechanical and sensorial properties of Cascaval Cheese as affected by plasticisation conditions. The curd was plasticised using four variants of brine, made from different solvents (water or water-whey mixture) and different quantities of salt. The firmness of the curd was determined by sensorial and instrumental methods and there was established a high correlation between the results. A series of other textural properties were determined by sensorial method. There were also determined some physical and chemical parameters. The best conditions of texturising curd involve the use of a 12% water-whey brine.*

Keywords: stretching, texture, firmness

INTRODUCTION

Cascaval cheese, together with Mozzarella and Provolone, belongs to the *pasta-filata* group of cheeses. They undergo a texturization process that involves soaking the acidified curd in hot brine until a plastic consistency is achieved. The hot plastic curd is then kneaded and stretched to produce a homogeneous cheese with a fibre-like structure. The specific technology in the production of Cascaval results in the characteristic structure of the final cheese: laminar, elastic, very close with visible layers and random slits, but no gas holes (Kindstedt *et al.*, 2004). According to this, the main operation in the technological flowchart of Cascaval manufacturing is plasticisation (texturisation) which consists in the immersion of the acidified curd in hot water, whey or salt brain (Kindstedt, *et al*. 2010), followed by manual or mechanical stretching. The conditions of plasticisation vary from a sort of Cascaval to other. For example, for the obtaining of Dobrogea Cascaval the curd is immersed in a mixture made of water, desalbuminated whey and salt at 72…74°C, while for Penteleu Cascaval water at 95…98°C is used (Costin and Botez, 2003). Texturizing has an additional advantage, i.e., a pasteurizing effect which suppresses undesirable microbial growth and encourages desirable fermentation and ripening, resulting in high-quality cheese (Kindstedt *et al.*, 2004).

Cheese texture may be defined as a composite sensory attribute resulting from a combination of physical properties that are perceived by the senses of touch (including kinaesthesis and mouth-feel), sight and hearing. Thus, cheese texture is directly measurable only by sensory analysis. Sensory analysis requires definition and classification of textural attributes or descriptors (O'Callaghan and Guinee, 2004). For the textural evaluation of cheese there were defined a series of parameters. According to Szczesniak (1963) and Bourne (1978), cited by O'Callaghan and Guinee, 2004 *firmness* is defined as the force necessary to attain a given deformation. In sensorial terms, *firmness* is defined as the extent of resistance offered by the cheese, assessed during the first five chews using the front teeth, ranging from soft to firm (Delahunty and Drake, 2004). They defined also, a series of sensorial characteristics of cheese texture like: *cohesiveness* - the degree to which the chewed mass holds together, evaluated after five chews, *adesiveness* - the degree to which the chewed mass sticks to mouth surfaces, evaluated after five chews, *rubberiness* - the extent to which the cheese returns to its initial from after biting, assessed during the first 2–3 chews and *creaminess* - the extent to which the texture has broken down to a creamy semiliquid texture, assessed between tongue and palate during mastication.

The aim of the study was the evaluation of cheese textural properties as affected by four different plasticisation condition.

MATERIAL AND METHOD

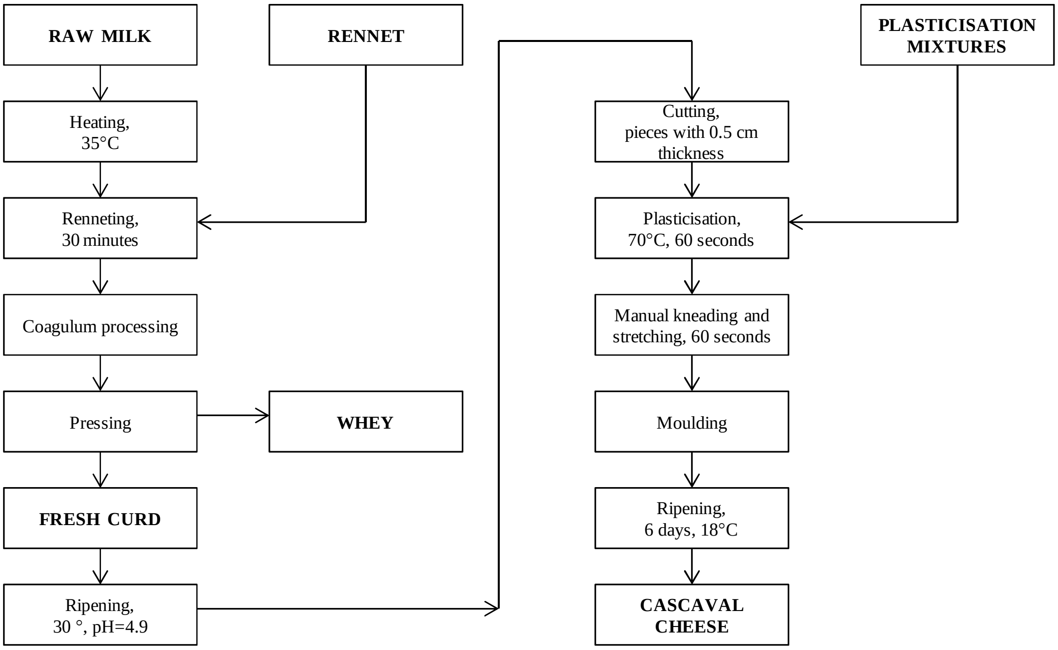


Fig. 1. Technological flowchart for manufacturing Cascaval Cheese

The curd was manufactured using the traditional method described by Costin and Botez in 2003 (figure 1). Row cow milk was heated at 35ºC as specified in rennet's prospectus. Renneting took place for 50 minutes. The coagulum was cut and graded and after that the coagulum and whey mix was heated at 40 ºC stirring continuously in order to expel the whey. After 20 minutes the coagulum was put on a sieve and pressed for 25 minutes. The obtained fresh curd was then cut into slices and ripened at 30 ºC until the pH of 4,9 was reached. The ripened curd was cut into pieces with 0.5 cm thickness, put in metal basket and scalded in four variants of mixtures: 10% salt and 90% water (encoded M1), 12% salt and 88% water (encoded M2), 10% salt, 63% water and 27% whey (encoded M3) and 12% salt, 61.60% water and 26.40% whey (encoded M4). All the mixtures had 70ºC, the operation lasted 60 seconds and was followed by manual kneading ang stretching for other 60 seconds. The texturized curd was than put in plastic cilindrical molds, with 14 cm diameter and 10 cm height and kept at 18°C for ripening. After 24 hours the molds were removed and the ripening continued in the same conditions for 6 days.

For all the samples there were determined the firminess and the physical chemical and sensorial parameters.

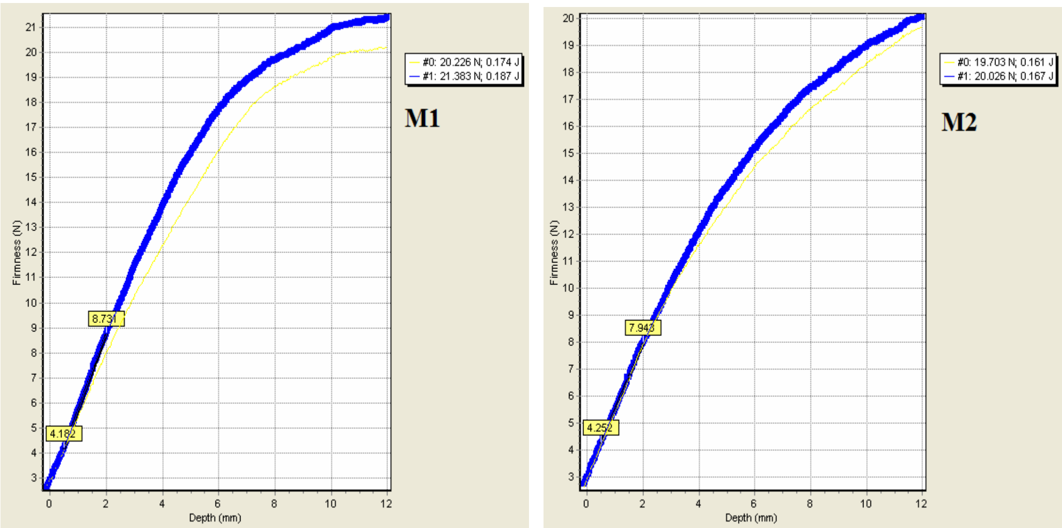
Firmness was measured using a texture analyzer made by Guss. The samples were placed on the support of the apparatus and then penetrated using a 8 mm diameter probe. The force required to penetrate the samples at 12 mm depth was measured. The software of the apparatus ploted the variation between force and depth.

Sensorial analysis was achieved with 10 panelists trained at Food Science and Engineering Faculty Galati. They analyzed a series of sensorial characteristics that describe texture: firmness, cohesiveness, adhesiveness, rubberyness and creaminess. The panelists were asked to give scores between 0 and 5 (0 most disliked, 5 most liked). The score was calculated as the average of the ten scores pointed by the 10 panelists.

The physical chemical analyses regarded pH (by direct measure using an IQ-SCIENTIFIC pH-meter), dry matter (according to SR EN ISO 5537:2005), fat content (according to SR EN ISO 1211:2010), and salt content (according to SR EN ISO 5943:2007).

RESULTS AND DISCUSSION

The firmness of the four samples revealed by the texture analyzer is presented in figure 2. According to the figure, the highest value for the firmness, 26.957N, was registered for the curd immersed in mixture M3 (10% salt, 63% water and 27% whey) while the lowest, 20.026N was registered for the curd immersed in mixture M2 (12% salt and 88% water).



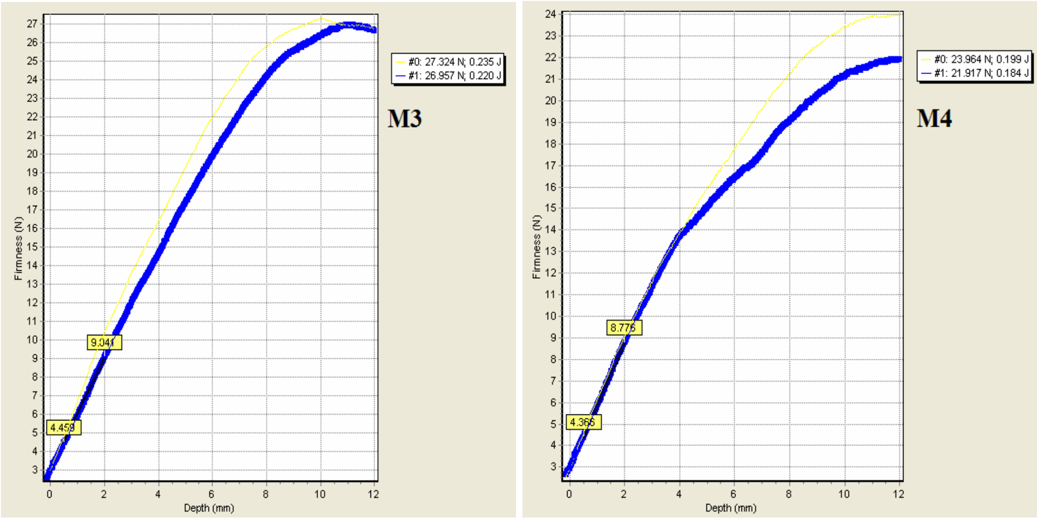


Fig. 2. Firmness plotted by the software of the apparatus

It can also been observed that the firmness increased with the decreasing of salt concentration, for both water and water-whey brain. This can be explained by the fact that the increase in casein hydration with NaCl may be attributed to the binding of Na^+ by the casein and the displacement of calcium or calcium phosphate from the para-casein by the Na^+. In effect, the addition of NaCl appears to create a sodium–calcium ion exchange effect with the para-casein. Indeed, an inverse relationship between casein hydration and casein-bound calcium in model systems has been reported by many investigators (Guinee and Fox 2004). Another observation is that the imersion of the curd in water brine has a softening effect comparing to the imersion in water-whey brine, at the same temperature due to the calcium present in whey, which increases casein–casein interactions and thereby reduces casein hydration (Pastorino *et al*., 2003).

The results of the sensorial analysis indicate the same influence of the plasticisation on the firmness of the curd as the instrumental analysis. On a scale from 0 to 5, the average score registered as follows: 4.5 for the curd immersed in M3, 4 for the one immersed in M4, 3.9 for M1 and 3.5 for M2.

In order to obtain a correlation between the sensorial and instrumental results for firmness, a scatter graph was drown (figure 3). The value of 0.9186 for R^2 coefficient shows a good linearity. The correlation coefficient was calculated using the CORREL function of EXCEL programme and its value of 0.95845 sows a very strong relationship between the results obtained by the two methods, according to Bower, 2009.

Because texture is a sensory property, the texture of cheese should be described by a series of texture terms, evaluated durin mastication (Foegeding and Drake, 2004). These textural parameters determined by sensorial analysis were cohesiveness, adhesiveness, rubberyness and creaminess. Te results are presented in table 1.

Cohesiveness (the degree to which the chewed mass holds together) pointed the highest scores for the samples imersed in water-whey brine 4.5 in the case of 10% salt concentration and 4.2 in the case of 12% salt concentration. Adhesiveness (the degree to which the chewed mass sticks to mouth surfaces, evaluated after five chews) varied between 1 for the samples immersed in M3 and 1.5 for the samples immersed in M2. There can be observed lower values for the samples immersed in whey brine.

Rubberyness, frequently associated with elasticity, was perceived more intensely for the samples immersed in whey brine. All this situations might be due the influence of NaCl on the proteic bounds in the casein matrix. Creaminess is ussualy associated with the fat content. As can be seen in table 1, although the fat content did not considerably vary, the creaminess was perceived more intensely (3.5-3.6 points) for the samples immersed in whey brine, probably due to the complex composition of whey.

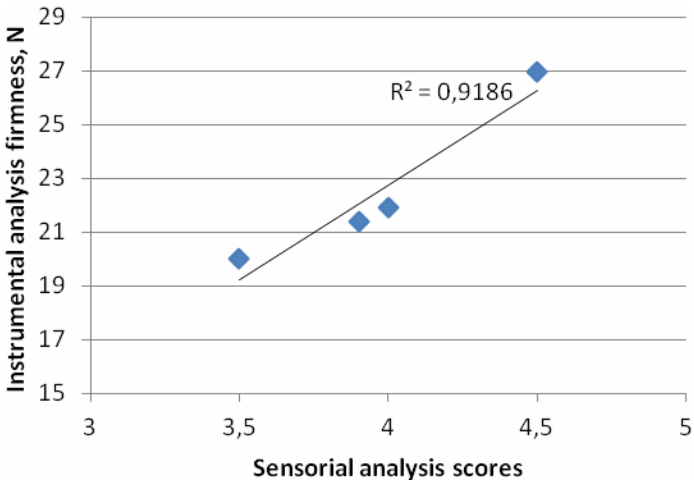


Fig. 3. The correlation between sensorial and instrumental results for firmness

Table 1

The results of the sensorial, physical and chemical analysis

Sample	M1	M2	M3	M4
sensorial				
Cohesiveness	4.1	3.9	4.5	4.2
Adhesiveness	1.3	1.5	1	1.2
Rubberyness	3.7	3.5	4.1	4
Creaminess	3	3	3.5	3.6
physical and chemical				
pH	4.6	4.8	4.7	4.8
Dry matter, %	52.1	52.2	53.5	53.7
Fat, %	24.6	24.6	24.6	24.7
NaCl, %	1.8	1.82	1.83	1.85

The pH varied between 4.6 and 4.8. It can be observed a slight decrease of the pH values comparing to the curd pH before texturising due to the accumulation of lactic acid produced in the infancy of maturation. The immersion in water-whey brine determined slight high values of the pH. The dry matter varied between 52.1% and 53.7%. It is obviously that the lower concentrations of NaCl determined higher humidity and this is in accordance with Gueene and Fox (2004) who consider that the outward migration of water is larger compared to inward flux of NaCl, during brining. The pores (estimated to be ~2.5 nm wide) of the protein matrix exert a sieving effect on both the inwarddiffusing NaCl molecules and outward-moving H_2O molecules but the effect is more pronounced on the former because of their greater effective diffusion radius, which is approximately twice that of the H_2O molecules. Hence, during brining, the H_2O flux is approximately twice the NaCl flux. The results of the physical and chemical analysis are presented in table 1.

Data presented in table 1 show that the texturizing conditions did not affect the fat content of the curd, and this is in contradiction with O'Connor, 1971 and 1974 who appreciate that higher salt levels in Cheddar cheese usually coincide with increased fat content probably due to the greater loss of water than salt uptake during salting. This contradiction might be due to the lower accuracy of the method and the influence should be studied forward.

The values of NaCl in samples are in accordance with Costin, 2003, who appreciate that after immersion in hot brine the content of salt must be between 1.8 and 1.9%. They are also in accordance with Gueene and Fox (2004) by the fact that the minerals dissolved in whey improves the absorption of NaCl.

CONCLUSIONS

The sensorial, textural and physical chemical properties of Cascaval cheese are influenced by texturising conditions, mainly due to the favorable effect of whey on absorption of salt. According to the results of this study, it is recommended to use a mixture of 12% salt, 61.60% water and 26.40% whey to immerse the curd before stretching in the texturising opperation in order to obtain Cascaval cheese. Taking into account that the texturising operation is verry complex and is influenced by many other factors there are necessary a series of other future studies in the field.

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