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The reduction of sodium chloride in Telemea cheese. Effect on textural and sensorial properties

G.D. Mocanu*, D.G. Andronoiu, O.V. Nistor, I. Cuşai, M. Angheloiu, E. Botez

"Dunarea de Jos" University of Galati, Food Science and Engineering Faculty, Food Science, Food Engineering and Applied Biotechnology Department, 800201 Galati, Romania.

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Sodium chloride is traditionally added to cheeses as a preservative and to improve flavor. Physicochemical analysis (sodium chloride, dry matter, fat, proteins, ash, pH and titratable acidity), textural analysis (hardness, adhesiveness, springiness, fracturability, chewiness, gumminess and cohesiveness) and sensorial properties (appearance and color, body and texture, flavor and acceptability) of Telemea cheese samples were investigated during 28 days of ripening. The reduction of sodium chloride had significant influence on cheese hardness, adhesiveness, springiness and gumminess but did not affect the sensorial characteristics of Telemea cheese.

Keywords. Telemea, sodium chloride, sea salt, texture profile analysis.

INTRODUCTION

Nowadays, health authorities recommend decreasing progressively salt content in food products, because an excessive sodium intake may be a cause of pathology. The main sodium source is the sodium chloride (salt) added during food processes or preparation of meals [1]. Salting is an important step in producing cheese, since it determines sensorial properties such as flavour, texture and colour, in addition to modifying microbial activity and producing physical changes in the proteins [2]. Texture is one of the most important characteristics of cheese that determines identity and acceptability. With this property the consumer first identifies and judges the specific variety. The textures of the various types of cheese are clearly very different, but factors that determine changes in texture are basically the same, since the components are the same for all cheese varieties. Only the proportions of the components differ. All the components of a cheese-protein, fat and water (brine) – affect its rheological behavior and therefore its textural properties [3]. Telemea cheese is a white-brined cheese, representing a category of cheeses that owe their characters primarily to a strong acidity and a high salt content. It originated in Romania and spread to other Balkan countries (e.g. Greece, Bulgaria, Turkey) [4]. In the present study, the effect of sodium chloride reduction on the textural and sensorial characteristics of cow milk Telemea cheese during ripening was investigated.

EXPERIMENTAL

Materials

Fresh, cow milk (≈ 20 L) for Telemea cheese production was purchased from a dairy factory from Galati, Romania. The CHOOZITMT1LYO10DC1 – starter culture (Danisco EZAL, France) was used to acidify the milk. This starter consists of: Lactococcus lactis subsp. lactis, Lactococcus lactis subsp. cremoris, Streptococcus thermophilus and Lactobacillus delbrueckii subsp. bulgaricus. As coagulant, it was used Fromase – Chr. Hansen 22000TL from Rhizomucor miehei with coagulation power Pc = 1:150.000. Calcium chloride was obtained from Chimcomplex S. A. (Bacau, Romania). Sodium chloride and sea salt were purchased from a local supermarket in Galati (Romania).

Cheese manufacture

The Telemea cheese was manufactured according to the classical method (Figure 1). Telemea cheese was ripened in 4 different brine solutions (variant A: 80% water + 20% NaCl; variant B: 80% whey + 20% NaCl; variant C: 80% water + 20% sea salt; variant D: 80% water + 13.2% NaCl + 6.8% KCl). Cheeses were sampled for analysis at the age of 1, 7, 14, 21 and 28 days.

Physicochemical analysis

The physical-chemical analysis was applied to: sodium chloride content (SR EN ISO 5943:2007),

* To whom all correspondence should be sent.
E-mail: dmocanu@ugal.ro

dry matter (SR EN ISO 5537:2005), fat content (SR EN ISO 1211:2010), proteins (SR ISO/TS 17837:2009), ash (SR EN ISO 707-2009), titratable acidity with NaOH 0.1 n, according SR 143:2008 and pH with a pH-meter InoLAB 730, after calibration with standard solutions of pH 4, 7 and 9. All analyses were performed in duplicate.

Texture profile analysis (TPA)

Texture measurements were performed at room temperature with a CT3 Texture Analyzer (Brookfield, UK). The samples (cylinder with 7 mm length and 12 mm depth) were compressed to 50 % of their original height with a cylindrical probe (TA11/1000) 25.4 mm diameter and a cross-head speed of 2.0 mm/s. The following parameters were determined: hardness, adhesive force, springiness, fracturability, chewiness, gumminess and cohesiveness. All analyses were performed in duplicate.

Sensory evaluation

Sensorial characteristics of the cheese after 28 days of ripening were carried out by five trained panel. The samples were presented to panelists in randomized order after having stood for 2 h at room temperature and were graded between 1 and 10 (1 being very bad and 10 being very good) for flavor, color, texture (hardness, adhesive force, springiness, fracturability, chewiness, gumminess and cohesiveness) and acceptability.

Statistical analysis

Two-way analysis of variance (ANOVA) was used for the comparison of the data obtained behind the sensorial analysis of each type of Telemea cheese. The level of significance was established at $P < 0.05$.

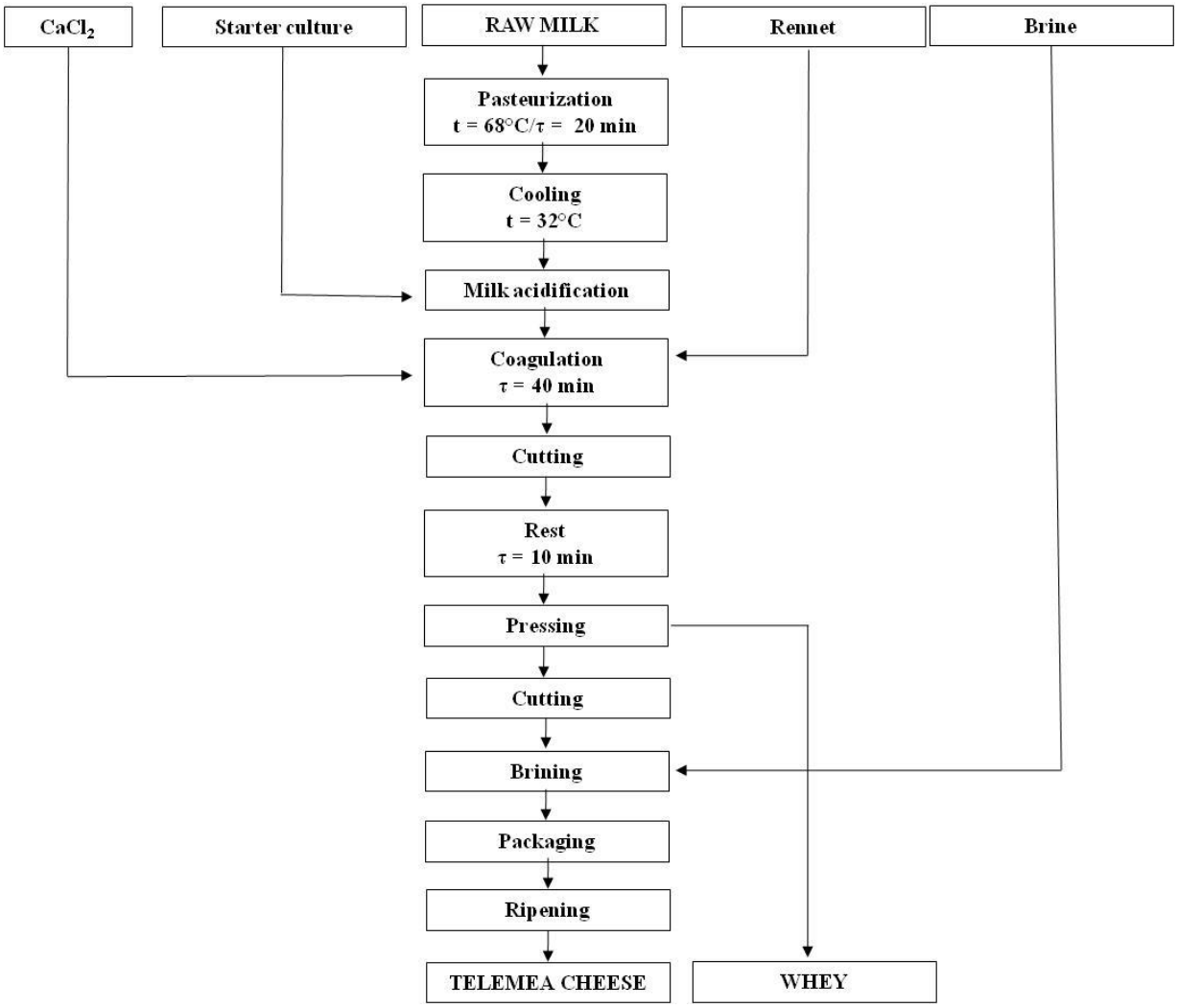

Fig. 1. Techological flowchart for manufacturing the Telemea cheese.

RESULTS AND DISCUSSION

Physicochemical characteristics

The chemical characteristics of cheese samples are reported in (Table 1). Dry matter content of the Telemea cheese samples decreased during ripening and was between 51.88% and 46.88% at the end of 28 days. When cheese is placed in brine, a dynamic mutual diffusion process is established as NaCl molecules move from the brine into the cheese while, water diffuses out through the cheese matrix [5].

Fat content of the Telemea cheese samples at the end of ripening period was between 19.01% and 20.86% and decreased gradually. Changes in fat content could be due to a decrease in dry matter and lipolytic activity. Protein content of the different Telemea cheese samples decreased during ripening and at the end of this period and was between 21.61% and 21.66%.

Decrease in protein content of Telemea cheeses throughout ripening was attributed to proteolysis activities, because proteolysis in Telemea cheese continues during ripening in brine. Titratable acidity of the sample increased throughout ripening period, while pH values decreased. The decrease in pH during the 28 days of curd preservation in brine is due mainly to completion of the lactose fermentation.

Evaluation of texture profile

Parameters revealed by texture profile analysis (TPA) are shown in Table 2. Hardness, that is a measure of the amount of force required to compress the Telemea cheese samples, continuously decreased as storage progressed probably due to breakdown of casein especially αs1 fraction in to lower molecular weight peptide and hydration of the protein matrix. Hardness was higher for cheese samples maintained in variant C of brine solution (80% water + 20% sea salt).

Fracturability values varied from 6.09 to 10.78 (N). These results are similar with the results obtained by Kandarakis [6]. Cohesiveness is the extent to which a cheese can be deformed before it ruptures [7]. Cohesiveness increased gradually during the 28 days of ripening. Finally, the lowest values of gumminess and chewiness were found for cheese sample maintained in brine solution B and D.

Table 1. Physicochemical composition of Telemea cheese samples during storage at 4 °C for 28 days.

Parameters	Telemea cheese			
	A	**B**	**C**	**D**
Dry matter, g/100g	51.88 ± 0.02	49.58 ± 0.05	46.88 ± 0.04	47.28 ± 0.05
Fat, g/100g	20.86 ± 0.05	20.05 ± 0.03	19.01 ± 0.04	19.12 ± 0.03
Protein, g/100g	21.65 ± 0.02	21.66 ± 0.02	21.61 ± 0.03	21.63 ± 0.02
Ash, g/100g	4.73 ± 0.01	6.31 ± 0.03	5.32 ± 0.01	5.68 ± 0.04
NaCl, g/100g	4.23 ± 0.03	4.54 ± 0.04	4.97 ± 0.08	4.01 ± 0.06
pH	4.45 ± 0.03	4.29 ± 0.05	4.35 ± 0.02	4.13 ± 0.02
Titratable acidity, °T	248.2 ± 0.07	249.8 ± 0.07	250.2 ± 0.03	251.4 ± 0.05

All values are mean ± standard deviation.

Table 2. Texture Profile Analysis in Telemea cheese after 28 days of storage.

Sample	Textural parameters						
	Hardness, N	Adhesive force, N	Springiness, mm	Fracturability, N	Chewiness, J	Gumminess, N	Cohesiveness, dimensionless
A	7.79±2.86	0.23±0.2	1.99±0.52	8.15±2.99	0.02±0.0	6.62±1.97	0.83±0.06
B	6.58±0.22	0.1±0.03	2.98±0.70	6.80±0.23	0.015±0.001	5.54±0.25	0.82±0.01
C	10.15±0.12	0.17±0.04	2.65±0.15	10.78±0.17	0.02±0.0	7.69±0.11	0.71±0.0
D	5.90±0.105	0.06±0.003	3.91±0.03	6.09±1.15	0.01±0.0	4.93±0.62	0.81±0.05

All values are mean ± standard deviation.

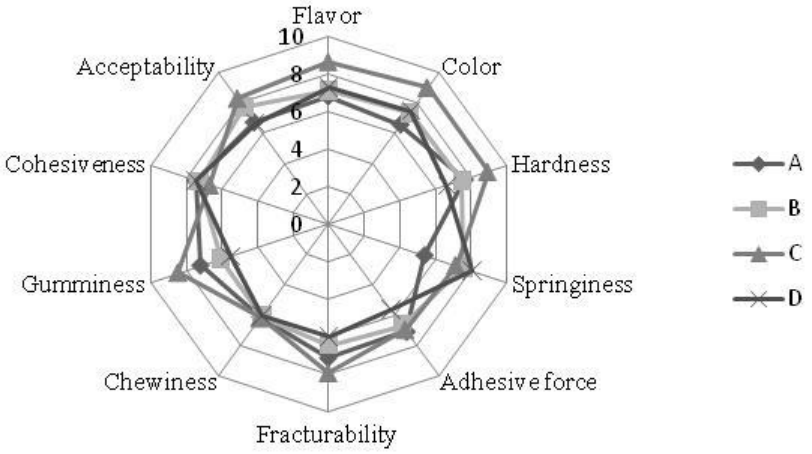

Figure 2. Graphical representation of sensory evaluation of Telemea cheese during storage at 4 °C for 28 days.

Sensory analysis

The results of sensorial analysis of Telemea cheese (Figure 2) showed that scores found for color, hardness, fracturability, chewiness and gumminess were significantly different among the evaluated cheeses. Higher average scores for sensorial characteristics were found for Telemea cheese sample C, which are also in accordance with the results of the instrumental analysis of texture. According to Delgado et al. [8], the flavor of cheeses depends on several reactions, especially the metabolism of lactose and lactate, lipolysis and proteolysis in the cheese matrix.

From the application of the statistical method two-way analysis of variance (ANOVA) (Table 3) it can be observed that between the cheeses samples there are significant differences ($P < 0.05$) expected due to the variability of the auxiliary materials. In the sensorial attributes case, the statistical analysis reveals that the panelists have perceived similar characteristics ($F < Fcr$) without significant differences in the assessment of cheese samples. The good correlation of data can be associated to the panelists experience in Telemea cheese tasting. The selected panelists being trained in this field.

CONCLUSIONS

Sodium reduction can be obtained by using a shorter brine time or a KCl brine. The sea salt adding influenced the textural parameters by increasing the hardness, fracturability, gumminess and cohesiveness values. The main results of the instrumental texture analysis are comparable to those of the sensory analysis. This study indicated that brine concentration had important effects on chemical composition and texture characteristics, but did not affect the sensorial quality of Telemea cheese. The statistical data suggest a good correlation and a correct valuation of the sensorial results.

Table 3. Two-way analysis of variance (ANOVA) applied for sensory attributes of Telemea cheese.

Source of variation	SS	df	MS	F	P-value	F crit
Telemea cheese samples	5.842763	2	2.921381481	5.54238616	0.014830587	3.633723468
Sensorial attributes	9.600652	8	1.200081481	2.276770438	0.026773872	2.59109618
Error	8.43357	16	0.527098148			
Total	23.87699	26				

In this table SS is Sum of Squares, df – degrees of freedom, MS – Mean Squares, F – statistic test and P-value – probability.

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НАМАЛЕНО СЪДЪРЖАНИЕ НА НАТРИЕВ ХЛОРИД В СИРЕНЕ ТЕЛЕМЕА. ВЛИЯНИЕ ВЪРХУ ТЕКСТУРНИЯ И СЕНЗОРНИЯ ПРОФИЛ

Г. Д. Мокану*, Д.Г. Андроною, О.В. Нистор, И. Кушаи, М. Ангелою, Е. Ботез

"Дунареа де Джос", Университет на Галац, Факултет по хранителна наука и инженерство, Катедра „Хранителна наука, хранително инженерство и приложна биотехнология", 800201 Галац, Румъния

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(Резюме)

Натриевият хлорид традиционно се добавя към сирена като консервант и за да подобри аромата им. В настоящата работа са изследвани физико-химични показатели (натриев хлорид, сухо съдържание, мазнини, протеини, пепел, pH титруема киселинност), текстурен профил (твърдост, адхезия, еластичност, чупливост, жилавост и кохезия) и сензорни свойства (външен вид и цвят, текстура, аромат и приемане) на образци от сирене Телемеа в продължение на 28 дни зреене. Намаляването на натриевия хлорид оказва съществено влияние твърдостта, адхезията и еластичността на сиренето, но не влияе върху сензорните характеристики.