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Researches concerning proteins content and proteic scindation indices evolution of some semi-hard cheeses during ripening

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Abstract

The aim of the investigations was to study the variation of proteins content and protein scindation indices on two types of semi-hard cheese (Holland and Moeciu) beginning with processing until the end of ripening. Analyses were carried out also to the commercial product at the end of shelf-life.

Keywords: physico-chemical parameters, proteins, ripening, proteic scindation index

1. Introduction

Nutritional interest for cheeses lies mainly from the presence in their composition of high biological value proteins, calcium, phosphorus and some vitamins, especially A and D.

Lately, was observed a significant increase of daily cheese consumption. Cheese is a form of milk preservation and the mainly processing operations are milk coagulation, curd syneresis and cheese ripening. Cheese ripening is a slow process and is dependent of cheese moisture content. During ripening, defects may occur. Both technological and economical point of view, the ripening process has to be as short as possible, but in such way that the normal characteristics of cheese to not be affected.

2. Materials and methods

Two types of semi-hard cheese have been analyzed: Holland and Moeciu. Cheeses were sampling as follows:

P_1 – cheese at 48 hours from processing;
P_2 – cheese at 10 days from processing;
P_3 – cheese at 25 days of ripening;
P_4 – cheese at 50 days of ripening;
P_5 – cheese at the end of shelf-life (60 days after delivery, the period of time in which the cheeses are kept in the refrigeration conditions);

Cheese sampling was done according to STAS 6343/81.

Banu, C., [1] have found a correlation between products freshness and the total nitrogen, the ammonia nitrogen and the amino nitrogen dynamic. In that way were established the *proteic scindation indices.*

The following methods were used:

- Determination of the proteins content – Kjeldahl method, according to STAS 6355/89;
- Determination of the amino nitrogen– titrimetric method;
- Determination of the ammonia nitrogen – direct titration method with hydrochloric acid, according to SR 9065/7-2007;

The proteic scindation indices were calculated based on the relations:

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$$\frac{N-NH_2 \times 100}{N_{total}}; \frac{N-NH_3 \times 100}{N_{total}}$$

3. Results and Discussion

The results obtained by determination of the amino nitrogen, the ammonia nitrogen and the proteic scindation indices are shown in table 1.

To both cheese types, the *amino nitrogen* and the *ammonia nitrogen* increase during ripening. From the moment of ripening ending and beginning of cold storage, the amino nitrogen decrease and the ammonia nitrogen increase. Thus, at Holland cheese type, the amino nitrogen increase with 140 mg% after 50 days of storage, then decrease with 140 mg% until the end of shelf-life and the ammonia nitrogen increase with 3.03 mg% during ripening and with 15.98 mg% after 50 days of storage. At Moeciu cheese type, the amino nitrogen increase with 264 mg% after 50 days of ripening, then decrease with 210 mg% until the end of shelf-life and the ammonia nitrogen increase with 2.81 mg% during ripening and with 11.86 mg% during storage.

The proteic scindation indices followed a similar pattern. At Holland cheese type, the amino scindation index increase with 4.07% during ripening and then decrease with 3.47% until the end of shelf-life and the ammonia scindation index increased with 0.57% during processing-ripening-storage. At Moeciu cheese type, the amino scindation index increase with 7.21% during ripening and then decrease with 4.98% until the end of shelf-life and the amino scindation index increased with 0.52% during processing-ripening-storage.

Semi-hard cheese proteolysis is mainly determined by enzymes from starter culture, by residual coagulant enzymes and in a less measure by milk proteases. In some cases can contribute also the surface microflora from the cheese. Proteolysis rate is faster at the beginning of cheese ripening. The proteolysis is faster as the fresh cheese is more moisturized [2-4].

From a nutritionally point of view, whey proteins are superior to casein (because of its lack in sulfur-containing-aminoacids); biological value of cheese proteins is smaller than of the milk total proteins, but still higher than of the casein themselves [2-5].

The statistical analysis was performed with two-way analysis of variance (ANOVA) test at both semi-hard cheese types during ripening, as shown in tables 2 and 3.

Table 1.Evolution of the proteic scindation indices of analyzed semi-hard cheeses

Crt. no.	***Cheese type***	***Sample***	***Amino nitrogen, mg%***	***Ammonia nitrogen, mg%***	***Proteic scindation index (PSI), %***	
					$\frac{N-NH_2 \times 100}{N_{total}}$	$\frac{N-NH_3 \times 100}{N_{total}}$
1.	*Holland*	P_1	140	17.4	3.04	0.38
		P_2	168	19.145	3.87	0.44
		P_3	280	19.145	7.02	0.48
		P_4	280	20.43	7.11	0.52
		P_5	140	36.41	3.64	0.95
2.	*Moeciu*	P_1	156	20.01	3.96	0.5
		P_2	170	20.88	4.39	0.54
		P_3	280	21.92	7.45	0.58
		P_4	420	22.82	11.17	0.6
		P_5	210	34.68	6.19	1.02

Table 2.Statistical analysis of physico-chemical parameters of Holland cheese

Crt. no.	***Analyzed parameters***	***P_1-P_3***	***t***	***p***	***Significance***	***P_1-P_4***	***t***	***p***	***Significance***
1.	Proteins content, %	3.920 ± 0.3607	10.87	0.0004	***	4.250 ± 0.2466	17.23	p<0.0001	***
2.	Total nitrogen, %	0.6200 ± 0.03697	16.77	p<0.0001	***	0.6700 ± 0.03697	18.12	p<0.0001	***
3.	Amino nitrogen, mg%	-140.0 ± 8.165	17.15	p<0.0001	***	-140.0 ± 10.41	13.45	0.0002	***
4.	Ammonia nitrogen, mg%	-1.745 ± 0.2708	6.443	0.0030	**	-3.030 ± 0.4020	7.537	0.0017	**
5.	PSI amino	-3.980 ± 0.5013	7.939	0.0014	**	-4.070 ± 0.6742	6.037	0.0038	**
6.	PSI ammonia	-0.1000 ± 0.04509	2.218	0.0908	ns	-0.1400 ± 0.03697	3.787	0.0193	*

ns – (p> 0.05); * – (0.01 < p < 0.05); ** – (0.001 < p < 0.01); * – (p < 0.001)**

Table 3.Statistical analysis of physico-chemical parameters of Moeciu cheese

Crt. no.	***Analyzed parameters***	***P_1-P_3***	***t***	***p***	***Significance***	***P_1-P_4***	***t***	***p***	***Significance***
1.	Proteins content, %	1.110 ± 0.04509	24.62	p<0.0001	***	1.140 ± 0.04509	25.28	p<0.0001	***
2.	Total nitrogen, %	0.1800 ± 0.04899	3.674	0.0213	*	0.1800 ± 0.04163	4.323	0.0124	*
3.	Amino nitrogen, mg%	-124.0 ± 8.165	15.19	0.0001	***	-264.0 ± 8.165	32.33	p<0.0001	***
4.	Ammonia nitrogen, mg%	-1.910 ± 0.4584	4.166	0.0141	*	-2.810 ± 0.4678	6.007	0.0039	**
5.	PSI amino	-3.490 ± 0.2608	13.38	0.0002	***	-7.210 ± 0.1576	45.75	p<0.0001	***
6.	PSI ammonia	-0.080 ± 0.03651	2.191	0.0936	ns	-0.1000 ± 0.03651	2.739	0.0520	ns

ns – (p> 0.05); * – (0.01 < p < 0.05); ** – (0.001 < p < 0.01); * – (p < 0.001)**

At Holland cheese type, the differences between cheese samples at processing and cheese samples after 25 days of ripening ($P_1 – P_3$) were statistically extremely significant (***) for the following parameters: the proteins content, the total nitrogen and the amino nitrogen.

The differences between cheese samples $P_1 – P_3$ were statistically very significant (**) for the following parameters: the amino nitrogen and the amino scindation index and not significant (ns) for the ammonia scindation index.

At the same cheese type, the differences between cheese samples at processing and cheese samples after 50 days of ripening ($P_1 – P_4$) were statistically extremely significant (***) for the following parameters: the proteins content, the total nitrogen, statistically very significant (**) for the ammonia nitrogen and the ammonia scindation index and

statistically significant (*) for the ammonia scindation index.

At Moeciu cheese type, the differences between cheese samples $P_1 – P_3$ and $P_1 – P_4$ were statistically extremely significant (***) for the following parameters: the proteins content, the amino nitrogen and the amino scindation index, statistically very significant (**) between cheese samples $P_1 – P_4$ for the ammonia nitrogen, statistically significant (*) between cheese samples $P_1 – P_3$ for the following parameters: the total nitrogen and the ammonia nitrogen, statistically significant (*) between cheese samples $P_1 – P_4$ for the total nitrogen and not significant (ns) differences for the ammonia scindation index.

The degree of ripening is the ratio between the nitrogen from nitrogenous soluble fractions and the total nitrogen from the cheese at some point of ripening process. *The ripening volume (the global degree of ripening)* is determined by the ratio between the nitrogen soluble in water and the total nitrogen and *the depth of ripening* by the ratio between the amino nitrogen and the total nitrogen (Codoban, 2006).

4. Conclusion

Based on the results of the experimental investigations, the following conclusions were drawn:

- The amino nitrogen content increased during ripening at all cheese types taken in study, after which was observed a decrease during storage. The proteic scindation index ($N\text{-}NH_2/N_{total}$) showed a similar pattern; the ammonia nitrogen content and the proteic scindation index ($N\text{-}NH_3/N_{total}$) increased during ripening and storage at both cheese types;
- The proteins content decreased during ripening because of their hydrolysis under the influence of proteolitic enzymes; are formed simple compounds like peptones, aminoacids and ammonia, which are responsible for specific aroma, taste and smell of cheese. At Holland cheese type, the proteins content decreased with 4.25% during ripening and just with 0.61% during storage in commercial network (60 days after delivery), while at Moeciu cheese type, the proteins content decrease with 1.14% until the end of ripening and with 3.47% until the end of shelf-life. During ripening, the total nitrogen at both cheese types registered similar variation as the proteins content;
- To both cheese types were registered the differences statistically extremely significant (***) and statistically very significant (**) for the proteins content, the amino nitrogen and the amino scindation index. There are two distinguish phases in the cheeses ripening process: the first phase (the first 10 days of ripening) is characterized by a slow modification of parameters values; the second phase (after 10 days of ripening) is characterized by a significant parameters changes. *Thus, analyzing the cheeses composition, the ripening period can be estimated.*

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