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INFLUENCE OF CURD PARTICLES WASHING ON THE COMPOSITION OF CURD MADE OF MILK IN WHICH COAGGREGATES WERE FORMED

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Abstract: The composition of curd A and curd B was investigated as influenced by the technological process known as curd washing after removing 1/3 or 1/2 of whey and replacing by the same volume of water at the drying temperatures of 42ºC and 45ºC, respectively. Milk used for experiments was heat-treated at 87ºC/10 min, during which the chemical complex between casein and whey proteins (milk protein coaggregates) was formed.

It is shown that the applied drying temperatures of 42ºC (curd A) and 45ºC (curd B) do not have significant influence on the curd composition.

The curd A and B gained without washing of the curd had 50.91% and 50.60% of moisture, respectively. If the curd washing process is applied after removing 1/3 of whey, the resulting curd has higher moisture content, 52.27% and 52.63%, respectively, for the curd A and B. The highest moisture content in the curd is noted in the curd gained when 1/2 of whey is replaced by water during washing treatment. The same tendency is noted for the moisture in fat- free basis (MFFB), the parameter used for cheese classification. Also, it is observed that fat, protein and ash content are lower in the curd A and B when the curd washing process is applied than in the curd produced without the curd washing process.

However, regardless of the increased moisture content of the curd gained by washing process, it is possible (even from heat-treated milk in which coaggreagates are formed) to achieve the average MFFB typical for semi-hard cheeses of Dutch type, by further technological processes, such as molding, pressing, salting and ripening.

Key words: milk, heat treatment, coaggreagtes, semi-hard cheese, drying and washing of curd particles.

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Introduction

Curd washing is a technological process applied in the production of certain cheese varieties. The basic goal of curd washing is to decrease the concentration of water soluble matters, and consequently forming of concentration gradient between the whey surrounding curd and the whey present in the curd. During washing and stirring of curd, the water soluble matters easier diffuse into diluted whey surrounding the curd. Lactose shows the fastest rate of diffusion, since it is completely soluble, and its solubility is not influenced by pH value and applied temperature. However, solubility and diffusion rate of mineral matters is influenced by both pH and temperature, because of the fact that mineral matter is present in milk as insoluble colloidal salts and as soluble salts. It means that washing practically regulates lactose content, mineral matter content and moisture content of the curd (Fox and Cogan, 2000, Scott, 1986, Walstra, 1993). The addition of washing water can be done either at the same time with cooking of the curd or separately, where the whey is replaced by water heated to the same temperature (Fox and Cogan, 2000).

During the production of Gouda cheese it is very important to determine an accurate volume of washing water, since the lactose content in the curd before salting is supposed to be at a level which would ensure the final pH of 5.3 in cheese (Lawrence et al., 1984). According to Scott, 1986, curd heating is performed by the addition of water temperature of 60ºC, which increases the whey temperature from 30º to 40ºC. Such way of heating and washing of the curd ensures maintaining of cheese pH within the interval of 5.2 and 5.4. In the production of Edam cheese, water at 60ºC is used for washing and heating, after the 1/3 of whey is drained. As a result, the temperature of whey surrounding the curd is increased to 36-37ºC, which regulates and maintains pH of the curd in the interval 5.2-5.4. Otherwise, pH of curd would drop significantly, up to 4.6-4.8.

In the production of French cheese St. Paulina, low salt brine (0.02% NaCl and $NaNO_3$) is added after draining of 1/2 of whey. The brine facilitates curd firming and ensures adequate whey removal (syneresis) (Carić et al., 1988, Scott, 1986). According to Walstra (1993), the addition of hot water for washing increases syneresis at the temperature of 38ºC and above, and decreases the starter activity and therefore regulates pH of the curd particles.

During the production of Gouda, whey is drained at the high pH value, which, on the other hand, influences the high level of calcium (32.2 mg Ca/g protein) and phosphorous (17.3 mg P/g protein) in final cheese (Lucey, 1990).

The importance of washing during cheese production is supported by the fact that mineral matter level in cheese influences the rheological characteristic of cheese as well as its buffer capacity. Namely, the lower level of calcium and phosphorous in the curd, the lower the elasticity of the curd is. Therefore, the curd washing represents the important technological process, since by regulating the lactose content we can directly influence pH value of the curd and cheese, and indirectly, through pH value, it is possible to affect the calcium level and rheological properties and texture of cheese (springy, plastic, mealy, non-cohesive) (Corredig and Dalgleish, 1996, Lawrence et al., 1987, Pudja and Obradović, 1994).

Technological processes applied during curd treatment have a great importance for gaining the cheese with the defined physical properties and chemical composition characteristic of particular cheese group. It is important to state that casein gel gained by rennin coagulation of heat-treated milk in which the chemical complex between casein and whey proteins is formed, has different characteristics than the casein gel produced from milk heat-treated at the lower temperature usually applied in traditional cheese-making. The application of severe heat treatments that enable coaggregates formation, results in the formation of the curd characterized by smaller firmness and higher cross-linkness, which has lower capability to contract and which releases whey slowly (Green and Grandison, 1993, Pearse and Mackinlay, 1989, Pearse et al., 1985, Pearse et al., 1986, Walstra, 1993, Jovanović et al., 2002).

The aims of this investigation were to investigate the influence of washing process after draining 1/3 and 1/2 of whey and addition of the same volume of water, at the drying temperature of 42ºC and 45ºC, on the composition of curd gained from milk in which coaggreagtes were present.

Material and Method

Milk heat-treated at 87^{o}C/10 min in which the chemical complex between casein and whey proteins is formed (milk proteins coaggregates) is used for the experiments. Coagulation is performed by the addition of rennet into milk at 35ºC during 20 min. Gained curd is handled in accordance with technological process typical for semi-hard cheeses of Dutch type with an alteration of drying temperature.

In these experiments, washing of curd was done after achieving the drying temperature of 42ºC and 45ºC and removing 1/3 and 1/2 of whey. Water used for washing had the same temperature.

All experiments were repeated 6 times (n=6).

The following methods were used to determine curd composition:

a) Determination of total solids by standard drying method at 102±2ºC, (IDF Standard 4A:1982)
b) Determination of milk fat by Van Gulik method (Carić et al., 2000)
c) Determination of total nitrogen matter by Kjeldahl method, (IDF standard 20B:1993)
d) Ash was determined by standard method (Carić et al., 2000)

Statistical analysis was performed. All data for the investigated parameters are shown as mean values (X). Also, analyses of variance for all data were performed (Standard deviation - Sd and coefficient of variation - Cv).

Results and Discussion

The most important composition parameters of the curd gained without washing step are shown in table 1., whereas the most important composition parameters of the curds gained with washing of curd after 1/3 and 1/2 of whey was removed, at the drying temperatures of 42ºC and 45ºC, are shown in tables 2. and 3., respectively.

T a b. 1. - Major composition parameters of the curd A and B depending on drying temperature without washing

Investigated parameters	Curd A Calculated parameters				
	min.	max.	x (n=12)	Sd	Cv (%)
Total solids (%)	46.50	50.89	49.09	1.2658	2.58
Moisture (%)	49.11	53.50	50.91	1.2658	2.49
Milk fat (%)	24.00	28.00	25.94	1.5155	5.84
Fat in total solids (%)	48.63	58.52	52.90	4.0459	7.65
MFFB * (%)	65.26	72.44	68.78	2.7851	4.05
Total nitrogen (%)	3.1200	3.7469	3.4852	0.2023	5.80
Total nitrogen in total solids (%)	6.49	7.46	7.10	0.3109	4.38
Proteins (%)	19.90	23.90	22.23	1.2908	5.80
Proteins in total solids (%)	41.39	47.62	45.27	1.9834	4.38
Ash (%)	1.81	2.26	1.98	0.1431	7.24
Ash in total solids (%)	3.71	4.44	4.02	0.2299	5.69
Investigated parameters	Curd B Calculated parameters				
	min.	max.	x (n=12)	Sd	Cv (%)
Total solids (%)	47.46	51.18	49.40	1.1530	2.33
Moisture (%)	48.82	52.54	50.60	1.1530	2.28
Milk fat (%)	24.00	29.75	26.14	1.9349	7.40
Fat in total solids (%)	47.38	60.84	53.00	4.7492	8.96
MFFB * (%)	64.45	72.74	68.58	3.0128	4.39
Total nitrogen (%)	3.1900	3.8267	3.5647	0.2238	6.28
Total nitrogen in total solids (%)	6.59	7.59	7.21	0.3344	4.64
Proteins (%)	20.35	24.41	22.74	1.4280	6.28
Proteins in total solids (%)	42.02	48.44	46.01	2.1334	4.64
Ash (%)	1.85	2.12	1.94	0.0783	4.03
Ash in total solids (%)	3.65	4.27	3.94	0.1537	3.90

Legend:
Curd A- drying at 42ºC *MFFB- moisture in fat free basis
Curd B - drying at 45ºC

From the results shown in table 1, it can be concluded that without the applied washing process different drying temperatures did not have significant influence on the chemical composition of curd.

T a b. 2. - Major composition parameters of the curd A and B gained when 1/3 of the whey is replaced

Investigated parameters	Curd A Calculated parameters				
	min.	max.	x (n=6)	Sd	Cv (%)
Total solids (%)	47.48	48.13	47.73	0.2197	0.46
Moisture (%)	51.87	52.52	52.27	0.2197	0.42
Milk fat (%)	24.00	28.25	25.75	1.5969	6.20
Fat in total solids (%)	49.86	59.19	53.95	3.3951	6.29
MFFB * (%)	68.25	72.85	70.42	1.5994	2.27
Total nitrogen (%)	3.1080	3.4800	3.3085	0.1871	5.65
Total nitrogen in total solids (%)	6.46	7.30	6.93	0.4013	5.79
Proteins (%)	19.83	22.20	21.11	1.1937	5.65
Proteins in total solids (%)	41.22	46.56	44.23	2.5603	5.79
Ash (%)	1.78	1.91	1.83	0.0450	2.47
Ash in total solids (%)	3.75	3.97	3.83	0.0783	2.05
Investigated parameters	**Curd B Calculated parameters**				
	min.	max.	x (n=6)	Sd	Cv (%)
Total solids (%)	45.67	48.72	47.37	0.9935	2.10
Moisture (%)	51.28	54.33	52.63	0.9935	1.89
Milk fat (%)	24.00	27.50	26.04	1.4354	5.51
Fat in total solids (%)	50.85	56.51	54.95	2.2929	4.17
MFFB * (%)	69.47	71.96	71.17	0.9385	1.32
Total nitrogen (%)	3.0270	3.5100	3.3198	0.2134	6.43
Total nitrogen in total solids (%)	6.62	7.40	7.01	0.4032	5.75
Proteins (%)	19.31	22.39	21.18	1.3617	6.43
Proteins in total solids (%)	42.22	47.21	44.70	2.5727	5.75
Ash (%)	1.78	1.86	1.83	0.0230	1.64
Ash in total solids (%)	3.76	4.03	3.86	0.1081	2.80

Legend:
Curd A- drying at 42°C
Curd B - drying at 45°C
*MFFB- moisture in fat free basis

It is visible from table 2. that total solids content of curd A gained by washing after 1/3 of whey was removed, was by 1.36% lower than total solids content of curd A gained without washing process. Total solids content ranged from 47.48 to 48.13%, the average being 47.73%. The small coefficient of variation (0.46%) shows that results were very consistent.

With the increased amount of replaced whey from 1/3 to 1/2, total solids content of curd A was decreased by 0.50%. The average total solids content was 47.23% and ranged from 45.97% to 47.72% (table 3.)

T a b. 3. - Major composition parameters of the curd A and B gained when 1/2 of the whey is replaced

Investigated parameters	Curd A Calculated parameters				
	min.	max.	x (n=6)	Sd	Cv (%)
Total solids (%)	45.97	47.72	47.23	0.6388	1.35
Moisture (%)	52.28	54.03	52.77	0.6388	1.21
Milk fat (%)	24.00	27.00	25.12	1.0216	4.07
Fat in total solids (%)	50.82	56.58	53.19	1.8880	3.55
MFFB * (%)	69.43	71.62	70.48	0.9071	1.29
Total nitrogen (%)	2.9900	3.4610	3.2743	0.2114	6.46
Total nitrogen in total solids (%)	6.50	7.29	6.93	0.3915	5.65
Proteins (%)	19.08	22.08	20.89	1.3489	6.46
Proteins in total solids (%)	41.50	46.55	44.21	2.4978	5.65
Ash (%)	1.64	1.82	1.76	0.0670	3. 80
Ash in total solids (%)	3.57	3.83	3.74	0.1026	2.74
Investigated parameters	Curd B Calculated parameters				
	min.	max.	x (n=6)	Sd	Cv (%)
Total solids (%)	47.22	48.04	47.61	0.3172	0.67
Moisture (%)	51.96	52.78	52.39	0.3172	0.60
Milk fat (%)	23.00	27.00	25.04	1.6764	6.69
Fat in total solids (%)	47.88	56.36	52.60	3.5589	6.77
MFFB * (%)	67.48	71.36	69.92	1.6362	2.34
Total nitrogen (%)	3.0100	3.4910	3.3050	0.2093	6.33
Total nitrogen in total solids (%)	6.36	7.39	6.94	0.4571	6.58
Proteins (%)	19.20	22.27	21.08	1.3356	6.33
Proteins in total solids (%)	40.56	47.17	44.29	2.9165	6.58
Ash (%)	1.70	1.85	1.79	0.0496	2.77
Ash in total solids (%)	3.54	3.89	3.76	0.1180	3.13

Legend:
Curd A- drying at 42°C
Curd B - drying at 45°C
*MFFB- moisture in fat free basis

As shown in tables 2. and 3., the applied drying temperatures of curd did not have significant influence on total solids content, regardless of the used way of washing.

For curd B, average total solids content was 47.37% when the curd washing process was used after 1/3 of whey was removed, and 47.61% when the curd was washed after 1/2 of whey was removed. In both cases, total solids content was lower than total solids content of curd B gained without the curd washing step, which was 49.40% as shown in table 1.

According to these results, it can be concluded that higher total solids content in the curd particles and curd can be achieved by applying higher drying temperature of the curd and by defining the conditions during pressing.

The results show that the application of curd washing influenced a decrease in fat content. The fat content of curd A, gained when washing was done after 1/3 of whey was removed, was 25.75% and was only by 0.19% lower than fat content of curd A gained without the curd washing step. By an increase of water volume used for the curd washing to 1/2 of original whey volume, fat content of curd A decreased by 0.63% compared with curd gained when 1/3 of whey was replaced by water, and by 0.82% compared with curd produced without the curd washing step.

The curd washing did not have significant influence on the fat content in total solids of curd A. Fat content in total solids of curd A, gained when washing is performed after 1/3 and 1/2 of whey was removed, was 53.95% and 53.19%, respectively, and therefore was by 1.05% and 0.29%, respectively, higher than fat content in total solids of curd A produced without the curd washing step.

The curd washing influenced the decrease of nitrogen matter in curd.

Comparing the results shown in tables 1., 2. and 3., it is visible that nitrogen content of curd A, gained when the curd washing is performed after 1/3 and 1/2 of whey was removed, was 6.93% and was by 0.17% lower than nitrogen content of curd A produced without the curd washing step.

When the curd washing process was performed after 1/3 of whey was removed, the resulting curd A had 1.12% lower protein content and 1.04% lower protein content in total solids than curd A produced without the curd washing.

The curd washing after 1/2 of whey was removed further reduced protein and protein in total solids content. Protein content was lower by 0.22% and 1.34%, respectively, than in curd A gained after 1/3 of whey was replaced and curd produced without the curd washing step. Also, protein content in total solids was lower by 0.46% and 1.50%, respectively.

Ash content was also reduced by 0.15% and 0.22%, respectively, for curd A gained after the replacement of 1/3 and 1/2 of whey.

The results gained for curd B show the same trend and hence the fat content of curd B gained after 1/3 of whey was replaced decreased by 0.10%, while fat content in total solids increased by 1.95% compared with curd B produced without the curd washing step. When 1/2 of original whey volume was replaced by water, the fat content dropped even more and was 25.04%, and thus was by 1.00% lower than fat content of curd B gained when 1/3 of whey was replaced by water.

Fat content in total solids of curd B was 52.60%, and as a consequence of fat content reduction was by 2.35% lower than fat content in total solids of curd B gained with the curd washing after 1/3 of whey was removed and by 0.40% lower than in curd B produced without the curd washing. It is visible from the results shown in tables 2. and 3. that curd A and B did not differ significantly regarding the fat content in total solids.

The curd washing process induced decreasing of nitrogen content in total solids. Consequently, the nitrogen content in total solids of the curd B gained after 1/3 and 1/2 of whey was removed, respectively, was by 0.20% and 0.27% lower than nitrogen content in total solids of the curd B gained without washing process. It is visible from gained results that different amounts of water used for the curd washing had small influence on the decrease of nitrogen content in total solids of curd B. Comparing the results gained for Index of nitrogen matter in total solids (as shown at figures 1. and 2.) for curd A and B gained after 1/3 of whey was removed, it is visible that Index of nitrogen in total solids was 97.61% and 97.23%, respectively. The curd washing after 1/2 of whey was removed gives Index of nitrogen in total solids of 97.61% for curd A and slightly lower for curd B (96.26%).

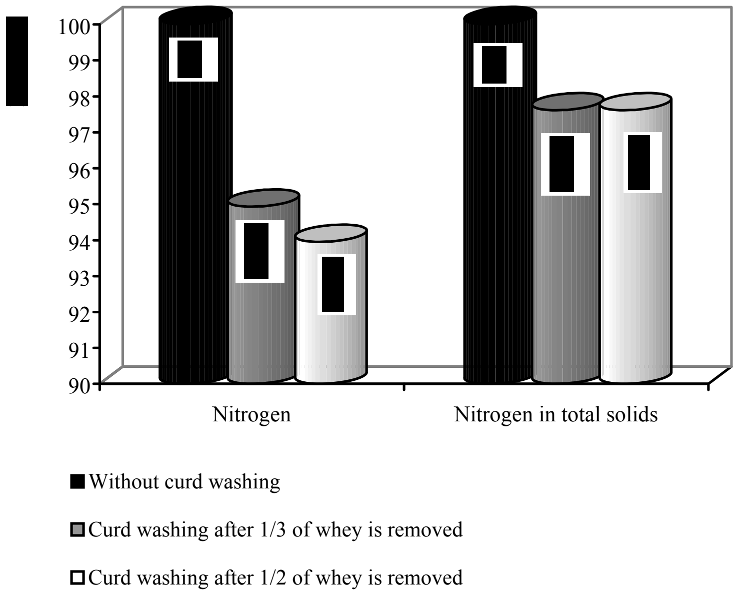

Fig. 1. - The influence of curd washing on nitrogen index and nitrogen in total solids index for curd A

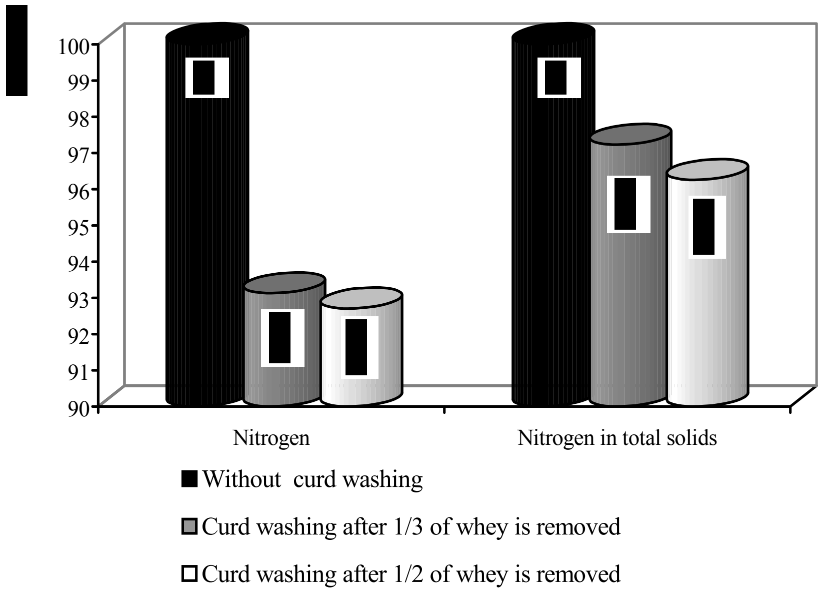

Fig. 2. - The influence of curd washing on nitrogen index and nitrogen in total solids index for curd B

From gained results it is noticeable that ash content of curd B differs a little when 1/3 or 1/2 of whey was removed before washing.

Conclusion

According to the results it can be concluded:

Under the same conditions of the curd handling, drying and pressing, the process of washing induced an increase of moisture level in the curd.

By washing of the curd after 1/3 of whey was removed, the total solids level of curd A was in the range from 47.48% to 48.13% (average 47.73%) while the total solids level of curd B was in the range from 45.67% to 48.72% (average 47.37%); by washing of the curd after 1/2 of whey was removed, the total solids content of the curd A was in the range 45.97% to 47.72% (average 47.23%), and within the range 47.22% to 48.04% (average 47.61%) for the curd B.

The moisture content in the fat-free basis (MFFB) for curd gained after removing of 1/3 of whey was 70.42% (68.25% to 72.85%); and 71.17% (69.47% to 71.96%), for curd A and B, respectively. After removing 50% of whey, average MFFB content was 70.48% (69.43% to 71.62%), and 69.92% (67.48 to 71.36%) for curd A and B, respectively.

By washing the curd gained after 1/3 of whey was removed, the fat, protein, and ash levels in total solids were 53.95%, 21.11%, and 1.83%, respectively, for the curd A; whereas these levels were 54.95%, 21.18% and 1.83, respectively, for the curd B. By washing the curd after 1/2 of whey was removed, the fat, protein, and ash levels in total solids were 53.19%, 20.89%, and 1.76%, respectively, for the curd A; and 52.60%, 21.08% and 1.79%, respectively, for the curd B.

According to the aforementioned, it can be concluded that regardless of the increased moisture content of the curd gained with the curd washing process, by properly led further technological processes, such as molding, pressing, salting, and ripening, it is possible to achieve the average MFFB typical for semi-hard cheeses of Dutch type, even from heat-treated milk in which coaggreagates are formed.

REFERENCES

1. Carić, M., Djordjević, J. and Kršev, LJ. (1988): Tehnologija mleka sa praktikumom. Zajednička stručna knjiga, Novi Sad.
2. Carić M., Milovanović, S. and Vucelja, D. (2000): Standardne metode analiza mleka i mlečnih proizvoda, Novi Sad.
3. Corredig, M. and Dalgleish, D.G. (1996): The binding of α-lactalbumin and β-lactoglobulin to casein micelles in milk treated by different heating systems. Milchwissenschaft 51 (3), 123-127.
4. Fox, P.F. and Cogan, T.M. (2000): Cheese: scientific highlights of the 20th century. 6th Cheese symposium. Ed. by Cogan, T.M., McSweeney, P.L.H. and Guinee, T.P., Moorepark, 83-121.
5. Green, M.L. and Grandison, A.S. (1993): Secondary (non-enzymatic) phase of rennet coagulation and post-coagulation phenomena in Cheese: chemistry, physics and microbiology. Volume 1, Chapter 4, 101-140.Second edition. Ed. by Fox, P.F., Chapman & Hall, London.
6. International Dairy Federation (IDF) (1982): Cheese and processed cheese. Determination of the total solids content. IDF Standard 4A.
7. International Dairy Federation (IDF) (1993): Milk. Determination of nitrogen content (Kjeldahl method) and calculation of crude protein content. IDF Standard 20B.
8. Jovanović, S., Maćej, O. and Denin-Djurdjević, J. (2002): Uticaj različitih faktora na sinerezis i reološke karakteristike sireva. Preh. ind. Mleko i mlečni proizvodi, Vol. 13 (1-2), 35-43
9. Lawrence, R.C., Heap, H.A. and Gilles, J. (1984): A controlled approach to cheese technology. J. Dairy Sci. 67 (8), 1632-1645.
10. Lawrence, R.C., Creamer, L.K. and Gilles, J. (1987): Texture development during cheese ripening. J. Dairy Sci. 70 (8), 1748-1760.
11. Lucey, J. (1990): Physico-chemical aspects of Cheddar cheese. 2nd Cheese symposium. Ed. by Cogan, T.M., Moorepark, 45-53.
12. Pearse, M.J., Linklater, P.M., Hall, R.J. and Mackinlay, A.G. (1985): Effect of heat induced interaction between β-lactoglobulin and κ-casein on syneresis. J. Dairy Res. 52 (1), 159-165.

13. Pearse, M.J., Linklater, P.M., Hall, R.J. and Mackinlay, A.G. (1986): Effect of casein micelle composition and casein dephosphorylation on coagulation and syneresis. J. Dairy Res. 53 (3), 381-390.
14. Pearse, M. J. and Mackinlay, A.G. (1989): Biochemical aspects of syneresis: a review. J. Dairy Sci. 72 (6), 1401-1407.
15. Pudja, P. and Obradović, D. (1994): Uzajamna povezanost tehnoloških i mikrobioloških faktora u proizvodnji sireva. Zbornik radova III Medjunarodnog simpozijuma "Savremeni trendovi u mlekarstvu". Ur. Krunić, M. i Čurić, M. Kopaonik, 57-60
16. Scott, R. (1986): Cheesemaking practice. Second edition. Elsevier Applied Science Publishers Ltd, London and New York.
17. Walstra, P. (1993): The syneresis of curd in Cheese: chemistry, physics and microbiology. Volume 1, Chapter 5, 141-191. Second edition. Ed. by Fox, P.F., Chapman & Hall, London.
18. Walstra, P., Noomen, A. and Geurts, T. J. (1993): Dutch-Type varieties in Cheese: Chemistry, physics and microbiology. Volume 2. Major cheese groups. Second edition. Chapter 2, 39-82. Ed. by Fox, P.F., Chapman &Hall, London and New York.

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UTICAJ ISPIRANJA SIRNOG ZRNA NA SASTAV SIRNE GRUDE DOBIJENE OD MLEKA U KOME SU OBRAZOVANI KOAGREGATI

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Rezime

U radu je ispitivan uticaj tehnološke operacije ispiranja sirnog zrna nakon odlivanja 1/3 i 1/2 surutke i dodatka iste količine vode pri temperaturama sušenja od 42ºC i 45ºC na sastav sirne grude (A i B). U ogledima je korišćeno mleko kod kojeg je prethodnim termičkim tretmanom na 87°C u toku 10 minuta, obrazovan hemijski kompleks izmedju kazeina i serum proteina, poznatih u literaturi kao koagregati proteina mleka.

Rezultati istraživanja su pokazali da se hemijski sastav sirne grude bez primenjenog procesa ispiranja sirnog zrna pri različitim temperaturama sušenja 42ºC (sirna gruda A) i 45ºC (sirna gruda B) nije značajno razlikovao.

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Procesom ispiranja sirnog zrna izdvajanjem 1/3 surutke kod sirne grude A i B je uočeno povećanje sadržaja vode (52.27% i 52.63%), kao i ispiranjem pri izdvajanju 1/2 surutke (52.77% i 52.39%) u odnosu na sirnu grudu bez ispiranja sirnog zrna (50.91% i 50.60%). Isti trend je zabeležen i kod parametra voda u bezmasnoj materiji sira (VBMS), koji služi kao jedan od parametara za klasifikaciju sireva. Procesom ispiranja sirnog zrna (1/3 i 1/2) kod sirne grude A i B je uočeno blago sniženje sadržaja mlečne masti, proteina i pepela u odnosu na sirnu grudu kod koje nije primenjen proces ispiranja.

Medjutim, bez obzira na povećanje sadržaja vode u sirnoj grudi pri ispiranju sirnog zrna, tehnološkim operacijama kao što su kalupljenje, presovanje, soljenje i zrenje moguće je postići prosečan sadržaj VBMS, koji je karakterističan za polutvrde sireve holandskog tipa, i od mleka u kome su obrazovani koagregati.

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