

# The Effect of Specific Nutritional Feed Supplements on the Quality of Dairy Cow Products

Călin Julean<sup>1</sup>, Lavinia Stef<sup>1</sup>, Ioan Pet<sup>1</sup>, Ducu Sandu Stef<sup>1</sup>, Ion Valer Caraba<sup>1</sup>, Voichița Gherasim<sup>1</sup>, Nicolae Pacală<sup>1</sup>, Eliza Simiz<sup>1</sup>, Igori Balta<sup>1</sup>, Nicolae Corcionivoschi<sup>2</sup>, Iulia Adelina Bunduruș<sup>1</sup>, Cătălin Daniel Necula<sup>1</sup>, Ahmad Sufyan<sup>3</sup>, Ionela Hotea<sup>1</sup>, Diana Ioana Marcu<sup>1</sup> Adela Marcu<sup>1\*</sup>

<sup>1</sup>University of Life Sciences "King Mihai I" from Timisoara, 300645-Timisoara, Calea Aradului 119, Romania

<sup>2</sup>Bacteriology Branch, Veterinary Sciences Division, Agri-Food and Biosciences Institute, Belfast BT4 3SD, UK

<sup>3</sup>University of Turin, Department of agricultural, forest and food science, Leonardo da Vinci 44, 10095, Italy

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## Abstract

This experimental trial explored the impact of incorporating specific nutritional feed into the diet of dairy cows and assessed their influence on the quality of products derived from the processing of raw milk. Results showed that nutritional feed changed several parameters of dairy products, such as dry matter, crude protein, crude fat, ash, and fatty acid profiles between the two groups for produced dairy products. The resulting two types of cheeses, namely Caș and Telemea, made from the milk of Experimental Group (EG) cows had a decreased content of saturated fatty acids (SFA) and an elevated content of unsaturated fatty acids (UFA) compared to the Control Group (CG), whereas the situation was the opposite. The associations of the n6:n3 ratio were lower in the Caș cheese from the EG compared to CG, while in the Telemea cheese, the observations also revealed inverted results.

**Keywords:** Caș cheese, chemical composition, Telemea cheese, unsaturated fatty acids

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## 1. Introduction

Milk is a very complex fluid and has a complex chemical composition, well balanced in nutritional principles, being considered a complete food, which, after processing, maintains its nutritional value in the greatest proportion [1, 2]. Its chemical composition varies according to several factors such as species, breed, diet, age, state of health, stage of lactation etc. In addition to variations in the concentrations, the composition of the fatty acid profile is strongly influenced by diet. Milk and milk products are considered products with high digestibility due to their complex chemical composition and high degree of assimilation.

These products occupy an important place in the human diet, being one of the most accessible sources of protein of animal origin [1]. Dairy products also have "high-quality proteins" that meet human nutritional needs [1]. The chemical composition of cheese is predominantly determined by the constituent components of the milk, particularly its fat and protein content. Ongoing advancements in cheese production aim to enhance productivity, extend product shelf life, and modify the functional properties of the resulting dairy products [2]. The worldwide demand for health-centric dairy is increasing. Consequently, various markets are seeking dairy foods enriched with specific nutrients achieved through the integration of biologically active compounds and higher contents in unsaturated fatty acids such as conjugated linoleic acid (CLA) and  $\omega$ -3 fatty acids, but with a reduced amount of saturated fatty acids [3]. Milk fats, with their

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\* Corresponding author: Adela Marcu,  
Tel:+40723235396, E-mail: [adelamarcu@usvt.ro](mailto:adelamarcu@usvt.ro)

distinct fatty acid profiles, significantly influence the sensory properties of milk and dairy products. The diverse composition of fatty acids in milk fats imparts unique technological and nutritional characteristics. Furthermore, the structural composition of these fatty acids and their respective ratios play an important role in the processing technology of dairy products [4]. In milk production, the nutritional component is the most important factor, accounting for approximately 60-70% of the costs [5]. For optimal profitability, feed must be both nutritionally balanced and cost-effective. Adopting scientific feeding strategies for dairy cows is essential to maximise milk production profitability. Therefore, in recent times, nutritionists have shifted focus towards incorporating various food supplements, including probiotics, to enhance animal productivity. So, in recent years, nutritionists have turned their attention to using different food supplements, such as probiotics to improve animal productivity. *Probiotics* are defined as "live microorganisms" that beneficially influence the host by improving the balance of intestinal microflora [6]. Yeast has been used to improve milk production and quality in ruminants for over 50 years. Several studies investigated the effects of including yeast in the diet of dairy cows, and the results obtained showed improved milk production, higher milk fat concentration [7-10] and raised milk protein [11, 12]. The inclusion of yeast in the diet of cows elevated the amount of linolenic acid (18:3) and the concentration of some essential amino acids in milk, the possible effect could be attributed to the effectiveness of yeast in modulating the biohydrogenation of unsaturated fatty acid profile in the rumen, which leads to their increase in milk [13]. Valli and Anuradha (2020) [14] conducted a study to determine the effects of introducing live yeast (*Saccharomyces cerevisiae*) as a dietary supplement for dairy cows. Their findings highlighted several benefits of this supplementation. Specifically, the inclusion of the yeast led to a notable decrease in methane production in the rumen, leading to a more efficient nutrient utilization from the feed. Additionally, there was an enhancement in microbial biomass production within the rumen, an increase in the consumption and digestibility of dry matter, and a significant increase in milk production. The research also found a marked

reduction in the somatic cell count in the milk, translating to heightened milk quality, and a subsequent increase in profit per animal.

Protected and unprotected fats and whole oilseeds (soybean, sunflower, cottonseed and canola) fed to dairy cows had variable effects on milk production and milk fat content. Protected oilseeds or oils are rich in linoleic acid (sunflower, corn, and soybean) and produce large and rapid gains in the linoleic acid content of milk fat after dietary supplementation. The increases in linoleic acid content are generally associated with declines in myristic, palmitic, and oleic acids. Transfer of linoleic acid from protected supplements to milk is reported to be between 20 and 40% [15, 16].

Dietary manipulations can increase the unsaturated fatty acid profile of milk and dairy products while decreasing the levels of saturated fatty acids [17]. However, there still needs to be more published literature regarding yeast's effectiveness in modifying milk's fatty acid profile and conjugated isomers. Most of the available publications highlight the effects of yeast on milk production and milk fat production.

## 2. Materials and methods

A total of 20 dairy cows were equally distributed into two groups: the control group (CG) and the experimental group (EG). Both groups received balanced rations according to the INRA recommendations [18]. The CG received in diet a mixture of farm-produced feed concentrates (FC), while the EG received an FC including the specific nutritional feed. Next, the milk from the two groups was processed into two varieties of semi-soft cheese (Caş and Telemea).

To determine the cheese's chemical constituents: dry matter, protein, lipids, ash, and fatty acid profiles, standard methods were used [19, 20].

The primary data obtained were processed by statistical methods with the help of the Microsoft Excel calculation application, and for the statistical significance of the differences between the means of the studied characters, the Student test was used. The experiments were carried out at the milk cow farm Pilot Farm 1 in the town of Maşloc, Timis County. The animals from the CG group received a diet composed of alfalfa hay 9 kg, grass hay 6, brewers spent grain 12 kg, and a mixture of concentrates 9 kg, which ensures 23,85

kg DM, 19,95 UFL, 1861,99 g PDIN, 2022,87 g PDIE. While, the animals from EG group received a diet comprised of alfalfa hay 6 kg, grass hay 8, brewers spent grain 10 kg, a mixture of concentrates 7.7 kg and innovative feed prepared (PFI) 2,5 kg, which ensures 23,63 kg DM, 20,22 UFL, 1862,07 g PDIN, 2003,76 g PDIE. All the dairy cows in the study belonged to the Romanian Spotted breed and had an average body weight of 650 kg.

### 3. Results and discussion

The results regarding the impact of the incorporation of specific nutritional feed in the diet of dairy cows on Caş and Telemea cheese chemical composition are shown in Tables 1 and 2 and Figures 1 a, b, c, and d. Fatty acids in Telemea cheese are represented in Tables 3 and 4 for Caş and Telemea cheese, respectively. From the results presented in Table 1, the statistical analysis of the Dry matter (DM) content in the Caş cheese samples demonstrated a significant difference between the two groups ( $p \leq 0.05$ ). Specifically, the Caş cheese originating from the milk of the EG presented a higher DM content relative to the CG. A similar trend is observable with the protein (P) content, where a significant elevation in total protein content was noted in the EG samples compared to the CG ( $p \leq 0.05$ ). Similarly, the fat

(F) content was also higher in the Caş samples from the EG as compared to those from the CG ( $p \leq 0.01$ ) group. Analyzing the fat content concerning its dry matter equivalency (FDM), EG samples consistently demonstrated superior content relative to the CG ( $p \leq 0.05$ ). Interestingly, the Caş samples from the CG displayed a heightened mineral salt content compared to the EG, a statistically significant variation ( $p \leq 0.05$ ). From the results presented in Table 2, Telemea cheese sourced from the milk of EG cows was characterized by a superior DM content when compared with the cheese from the CG cows. This difference is evident and statistically compelling, with a significance level of ( $p \leq 0.01$ ). Regarding protein content, the Telemea cheese from the EG cows registers a greater amount. Nevertheless, it is important to note that this difference, while perceptible, does not reach statistical significance ( $p \geq 0.05$ ). A notably significant difference can be observed in the F content, with the Telemea cheese from the EG cows showing a higher content ( $p \leq 0.01$ ). Similarly, when considering the FDM, the Telemea cheese derived from the EG cows still exhibits a higher content ( $p \leq 0.001$ ). Contrarily, when the results shift to the SEN content, the Telemea cheese from the CG cows appears superior to cheese from the EG cows. This variance holds statistical weight with a significance level of ( $p \leq 0.01$ ).

**Table 1.** Mean values for physicochemical characteristics of Caş cheese

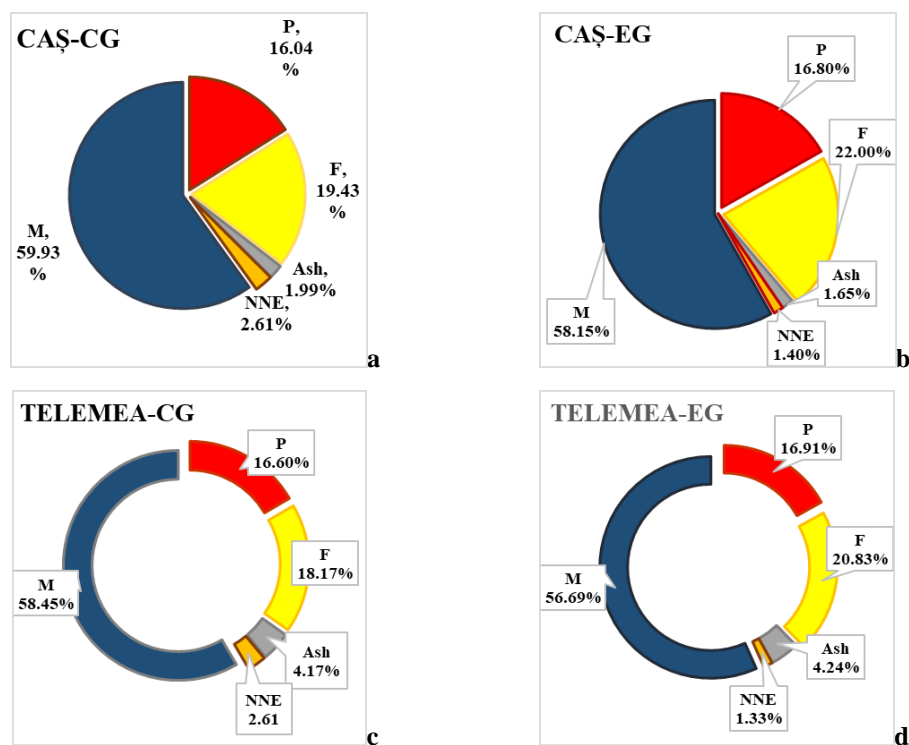
Component	n	CG	n	EG	P value
		$\bar{x} \pm SD$		$\bar{x} \pm SD$	
DM (%)	3	40.07±0.61	3	41.85±0.28	0.038956852
P (%)	3	16.04±0.21	3	16.80±0.17	0.045752931
F (%)	3	19.43±0.43	3	22.00±0.35	0.006531905
Ash (%)	3	1.99±0.09	3	1.65±0.02	0.027086387
NNE (%)	3	2.61±0.24	3	1.40±0.29	0.045138496
FDM (%)	3	48.50±0.61	3	52.56±0.76	0.012605393

DM- dry matter, P – proteins, F- fats, NNE-non-nitrogenous extractives, FDM- fats in dry matter

**Table 2.** Mean values for physicochemical characteristics of Telemea cheese

Component	n	CG	n	EG	P value
		$\bar{x} \pm SD$		$\bar{x} \pm SD$	
DM (%)	3	41.55±0.50	3	43.31±0.43	0.009904556
P (%)	3	16.60±0.18	3	16.91±0.34	0.220703848
F (%)	3	18.17±0.41	3	20.83±0.54	0.001941755
Ash (%)	3	4.17±0.26	3	4.24±0.20	0.437276254
NNE (%)	3	2.61±0.47	3	1.33±0.36	0.006005737
FDM (%)	3	43.73±0.88	3	48.10±1.09	0.000738560

DM- dry matter, P – proteins, F- fats, NNE-non-nitrogenous extractives, FDM- fats in dry matter



**Figure 1.** The chemical composition of cheese: a-Caş CG; b-Caş EG; c-Telemea CG and d-Telemea EG  
M- moisture, P- proteins, F-fats, NNE-non-nitrogenous extractives

The content of mineral salts was more elevated in the Telemea cheese obtained from the CG cows. However, the differences between the means are not statistically significant ( $p \geq 0.05$ ).

In the studies of Palmquist 1984, Leonardi et al. (2005) [21, 22], the use of protected fats as a supplement in the ration of dairy cows resulted in increased milk fat content and total milk protein. These results registered statistically assured differences between the experimental and the control groups. The authors argued that the increase in protein in milk resulted from supplementing protected fats in the cows' feed, which constitute the energy source for synthesizing protein substances. At the same time, the authors also reported a growth in the amount of lactose in the milk, but these differences between the control group and the experimental group were not statistically ensured. Earlier studies [23] identified that rumen-protected fat and vegetable oil supplements increased milk fat percentage compared to the control group, and as a result, the milk fat percentage was improved by feeding bypass fat to animals. Other studies [24] found a significant increase in milk fat percentage by feeding buffaloes with protected fat for up to five weeks of the experimental period. Recently,

Sallam et al. (2021) [25], noted that there were no obvious effects on milk composition (fat, protein, lactose, total SU, fat-free SU and ash), even though SNF and lactose percentages showed slight improvements in the group with full-fat soy compared to the MEGALAC group. Fat/protein ratio was the only parameter that increased ( $p < 0.05$ ) in the full-fat soy group compared to the MEGALAC group based on the increase in milk fat percentage. Radivojević et al. (2011) [26] showed an opposite trend to those observed, including full-fat soy increasing milk fat/protein ratio, compared to diets containing both soy and extruded whole soy. Our results from the Table 3, focusing on the fatty acid composition of cheese (caş) produced from two experimental cow groups, provides several key insights. Firstly, the cheese derived from the CG cows exhibited a marginally increased content of SFA when contrasted with the cheese from the EG cows. Notably, this difference in means did not attain statistical significance ( $p \geq 0.05$ ). Similarly, the MUFA content from the cheese produced by the EG cows manifested a reduced MUFA in contrast to that from the CG group. However, as with the SFA observation, the variation was not statistically noteworthy ( $p \geq 0.05$ ).

On the other hand, when examining PUFA, the cheese from the EG showcased a slightly elevated PUFA content relative to its CG counterpart.

However, this disparity, consistent with the previous trends, was not statistically significant ( $p \geq 0.05$ ).

**Table 3.** Mean values of the fatty acid content in Caş cheese

Fatty acid	n	CG		EG		n	P value
		$\bar{x} \pm SD$	$\bar{x} \pm SD$	$\bar{x} \pm SD$	$\bar{x} \pm SD$		
C4:0 butyric acid (%)	3	2.824	1.326	2.343	1.061	3	0.649
C6:0 caproic acid (%)	3	1.807	0.746	1.425	0.629	3	0.535
C8:0 caprylic acid (%)	3	1.021	0.359	0.770	0.350	3	0.435
C10:0 decanoic acid (%)	3	1.913	0.512	1.391	0.763	3	0.381
C11:0 undecylic acid (%)	3	0.452	0.262	0.804	0.535	3	0.364
C12:0 lauric acid (%)	3	1.604	0.702	1.255	0.719	3	0.580
C13:0 tridecanoic acid (%)	3	0.799	0.651	0.926	0.563	3	0.812
C14:0 C14:0 myristic acid (%)	3	5.266	0.685	3.478	1.697	3	0.166
C15:0 C15:0 pentadecanoic acid (%)	3	0.380	0.030	0.272	0.073	3	0.077
C16:0 C16:0 palmitic acid (%)	3	11.903	1.160	3.838	2.789	3	0.010
C17:0 heptadecanoic acid (%)	3	0.231	0.057	0.138	0.011	3	0.101
C18:0 stearic acid (%)	3	3.892	0.350	3.641	3.013	3	0.899
C20:0 eicosanoic acid (%)	3	0.188	0.115	0.127	0.075	3	0.486
C22:0 behenic acid (%)	3	0.354	0.116	0.294	0.213	3	0.690
C23:0 tricosanoic acid (%)	3	1.122	0.778	1.756	0.413	3	0.281
C24:0 lignoceric acid (%)	3	0.125	0.214	0.075	0.128	3	0.749
ΣSFA (%)	3	33.880	0.073	22.533	4.113	3	0.040
C14:1 myristoleic acid (%)	3	0.162	0.168	0.365	0.161	3	0.223
C15:1 pentadecenoic acid (%)	3	0.555	0.399	0.106	0.026	3	0.598
C16:1 palmitoleic acid (%)	3	0.172	0.045	0.297	0.142	3	0.352
C17:1 heptadecenoic acid (%)	3	10.273	1.506	0.961	1.193	3	0.371
C18:1C+T oleic acid (%)	3	0.181	0.029	4.304	2.035	3	0.015
C20:1n9 eicosenoic acid (%)	3	0.889	1.044	0.285	0.025	3	0.009
C22:1n9 erucic acid (%)	3	0.262	0.350	0.455	0.127	3	0.547
C24:1n9 nervonic acid (%)	3	13.005	0.755	0.547	0.787	3	0.597
ΣMUFA (%)	3	13.0052	0.778	7.319	1.881	3	0.008
C18:2C+T n6 linoleic acid (%)	3	2.665233	0.826	2.474	1.969	3	0.883
C18:3n6 γ-linolenic acid (%)	3	0.5213	0.975	0.069	0.040	3	0.443
C18:3n3 α-linolenic acid (%)	3	0.819433	2.273	0.118	0.059	3	0.338
C20:2 n6 eicosadienoic acid (%)	3	10.78653	0.395	12.731	2.319	3	0.358
C20:3n6+C21:0 homo-γ-linolenic (%)	3	0.5097	0.011	0.584	0.524	3	0.853
C20:3n3 eicosatrienoic acid (%)	3	0.325933	0.078	0.862	0.474	3	0.189
C20:4n6 arachidonic acid (%)	3	0.6446	0.130	1.235	0.052	3	0.000
C20:5n3 eicosapentaenoic acid (%)	3	1.037133	4.878	6.199	7.245	3	0.342
C22:2 n6 docosadienoic acid (%)	3	32.31303	5.570	45.473	5.830	3	0.040
C22:6n3 docosahexaenoic acid (%)	3	3.487133	5.809	0.400	0.051	3	0.438
ΣPUFA (%)	3	53.11003	5.078	70.144	3.633	3	0.013
ΣUFA (%)	3	66.11523	0.002	77.464	4.110	3	0.040
ΣFA (%)	3	99.99557	6.678	99.997	0.004	3	0.646
n3	3	5.669633	4.850	7.579	7.060	3	0.751
n6	3	50.92753	13.077	62.965	9.808	3	0.129
n6: n3	3	8.982509	1.326	8.308042	9.705	3	0.627

This pattern persisted for unsaturated fatty acids overall, where the cheese sourced from the EG held a higher content than that from the CG, yet

without any significant statistical differentiation ( $p \geq 0.05$ ). Further, in the specific context of n3 and n6 fatty acid categories, cheese from the EG

displayed a more substantial content than that derived from the CG cows. Once again, this observed difference did not reach statistical significance ( $p \geq 0.05$ ). To summarize, while there

are apparent variations in the fatty acid profiles between cheese samples from the two groups, the statistical robustness of these differences remains unconfirmed.

**Table 4.** Mean values of the fatty acid content in Telemea cheese

Fatty acid	n	CG		n	EG		P value
		$\bar{x} \pm SD$			$\bar{x} \pm SD$		
C4:0 butyric acid (%)	3	2.289	0.519	3	1.361	0.136	0.040
C6:0. caproic acid (%)	3	1.326	0.295	3	0.876	0.115	0.069
C8:0. caprylic acid (%)	3	0.704	0.153	3	0.496	0.090	0.113
C10:0. decanoic acid (%)	3	1.220	0.219	3	0.921	0.197	0.153
C11:0 undecylic acid (%)	3	0.749	0.200	3	0.647	0.185	0.551
C12:0. lauric acid (%)	3	1.131	0.160	3	0.873	0.210	0.166
C13:0 tridecanoic acid (%)	3	0.879	0.233	3	0.630	0.556	0.513
C14:0 C14:0. myristic acid (%)	3	3.207	0.329	3	1.882	1.542	0.219
C15:0 C15:0 pentadecanoic acid (%)	3	0.292	0.025	3	0.170	0.055	0.025
C16:0 C16:0. palmitic acid (%)	3	7.149	0.522	3	4.775	4.059	0.418
C17:0 heptadecanoic acid (%)	3	0.190	0.008	3	0.117	0.069	0.144
C18:0 stearic acid (%)	3	2.600	0.122	3	2.609	0.441	0.973
C20:0 eicosanoic acid (%)	3	0.162	0.055	3	0.100	0.051	0.224
C22:0 behenic acid (%)	3	0.401	0.087	3	0.467	0.273	0.711
C23:0 tricosanoic acid (%)	3	1.753	0.403	3	1.845	0.133	0.725
C24:0 lignoceric acid (%)	3	0.001	0.000	3	0.085	0.146	0.423
ΣSFA (%)	3	24.051	1.597	3	17.854	6.753	0.197
C14:1. myristoleic acid (%)	3	0.326	0.043	3	0.176	0.090	0.061
C15:1. pentadecenoic acid (%)	3	0.120	0.016	3	0.046	0.028	0.017
C16:1. palmitoleic acid (%)	3	0.485	0.049	3	0.270	0.206	0.153
C17:1. heptadecenoic acid (%)	3	0.228	0.051	3	0.176	0.124	0.539
C18:1C+T. oleic acid (%)	3	7.253	0.476	3	3.819	3.395	0.158
C20:1n9. eicosenoic acid (%)	3	0.249	0.032	3	0.131	0.052	0.029
C22:1n9. erucic acid (%)	3	0.412	0.096	3	0.296	0.022	0.111
C24:1n9. nervonic acid (%)	3	7.861	11.303	3	7.191	11.399	0.946
ΣMUFA (%)	3	16.933	11.633	3	12.106	7.681	0.581
C18:2C+T. n6. linoleic acid (%)	3	3.018	0.665	3	2.815	2.401	0.895
C18:3n6. γ-linolenic acid (%)	3	0.367	0.149	3	0.111	0.020	0.041
C18:3n3. α-linolenic acid (%)	3	0.429	0.311	3	0.086	0.055	0.133
C20:2n6. eicosadienoic acid (%)	3	11.799	2.043	3	13.556	1.051	0.256
C20:3n6+C21:0 homo-linolenic (%)	3	0.893	0.203	3	0.646	0.528	0.492
C20:3n3. eicosatrienoic acid (%)	3	0.475	0.091	3	0.506	0.151	0.775
C20:4n6. arachidonic acid (%)	3	0.978	0.222	3	0.994	0.183	0.926
C20:5n3. eicosapentaenoic acid (%)	3	1.551	0.353	3	1.010	0.819	0.352
C22:2n6. docosadienoic acid (%)	3	39.117	8.463	3	50.107	2.545	0.098
C22:6n3. docosahexaenoic acid (%)	3	0.390	0.032	3	0.209	0.131	0.132
ΣPUFA (%)	3	55.999	10.963	3	67.225	2.413	0.214
ΣUFA (%)	3	72.932	1.608	3	79.331	8.979	0.342
ΣFA (%)	3	96.983	0.665	3	97.185	2.401	0.895
n3	3	2.784	0.285	3	1.836	0.810	0.129
n6	3	56.234	11.339	3	68.205	2.470	0.149
n6: n3	3	20.058	2.155	3	44.879	26.290	0.243

Based on the results detailed in Table 4, which analyses the fatty acid composition of Telemea cheese from two distinct experimental cow

groups, several noteworthy observations emerge. Firstly, the Telemea cheese derived from the Experimental Group (EG) cows exhibited a lower

content of Saturated Fatty Acids (SFA) when juxtaposed with the cheese from the Control Group (CG) cows. However, intriguingly, this disparity in mean values failed to reach statistical significance ( $p \geq 0.05$ ). A similar trend was observed in the case of Monounsaturated Fatty Acids (MUFA), where the Telemea cheese from the EG manifested a lower MUFA content than its counterpart from the CG, but once again, the difference was not statistically significant ( $p \geq 0.05$ ). In a contrasting vein, the PUFA content was discernibly higher in the Telemea cheese sourced from the EG as opposed to that from the CG, although this difference, in line with prior observations, lacked statistical significance ( $p \geq 0.05$ ). This trend of higher fatty acid content in the EG was consistent when examining unsaturated fatty acids and n6 fatty acids. Both showed elevated levels in the Telemea cheese from the EG compared to the CG, yet neither exhibited a statistically significant difference ( $p \geq 0.05$ ). However, a deviation from this pattern emerged when considering n3 fatty acids. In this study, the Telemea cheese from the CG cows demonstrated a superior n3 fatty acid content compared to the EG-derived cheese.

Several studies conducted by Vargas et al. [27-30] reported increasing the amount of linoleic acid and UFA and reducing the amount of SFA in raw milk and dairy products by supplementing the ration of dairy cows with hydrogenated fats [29-30] vegetable oils [28] and UFA [27]. Thus, in the dairy products made from this milk (cheese, ice cream) the UFA profile and sensory characteristics have improved. Marques et al. (2019) [31], Kiem et al. (2019) [32] evaluated the effect of supplementing the ration of dairy cows with fish oil in combination with soybean or soybean extrudates or hydrogenated fats to improve the fat composition of milk and dairy products and obtained promising results. Also, Bu et al. 2007 [33] reported an increase in the amount of CLA in the milk of cows whose rations were supplemented with vegetable oils rich in linoleic acid. The authors obtained similar results in the case of supplementing the rations of dairy cows with linoleic acid.

#### 4. Conclusions

In the two varieties of cheese (Caş and Telemea), the major chemical components (proteins and fats) showed a significant difference in the experimental group (EG) compared to the control group (CG), as a result of supplementing the ration with the innovative feed preparation. Telemea cheese obtained from the milk of cows that consumed the innovative feed preparation had a lower content of saturated fatty acids and a higher content of unsaturated fatty acids.

The Caş cheese obtained from the milk of cows that consumed the innovative feed preparation had a lower content of saturated fatty acids and a higher content of unsaturated fatty acids. The n6:n3 ratio was lower in the curd obtained from the milk of cows that consumed the innovative feed preparation.

Future studies should evaluate how supplementing the ration with innovative feed preparations influences both dairy product quality and consumer health, ensuring that the resulting dairy products meet the highest consumer health standards worldwide.

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