Article

Effects of Dairy Cows Management Systems on the Physicochemical and Nutritional Quality of Milk and Yogurt, in a North-Eastern Romanian Farm

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Abstract: The study's objective was to investigate changes in the fatty acid composition of cow milk in general and in 80 Romanian Spotted cows' husbandry and feeding systems in particular (grazing – GC group vs. stabulation – SC group). The ultimate objective was to determine if the changes that happened in the milk also transferred to the finished product. Also, the influence of the raw milk quality produced by both systems was evaluated when yogurt was made from it. The milk was gathered in May, July, and September and used for both the yogurt-making process and the study, which lasted from May to October. As comparison to milk from SC, milk from grazed caws had larger percentages of fat and dry matter throughout the summer (GC) season. Moreover, pasture-based rations (MGC) contained more PUFA than MCS did. Data research revealed that not only do factors like milk origin and initial quality have a substantial impact on yogurt quality parameters, but also technologies like milk fermentation have a considerable impact on the fatty acid profile of yogurt. As comparison to cows kept permanently in stables, grazed cows (MGC) had fat with a lower concentration of saturated fatty acids and a higher proportion of rumenic, vaccenic, and oleic acids (MSC). When fresh milk is processed into yogurt and other dairy products, the fatty acid profiles alter, with saturated fatty acids predominating over unsaturated ones. The findings show that pasture-fed cows have a positive impact on milk quality, particularly in terms of fatty acid profile, as well as on yogurt's ultimate nutritional and dietary quality.

Keywords: cows feeding; milk; yogurt; fatty acids; quality

1. Introduction

Cow milk is a significant source of energy, high-quality protein, lipids, lactose, micro- and macroelements, vitamins, and enzymes that support healthy human growth, development as well as essential organism processes [1].

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The majority of milk lipids are in the form of triacylglycerols, which consist of a molecule of glycerol bonded to three ways of fatty acids. During recent decades, milk fatty acid composition has gained the interest of manufacturers and consumers as it influences various nutritional, physical and flavor properties of dairy products [2].

Dietary lipids from dairy products play a significant role in human nutrition. The complexity of milk fat arises from the fact that it is composed of more than 400 different fatty acids, which makes milk fat the most complex of all all-natural fats. Nevertheless, the majority of these acids are consumed in trace amounts, and only about 15 acids are consumed in quantities exceeding 1% [3]. C16:0, C18:1, C14:0, and C18:0 are the most abundant, ordered from largest to smallest.

Milk composition is influenced by a number of variables, such as the state of the environment or the animal feeding, with impact on the quality of the raw material and of the subsequent manufactured dairy products [4]. Indirectly or directly, several variables can influence milk composition, such as animal health, farm management, different feeding methods, seasonal fluctuations, and environmental factors are a few of these variables.

Researchers have become interested in the prospect of enhancing the diet of humans due to the change of the milk's fatty acid (FA) composition by changing the ruminants diets [5]. Unsaturated fats are beneficial for human health, whilst the saturated ones, primarily those reach in C12:0, C14:0, and C16:0 FAs, are linked to cardiovascular disorders [6]. The effect of milk fat on human health is currently seen much more favourable than it was in the past [7, 8]. Despite this, this field of study continues to be a very compelling topic for knowledge advancement.

Multiple factors affect the fatty acid composition of cow milk, such as breed, season, lactation stage, number of lactations, cows' age, geographic location, and, most relevant, the diet. Cows' nutrition accounts for 95% of the variation in cow milk fat yield and mostly quality (fatty acids profile), through the dietary fatty acids and to the ruminal biohydrogenation processes [9, 10].

However, milk from exclusively pasture-raised cattle contains much more polyunsaturated FA (PUFA), conjugated linonic acid (CLA), n-3 FA and branched FA [11]. In addition to being superior to concentrate-based milk production methods, pasture-based dairying systems that include fresh and preserved forages as well as occasional concentrate supplementation result in acceptable and sustainable productivity [12]. Slots et al. [13] claim that to produce a milk with a high content of PUFA and a high level of potential antioxidants, an extensive production form with a high level of pasture is advised. Consumers may find the fatty acid (FA) profile of pasture-raised milk fat to be more palatable because of the increased levels of CLA and linolenic acid and lower levels of saturated hypercholesterolemic fatty acids [14].

The quality of fermented dairy products is subject to change due to variations in raw milk compounds, including fatty acids, that respond differently or interfere throughout several technological processes, including heat treatment, homogenization or pasteurization [15, 16], standardization, fermentation, inoculation microorganisms culture type, duration of fermentation, and storage conditions [17]. Apart from these, the high nutritional content of yogurts and other fermented milk beverages is greatly determined by the manufacturing technique, as well as by any potential improvement in bioavailability brought on by the fermentation process. The fermentation of lactic acid in milk by *Lactobacillus bulgaricus* and *Streptococcus thermophilus* produces yogurt, a coagulated milk product, that usually has improved nutritional and dietary traits, in comparison with the raw milk [18].

However high milk protein and fat yields can be supported in a number of ways, including increasing feed intake (if necessary, assisted by feed additives), offering a well-balanced diet, and supplying enough levels of minerals [19, 20, 21]. Monitoring diet composition, gathering and/or purchasing high-quality forage, and using silage inoculants are all crucial [22]. Despite all of these, the increased cost of improving cow nutrition may have contributed to Romania's sharp decline in bovine herds in recent years (2.092.414 head in 2016 to 1.910.900 head in 2020) [23].

Cows maintained on pasture from May through October not only lowers food costs but also alters the lipid content of milk, which may have a good effect on consumer health. The milk yields at grazing period can be higher compared to those obtained in the rest of the year or compared to those obtained from animals raised exclusively in stables. In Romania, in the area of Suceava county,

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seasonal grazing and supplements with freshly mowed grass for cows can be easily organised [24, 25]. Consumers prefer to buy dairy products labelled as ecological or natural, because they currently believe that milk from cows that graze is healthier than that issued from cows fed almost exclusively from feedstock, indoors [26].

We hypothesise that the experimental factor (cows feeding) affect mostly the lipids profile of raw milk and of the subsequent produced yogurts, while the proximate composition of the dairy products is pretty similar, regardless the cows' dietary specificity. For these reasons, the primary goal of this investigation was to examine the variations in the chemical composition and fatty acids profile of milk from cows maintained on pasture (MGC – milk from grazed cows) and of that produced by cows exclusively maintained in stable (MSC – milk from stable cows), in light of the growing attention that consumers pay to the quality attributes of milk and milk products. The milk from the two cows' groups was processed to prepare a yogurt (using whole, not skimmed milk), analysed to assess the differences given by the cows' maintenance system and of raw milk quality on its physical, chemical, textural and nutritional quality.

2. Materials and Methods

2.1. Animals and feeding

The research was carried out at the Best Cows Sadova farm, located in the village of Sadova, Suceava County, Romania. The territory of the village has a total area of 6,786 ha, out of which: forest vegetation 3,974 ha (58.56%), agricultural land, predominantly hay and pastures, 2,575 ha (38.00 %) and land with other uses. All investigations were carried on the basis of the Statement on Research Bioethics no. 32/03 May 2022, issued by the Committee of Ethics and Bioethics, Faculty of Food and Animal Sciences, Iasi University of Life Sciences.

Within the farm, 80 heads of Bălțată Românească breed (Romanian Spotted with Brown, part of the Siemmental breed family) are raised. They were randomly allotted in two groups: GC (n=40), cows mostly fed on pasture with corn silage supplementation and less concentrated feedstuffs and SC, (n=40) cows fed indoors benefiting from diet based on hay, corn silage and increased quantities of energy and protein concentrated feedstuffs (Table 1). Average body weight of cows was 700 kg, average individual daily milk yield was 25 kg, with 4% fat. These values were used to calculate the nutritional requirements and to elaborate diets, in accordance with INRA France methodology [27]. Chemical composition values of the feedstuffs available at the farm was assessed within an accredited laboratory and were used to formulate the diets. The values are presented in Table 1, along with the diet nutritional specifications.

The period in which the study was carried out was from May to mid October. The milk for analysis as well as for the production of yogurt was collected throughout 3 consecutive days in the last week of May, July and September, from the afternoon milking, daily. Animals have had passed the midterm of a normal lactation period (305 days), reaching lactation days 186-192 at the moment of the first samples collection, knowing they calved grouped within January 10-16 period. Grazed cows were kept in stable throughout the night, without fed access and with ad-libitum water. They were released on pasture at 5 AM and brought back in stable at 9 PM. After morning and afternoon milking, they were provided, under a covered shelter, corn silage and concentrate mix (corn crumbles, rapeseed meal, minerals, salt and premix), twice a day (at 6 AM and 5 PM). Cows kept exclusively in stable received two main meals per day after morning and afternoon milking, silage and concentrate mix (corn crumbles, minerals, salt and premix). After their intake, they were provided hay, throughout the day, in between milking moments.

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Table 1. – Nutritional requirements and diets provided daily to dairy cows (live weight 700 kg, daily milk yield 25 kg, milk fat 4%).

Daily diet type, structure and proximate composition	*Nutritional requirements:* IDM (kg)	MLDU	NEMU	PDI-N (g)	PDI-E (g)	Ca (g)	P (g)
	up to 19.5	up to 17.10	16.6	1645.00	1645.00	136.00	76.00
Cows maintained on pasture (GC)	*Covered:*						
Pasture – graminaea, 66.0 kg (9.5 kg IDM); Corn sillage, 20.5 kg (5 kg IDM); Corn crumbles, 2.9 kg (2.5 kg IDM); Rapeseed meal, 1.8 kg (1.6 kg IDM); Limestone, 0.1 kg (0.1 kg IDM); Sodium bicarbonate, 0.1 kg (0.1 kg IDM); Salt, 0.1 kg (0.1 kg IDM); Premix Vitafort Bio, 0.1 kg (0.1 kg IDM)	19.0	15.9	17.2	1705	1645	138	78
Diet proximate composition per 1000g IDM 87.3 g CAsh, 912.7 g OM, 230.8 g CP, 45.1 g EE, 183.2 g CF, 230.3 g ADF, 355.5 g NDF, 453.5 g NFC							
Cows maintained in stable (GS)	*Covered:*						
Meadow hay – graminaea, 11.6 kg (9 kg IDM); Corn sillage, 14.4 kg (3.5 kg IDM); Corn grains crumbles, 4.3 kg(3.8 kg IDM); Rapeseed meal, 3.0 kg (2.7 kg IDM); Limestone, 0.2 kg (0.2 kg IDM); Sodium bicarbonate, 0.1 kg (0.1 kg IDM); Salt, 0.1 kg (0.1 kg IDM); Premix Vitafort Bio, 0.1 kg (0.1 kg IDM)	19.5	13.8	17.3	1661	1654	139	76
Diet proximate composition per 1000g IDM 82.0 g CAsh, 918.0 g OM, 220.9 g CP, 45.2 g EE, 171.5 g CF, 215.6 g ADF, 332.8 g NDF, 480.5 g NFC							

IDM – ingested dry matter (maximal physiological threshold); Cash – Crude Ash; OM – Organic Matter; CP – Crude Protein; EE – ether extract; CF – Crude Fibre; ADF – Acid Detergent Fibre; NDF – Neutral Detergent Fibre; NFC – Non fibrous carbohydrates; ; MLDU -Milk Load Digestive Units (maximal physiological threshold), NEM U – Net Energy for Milk Units, PDI – N (Protein digestible at intestinal level – synthesised on dietary Nitrogen basis). PDIE (Protein Digestible at intestinal level – synthesised on dietary Energy basis).

2.2. Raw milk collecting, sampling and analysis

Grazed cows were milked using individual cans mechanic mobile collecting device and the milk was deposited in a separate tank, while cows in stabulation were milked in the parloir of the stable and the milk was stored in the main tank of the farm. The milk (150 L) was extracted from the two storage tanks of the farm. Due to the fact that cows were milked separately, in accordance with their allotting, the yielded milk was coded accordingly: MGC (milk from GC group, grazed cows) and MSC (milk from stabulation cows). Milk was transported to the dairy processing centre by a truck equipped with a thermo regulated refrigeration tank with separate cells. The temperature of the milk in the transportation tank was kept at 5°C. Five samples of 500 mL each were collected in sterile containers from each group cell and taken to the laboratory in special boxes equipped with ice packs, then stored under refrigeration conditions at 4°C, throughout 24 hours. Prior to analysing, an average sample was formed per group from each five original samples, milk was thoroughly homogenised and introduced to subsequent analytical laboratory investigations (10 replications per analysed trait / method).

After calibrating the pH meter (WTW InoLab, Xylem Analytics GmbH, Germany), the pH was measured using a glass electrode with a temperature probe (buffer solutions pH 4 and 7). Total solids (TS) in milk were assessed by the AOAC method no. 925.23 [28], dehydrating the samples in a Memmert UFE 700 forced air oven (Memmert GmbH, Germany). Water (W) content resulted from the difference, according to the relation (1).

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$$W\ (\%) = 100\% - TS\ (\%) \quad (1)$$

Fat of milk (Fat %) was assessed through the acid-butyrometric Gerber method [29], using a Nova Safety Funke Gerber thermo regulated centrifuge (Funke Gerber GmbH, Germany) and Funke Gerber Milch 65°C calibrated butyrometers (Funke Gerber GmbH, Germany). Regarding the non-fat solid (SNF) content, this acetate was calculated by difference, in accordance with relation (2).

$$SNF\ (\%) = TS\ (\%) - Fat\ (\%) \quad (2)$$

Crude ash (total minerals) content was assessed via incineration at 550°C, in a Super Therm C311 furnace (SuperTherm SRL, Romania) after prior combustion on a Bunsen funnel, until samples ceased to smoke, in accordance with AOAC 945.46 specifications [30, 31].

The crude protein (CP), true protein (TP), casein, noncasein- nitrogen (NCN), whey proteins and non protein nitrogen (NPN) contents were determined by using Kjeldahl method applied on a Velp Scientifica DK 6 digestion unit and UDK 7 distillation system (VelpScientifica, Italy) according to standard protocol of IDF [32]. The total nitrogen content was multiplied by 6.38, which generated the crude protein content. The TP in the milk sample were determined by treating with 12% trichloroacetic acid. The nitrogen (%) was converted to NPN and NCN contents by using the conversion factor 3.60 and 6.25 respectively. Protein (nitrogen) fractions were calculated using the Equations (3), (4) and (5):

$$TP = CP–NPN \quad (3)$$

$$Casein\ (N\ \%) = Total\ protein\ (N\%)–NCN\ (N\ \%) \quad (4)$$

$$Whey\ protein = NCN–NPN \quad (5)$$

2.3. Yogurt analysis

2.3.1. Yogurt preparation

From each type of milk (MGC and MSC), two quantities of 25 L were used as raw matter for yogurt processing and two corresponding groups were formed. Yogurt samples were codified basing on their originating raw matter: YGC samples (yogurt produced from milk cows maintained on pasture) and YSC samples (yogurt produced from milk cows maintained in stable). According to Attia et al. [33], milk was pasteurized using a thermal treatment installation (milk pasteuriser type IPL-1M, produced by ICPIAS S.A., Romania) at 90°C for 30 seconds, then chilled to 43°C, and the probiotic starter cultures (*Streptococcus thermophilus* and *Lactobacillus delbruckii* subsp. *Bulgaricus*, YF-L812 commercial product, Chr. HANSEN, Denmark), were inoculated (starting from the standard 50U culture per 250 L of milk, according to the manufacturer's guidelines). The mixture was afterwards incubated in plastic cups at 43°C, using a laboratory incubator (IT 40 thermostatic chamber, produced by Electronic April S.R.L. Romania) until a hard coagulum and a pH range of 4.3 to 4.5 were obtained (5-6 H). The samples of yogurt were then kept at 4°C for 24 hours, prior to further analyses.

2.3.2. Texture analysis

Textural analysis of yogurt assortments was carried out with the Mark 10 ESM 300 texturometer (Mark-10 Inc., USA), equipped with a digital dynamometer of 25N (resolution 0.005N). Analysis was carried out on 3 yogurt samples from each yogurt type, following a non-stationary manner, for two complete cycles of displacement of the probe in the yogurt mass. This test procedure results in the texture curve profile [34]. Regarding the principle of the method, it consists in determining the texture by exerting compressive stress on the coagulum using a Brookfield TA4/1000 cylindrical probe (h= 20 mm, D=38.1 mm, Brookfield AMETEK Inc., USA). The force was recorded continuously during the experiment. As a working method, throughout the course of the experiment, the cylindrical probe exerts different compression forces depending on the firmness of the clot. The data were recorded by obtaining the texture profile from which a series of textural parameters are determined such as: cohesiveness, elasticity, hardness, gumminess, consistency, resilience, adhesiveness, adhesive and

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coagulum breaking force. After returning the probe from the clot mass to its initial position, a new compression cycle is performed by reintroducing the probe into the clot mass to determine the resilience of the clot. Experimental results were obtained by 10 repetitions.

2.3.3. Physical and chemical analyses

The pH of yogurt samples was determined by the method as described by Igbabul et al. [35]. Briefly, 10 g of yogurt sample was dissolved in 100 mL of distilled water. The mixture was allowed to equilibrate at room temperature. The pH of the samples was then determined by a pH meter (WTW InoLab GmbH, Germany).

Using the technique described by Oladipo et al. [36], titratable acidity was measured and calculated. Samples of 10 g each were quickly dissolved in 30 mL of distilled water and carefully blended. In the obtained solution, a few drops of phenolphthalein indicator were added. To ensure full neutralization, it was titrated against a standard 0.1N NaOH until a light pink colour appeared and persisted for at least 10 -15 seconds. Lactic acid, the primary organic acid in yogurt samples, was used to compute the titratable acidity and is shown in the Equation (6).

$$\text{Titrable acidity (\%)} = \frac{\text{vol. 0.1 NaOH (mL) x 100}}{\text{mass of sample (g)}} \quad (6)$$

The proportion of free whey is used to represent the degree of syneresis (i.e. the spontaneous release of the watery part of yogurts due to gel contraction). Wijesinghe et al. [37] approach was used to measure it. In a nutshell, 10 g of each yogurt sample were placed separately on a sheet of filter paper and allowed to rest on top of a funnel. The quantity of residual yogurt was weighed after draining under vacuum for 10 minutes, and the syneresis was computed using the Equation (7).

$$\text{Free whey (\%)} = \frac{\text{mass of initial sample (g) - mass of sample after filtration (g) x 100}}{\text{weight of initial sample(g)}} \quad (7)$$

The total solids content of yogurt according to IDF [38]. The proximate analysis (moisture, crude protein, fat and ash) was assessed using the AOAC method [39] as follows: the moisture - Method No. 990.20, crude protein - Methods No. 945.46, fat content - Method No 905.02 and for ash - Methods No. 991.20. Experimental results were obtained by 10 repetitions.

2.4. Fatty Acids analysis in Milk and Yogurt

2.4.1. Fat Extraction

From raw milk, fat was extracted using the Roese-Gottlieb method [40] and the yogurt fat extraction was done using the Folch method [41]. Both for the determinations performed on milk and those performed on yogurt, 10 repetitions were performed

2.4.2. Preparation of Fatty Acid Methyl Esters

The IDF standard method (ISO 15884:2002) was used in the process of converting fatty acids into their corresponding fatty acid methyl esters (FAME) [42].

2.4.3. Analysis of Fatty Acid Composition by GC Method

Gas chromatography was utilized to analyze the fatty acid (FA) composition using an HP 6890 GC System (Münster, Germany) with a flame-ionization detector (FID). The lipid phase, was utilized, and the film thickness was 0.2µm in a capillary column CP Sil 88 (Chrompack, Middelburg, the Netherlands) with a length of 100 m and an internal diameter of 0.25 mm. The following settings were used for the analysis: helium was used as the carrier gas, and the gas flow rate was 1.5 mL/min. The column temperature ranged from 60°C (for 1 min) to 180°C (Δt = 5°C/min), the detector temperature was 250°C, and the injector temperature was 225°C. The volume of the sample injection was 0.4 µL. (split mode 50:1). To identify the fatty acids included in the examined products, the retention times of fatty acids were compared to the retention times of methyl esters of fatty acids of reference milk fat (BCR Reference Materials) of CRM 164 symbol and literature data [43, 44]. The cis-9, trans-11 CLA

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isomer was identified using a combination of CLA methyl esters from Sigma-Aldrich, St. Louis, Missouri, in the United States. Positional trans isomers of C18:1 were identified using standards of methyl esters (Sigma Aldrich, St. Louis, MO, USA), whereas trans isomers of C18:2 acid (cis, trans, and trans, cis) were identified using a combination of standards of C18:2 isomers (Supelco, Bellefonte, PA, USA). The individual fatty acids were expressed as mean relative percentages of the total FAME identified.

The hypocholesterolemic fatty acids were calculated using Equation (8) (DFA) [45].

$$DFA = UFA + C18:0 \quad (8)$$

The Index of Hypercholesterolemic fatty acids (OFA) was calculated using the Equation (9) [45].

$$OFA = C12:0 + C14:0 + C16:0 \quad (9)$$

2.5. Data Analysis

For physicochemical indices of raw milk and yogurts, the data issued from 10 analytical repetitions were conducted in triplicate for each sample and after subjected to statistical computation, using the GraphPad Prism 9.4.1 software (Graph Pad Ltd., CA, USA). Table data are presented as mean and standard deviation. Significant differences among results were identified using analysis of variance (ANOVA). Tukey's test was applied to determine which pairwise comparisons were significant. For all tests, P-values of $P < 0.05$ were considered [46].

3. Results

3.1. Raw milk quality

The results of this study highlight the fact that the feeding system as well as the period in which the milk was harvested has a significant effect ($P < 0.05$) on the chemical composition of the milk. Total lactation average milk solids content from cows on the MGC system was significantly higher than that of MCS ($P < 0.05$) systems. Maximum solids contents were recorded in September (12.90±0.08 % for MGC and 12.79±0.14% for MCS) and minimum contents were observed during early lactation (May) for each diet (Table 2). The cows from the MCS feeding system produced milk with significantly higher ($P < 0.05$) total lactation average milk fat content (4.21±0.05%) than that of MGC (4.32±0.09%). Regarding the fat content, the lowest level was recorded in May at MGC (4.18±0.04%), but the highest value was also noted in the case of milk from MGC collected in September, namely 4.41±0.06% compared to 4.23±0.04% as obtained at MCS ($P < 0.05$). Mean analysis of fat content was significantly higher in MGS compared to MCS ($P < 0.05$).

Table 2. The chemical composition and the fraction of protein of raw milk.

Physical-chemical trait	System of exploatation	Moment of analysis			Overall
		May	**July**	**September**	
pH	MGC	6.51±0.02^{xA}	6.44±0.03^{yB}	6.45±0.02^{yB}	6.47±0.04^{y}
	MCS	6.52±0.04^{xA}	6.50±0.04^{xA}	6.51±0.04^{xA}	6.51±0.04^{x}
Water (W) (%)	MGC	87.32±0.10^{xA}	87.13±0.13^{xB}	87.10±0.08^{xB}	87.18±0.14^{x}
	MCS	87.23±0.14^{xA}	87.24±0.14^{xA}	87.22±0.14^{xA}	87.23±0.14^{x}
Total solids (TS) (%)	MGC	12.68±0.10^{xC}	12.87±0.13^{xB}	12.90±0.08^{xAB}	12.82±0.14^{x}
	MCS	12.77±0.14^{yA}	12.78±0.14^{yA}	12.80±0.14^{yA}	12.78±0.14^{y}
Fat (%)	MGC	4.18±0.04 ^{xC}	4.37±0.05 ^{xB}	4.41±0.06 ^{xAB}	4.32±0.09^{x}
	MCS	4.20±0.06^{yA}	4.20±0.06^{yA}	4.23±0.04^{yA}	4.21±0.05^{y}
Solid non fat (SNF) (%)	MGC	8.63±0.10^{xB}	8.50±0.15^{xA}	8.49±0.06^{xBA}	8.54±0.12^{x}
	MCS	8.57±0.17^{yA}	8.58±0.17^{yA}	8.57±0.18^{yA}	8.57±0.17^{x}
Ash (%)	MGC	0.75±0.03^{xA}	0.79±0.02^{yA}	0.80±0.05 ^{xA}	0.78±0.04^{x}
	MCS	0.77±0.05^{xA}	0.76±0.05^{xA}	0.78±0.05^{yA}	0.77±0.04^{x}
The protein fractions of milk					
Crude protein (CP) (%)	MGC	3.45±0.07^{xA}	3.46±0.07^{xA}	3.48±0.07^{xA}	3.46±0.07^{x}
	MCS	3.34±0.04^{yB}	3.32±0.04^{yB}	3.36±0.04^{yA}	3.34±0.09^{y}

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True protein (TP) (%)	MGC	3.16±0.04^{xB}	3.15±0.05^{xB}	3.19±0.05^{xA}	3.17±0.08^{x}
	MCS	3.04±0.06^{yA}	3.02±0.06^{yA}	3.06±0.06^{yA}	3.04±0.06^{y}
Casein (%)	MGC	2.44±0.06^{xA}	2.42±0.06^{xA}	2.48±0.06^{xA}	2.45±0.06^{x}
	MCS	2.30±0.05^{yA}	2.29±0.06^{yA}	2.33±0.04^{xA}	2.33±0.07^{y}
Whey protein (WP) (%)	MGC	0.44±0.02^{xC}	0.42±0.02^{xB}	0.47±0.02^{xAC}	0.44±0.02^{x}
	MCS	0.41±0.01^{xA}	0.40±0.02^{xA}	0.42±0.02^{yA}	0.41±0.02^{y}

MGC = milk from grazed cows; MCS = milk from cows maintained permanently in stable; SEM - standard error of mea. $^{x\,\&\,y}$: There is no significant difference (P > 0.05) between any two means, within the same column that has the same superscript letter; $^{A,\,B\,\&\,C}$: There is no significant difference (P > 0.05) between any two means, within the same row that has the same superscript letter.

The analysis of the data regarding the ash content highlights a constant level throughout the period, the average being 0.78±0.04% at MGC and 0.77±0.04% at MCS (P > 0.05).

The analysis of the data regarding the protein fraction of milk highlights differences between MGC and MCS (P < 0.05) for crude protein, true protein and casein, but evaluating the data according to the period, we notice that differences appear in the case of TP to MGC between the milk collected in the months May and July compared to September (P < 0.05) (Table 2). In the case of WP, no differences were noted (P > 0.05) generated by the rearing system or the period in which the milk was collected.

Data on the profile of fatty acids in milk are reported in Table 3. Myristic (C14:0), Palmitic (C16:0) and Stearic (C18:0) acid contributed most to total FAs. Their concentration (overall)was 10,36, 28,05 and 9,81 g/100 g total FAs for MGC and 12,13, 35,31 and 8.91 g/100g for MCS. The saturated FAs contributed by 62.37 g în case of MGC and 71,34 g for MCS (P < 0.05), monounsaturated FAs by 5.62 g/100g in case of MGC and 2.41 g/100 g for MCS (P < 0.05). For the polyunsaturated FAs the overall was 4.66 g for MGC and 2.66 g for MCS (P < 0.05) . The content of CLA was 0.93 g/100 g total FAs. Table 3 demonstrates how the time of milk collection had a substantial impact on the amount of FAs present in MGC lacking C12:0, C17:0, C18:0 trans-11, and C18:2. In the case of PUFA, the highly significant differences caused by the milk harvesting time were also found in May, where an average value of 5.05 g/100g was obtained in contrast to 4.69 g/100g (July) and 4.26 g/100g (September) (P < 0.05). Moreover, differences for SFA, DFA, and OFA were identified within the MGC (P < 0.05). When it came to UFA, the May result (10.75 g/100 g) was significantly higher than the values from July and September (10.07 g/100 g and 10.04 g/100 g, respectively). For MGC, the highest DFA/OFA ratio values were in May (0.49 g/100 g) and July (0.50 g/100 g), as opposed to September, when the average value was 0.46 g/100 g (P < 0.05).

Table 3. The main fatty acids in cow's milk (g/100 g Fatty Acids Methyl Esters).

Physical-chemical trait	Type of nutrition	Moment of analysis			Overall
		May	July	September	
Butyric acid - C4:0	MGC	3.08±0.31^{xB}	3.29±0.14^{xA}	2.95±0.20^{xB}	3.11±0.26^{x}
	MCS	2.82±0.20^{yA}	2.83±0.20^{yA}	2.81±0.20^{xA}	2.82±0.19^{y}
Caprionic acid - C6:0	MGC	1.99±0.19^{xB}	2.11±0.14^{xA}	1.82±0.15^{yC}	1.97±0.20^{y}
	MCS	2.07±0.04^{xA}	2.08±0.04^{xA}	2.06±0.04^{xA}	2.07±0.04^{x}
Caprylic acid - C8:0	MGC	1.19±0.07^{yB}	1.45±0.07^{xA}	1.24±0.06^{yB}	1.29±0.13^{x}
	MCS	1.30±0.02^{xA}	1.31±0.02^{yA}	1.29±0.02^{xA}	1.30±0.02^{x}
Capric acid - C10:0	MGC	3.03±0.16^{yA}	2.91±0.12^{yB}	2.44±0.12^{yC}	2.79±0.29^{y}
	MCS	3.13±0.08^{xA}	3.14±0.08^{xA}	3.12±0.08^{xA}	3.13±0.07^{x}
Lauric acid - C12:0	MGC	3.18±0.10^{yB}	3.17±0.09^{yB}	2.64±0.33^{yA}	2.99±0.33^{y}
	MCS	3.50±0.08^{xA}	3.51±0.08^{xA}	3.49±0.08^{xA}	3.50±0.08^{x}
Myristic acid - C14:0	MGC	9.61±0.48^{yC}	11.22±0.31^{yA}	10.24±0.32^{yB}	10.36±0.77^{y}

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	MCS	12.13±0.09^{xA}	12.14±0.09^{xA}	12.12±0.09^{xA}	12.13±0.08^{x}
Myristoleic acid - C14:1	MGC	1.20±0.04^{xB}	1.15±0.04^{xC}	1.26±0.04^{xA}	1.20±0.06^{x}
	MCS	0.65±0.04^{yA}	0.66±0.04^{yA}	0.64±0.04^{yA}	0.65±0.04^{y}
Pentadecylic acid - C15:0	MGC	1.26±0.05^{yA}	1.15±0.03^{yB}	1.12±0.04^{yC}	1.18±0.07^{y}
	MCS	1.34±0.03^{xA}	1.35±0.03^{xA}	1.33±0.03^{xA}	1.34±0.03^{x}
Palmitic acid - C16:0	MGC	28.64±1.07^{yA}	27.85±0.83^{yB}	27.65±0.67^{yB}	28.05±0.95^{y}
	MCS	35.31±0.31^{xA}	35.32±0.31^{xA}	35.30±0.31^{xA}	35.31±0.30^{x}
Palmitoleic acid - C16:1	MGC	2.12±0.09^{xA}	1.94±0.09^{xC}	2.02±0.07^{xB}	2.02±0.11^{x}
	MCS	1.14±0.04^{yA}	1.15±0.04^{yA}	1.13±0.04^{yA}	1.14±0.04^{y}
Margaric acid - C17:0	MGC	0.72±0.11^{xA}	0.67±0.06^{xA}	0.60±0.07^{xB}	0.66±0.10^{x}
	MCS	0.62±0.02^{yA}	0.63±0.02^{xA}	0.61±0.02^{xA}	0.62±0.02^{y}
Stearic acid - C18:0	MGC	9.56±0.43^{xB}	11.08±0.82^{xA}	8.80±0.37^{xC}	9.81±1.11^{x}
	MCS	8.91±0.48^{yA}	8.92±0.48^{yA}	8.90±0.48^{xA}	8.91±0.46^{y}
Vaccenic acid - C18:1 trans-11	MGC	2.39±0.14^{xB}	2.30±0.14^{xB}	2.50±0.14^{xA}	2.40±0.16^{x}
	MCS	0.62±0.06^{yA}	0.63±0.06^{yA}	0.61±0.06^{yA}	0.62±0.06^{y}
C18:2	MGC	2.52±0.20^{xA}	2.46±0.18^{xA}	1.96±0.18^{xB}	2.31±0.31^{x}
	MCS	1.51±0.03^{yA}	1.52±0.03^{yA}	1.50±0.03^{yA}	1.51±0.03^{y}
C18:3	MGC	1.13±0.10^{xA}	0.91±0.05^{xC}	1.02±0.05^{xB}	1.02±0.12^{x}
	MCS	0.24±0.02^{yA}	0.25±0.02^{yA}	0.23±0.02^{yA}	0.24±0.02^{y}
Arachidic acid C20:0	MGC	0.19±0.02^{xA}	0.17±0.02^{yB}	0.13±0.02^{yC}	0.16±0.03^{y}
	MCS	0.19±0.02^{xA}	0.20±0.02^{xA}	0.18±0.02^{xAB}	0.19±0.02^{x}
Rumeric acid - CLA	MGC	1.40±0.08^{xA}	1.32±0.07^{xB}	1.28±0.05^{xB}	1.33±0.08^{x}
	MCS	0.91±0.08^{yA}	0.92±0.08^{yA}	0.90±0.08^{yA}	0.91±0.08^{y}
Monounsaturated fatty acid - MUFA	MGC	5.71±0.22^{xA}	5.39±0.22^{xB}	5.78±0.19^{xA}	5.62±0.27^{x}
	MCS	2.41±0.08^{yA}	2.44±0.08^{yA}	2.38±0.08^{yA}	2.41±0.08^{y}
Polyunsaturated fatty acid - PUFA	MGC	5.04±0.23^{yA}	4.69±0.18^{xB}	4.26±0.22^{xC}	4.66±0.38^{x}
	MCS	2.66±0.09^{xA}	2.69±0.09^{yA}	2.63±0.09^{yA}	2.66±0.09^{y}
Saturated fatty acid - SFA	MGC	62.45±1.26^{yB}	65.06±0.67^{yA}	59.61±0.62^{yC}	62.37±2.42^{y}
	MCS	71.34±0.61^{xA}	71.45±0.61^{xA}	71.23±0.61^{xA}	71.34±0.60^{x}
Unsaturated fatty acids - UFA	MGC	10.75±0.33^{xA}	10.07±0.32^{xB}	10.04±0.32^{xB}	10.29±0.46^{x}
	MCS	5.07±0.07^{yA}	5.13±0.07^{yA}	5.01±0.07^{yA}	5.07±0.08^{y}
DFA	MGC	20.31±0.49^{xB}	21.15±0.83^{xA}	18.84±0.51^{xC}	20.10±1.15^{x}
	MCS	13.99±0.48^{yA}	14.06±0.48^{yA}	13.92±0.48^{yA}	13.99±0.46^{y}
OFA	MGC	41.42±1.18^{yB}	42.24±0.78^{yA}	40.53±0.58^{yC}	41.40±1.11^{y}
	MCS	50.95±0.27^{xA}	50.98±0.27^{xA}	50.92±0.27^{xA}	50.95±0.26^{x}
DFA/OFA	MGC	0.49±0.02^{xA}	0.50±0.03^{xA}	0.46±0.01^{xB}	0.49±0.02^{x}
	MCS	0.27±0.01^{yA}	0.28±0.01^{yA}	0.27±0.01^{yA}	0.27±0.01^{y}

DFA = desirable hypocholesterolemic fatty acids, OFA = hypercholesterolemic fatty acid, DFA/OFA = desirable hypocholesterolemic fatty acids/ hypercholesterolemic fatty acid. $^{x\ \&\ y}$: There is no significant difference (P > 0.05) between any two means, within the same column that has the same superscript letter; $^{A,\ B\ \&\ C}$: There is no significant difference (P > 0.05) between any two means, within the same row that has the same superscript letter.

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In the case of milk collected from MCS, differences given by the period of milk collection were reported only in the case of C20:0 where the average value obtained in May was 0.19 g/100 g, 0.20 g/100 g in July and 0.18 g /100 g in September.

In comparison to the indoor period, the milk fat produced during the grazing period (MGC) contained more long-chain FAs and less medium-chain FAs (MCS). The milk fat in the grazing period had higher monounsaturated fat (5.62 g/100 g) and polyunsaturated fat (4.66 g/100 g total FAs) ($P < 0.05$) and less saturated fat (62.37 g/100 g; P 0.05) than the milk fat in the indoor period (MCS) ($P < 0.05$) showed that milk fat from the indoor period (MCS) (35.31 g/100 g) had higher palmitic acid than milk fat from the grazing period (MGC) (28.05 g/100 g).

The concentration of CLA was higher in the grazing period (MGC) (1.33 g/100 g total FAs) than in the indoor period (0.91 g/100 g total FAs) ($P < 0.05$). Also, higher concentrations in the grazing period (MGC) were also observed in the case of MUFA, PUFA, UFA, ($P < 0.05$) compared to those obtained for milk fat from the indoor period (MCS).

For the DFA the average value obtained was 20.10 g/100g for milk fat produced in the grazing period (MGC) and 13.99 g/100 g for milk fat from the indoor period (MCS) ($P < 0.05$). For OFA, milk fat produced in the grazing period (MGC) was 41.40 g/100g lower compared to that from MCS which was 50.95 g/100g ($P < 0.05$). Regarding the DFA/OFA ratio, the mean value for MGC was 0.49 g/100g and 0.27 g/100g for MCS ($P < 0.05$).

3.2. Yogurts quality

3.2.1. Texture testing

TPA parameters (cohesiveness, springiness, hardness, gumminess, firmness, resilience adhesiveness, adhesiveness force and breaking force) of the yogurt samples are given in Table 4.

The study of the data pertaining to the texture of the yogurt reveals that the time (se-asone) during which the milk was gathered and processed had bearing on the qualitative indexs ($P > 0.05$).

Table 4. Texture parameters of yogurt.

Physical-chemical trait	System of exploatation	Moment of analysis			Overall
		May	**July**	**September**	
Cohesiveness	YGC	0.21 ± 0.03^{xC}	0.26 ± 0.03^{xB}	0.28 ± 0.03^{xAB}	0.25 ± 0.04^{x}
	YCS	0.19 ± 0.04^{xC}	0.24 ± 0.04^{xB}	0.24 ± 0.04^{xAB}	0.23 ± 0.05^{x}
Springiness	YGC	0.49 ± 0.05^{yC}	0.54 ± 0.05^{yB}	0.56 ± 0.05^{yAB}	0.53 ± 0.06^{y}
	YCS	0.57 ± 0.04^{xB}	0.62 ± 0.04^{xA}	0.62 ± 0.04^{xA}	0.60 ± 0.05^{x}
Hardness *(N)*	YGC	1.62 ± 0.05^{xC}	1.67 ± 0.05^{xB}	1.69 ± 0.05^{xAB}	1.66 ± 0.05^{x}
	YCS	1.62 ± 0.05^{xB}	1.67 ± 0.05^{xA}	1.67 ± 0.05^{xA}	1.65 ± 0.05^{x}
Gumminess *(N)*	YGC	0.35 ± 0.04^{xC}	0.40 ± 0.04^{xB}	0.42 ± 0.04^{xAB}	0.39 ± 0.05^{x}
	YCS	0.35 ± 0.04^{xB}	0.40 ± 0.04^{xA}	0.40 ± 0.04^{xA}	0.38 ± 0.05^{x}
Firmness	YGC	5.16 ± 0.04^{xA}	5.21 ± 0.04^{xA}	5.23 ± 0.04^{xA}	5.20 ± 0.05^{x}
	YCS	4.67 ± 0.44^{yA}	4.72 ± 0.44^{yA}	4.72 ± 0.44^{yA}	4.71 ± 0.43^{y}
Resilience	YGC	0.23 ± 0.04^{yC}	0.28 ± 0.04^{Bx}	0.30 ± 0.04^{xAB}	0.27 ± 0.05^{y}
	YCS	0.29 ± 0.03^{xB}	0.29 ± 0.04^{xB}	0.34 ± 0.03^{xA}	0.30 ± 0.04^{x}
Adhesiveness *(mJ)*	YGC	-0.23 ± 0.04^{xA}	-0.18 ± 0.04^{xB}	-0.16 ± 0.04^{xB}	-0.19 ± 0.05^{y}
	YCS	-0.19 ± 0.04^{yA}	-0.14 ± 0.04^{yB}	-0.14 ± 0.04^{xB}	-0.16 ± 0.05^{x}
Adhesiveness force *(N)*	YGC	-0.33 ± 0.04^{yA}	-0.28 ± 0.04^{yB}	-0.26 ± 0.04^{xB}	-0.29 ± 0.05^{y}
	YCS	-0.27 ± 0.05^{xA}	-0.22 ± 0.05^{xB}	-0.22 ± 0.05^{xB}	-0.24 ± 0.05^{x}
	YGC	1.48 ± 0.04^{xC}	1.53 ± 0.04^{xB}	1.55 ± 0.04^{xAB}	1.52 ± 0.05^{x}

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Breaking force *(N)*	YCS	1.45±0.04^{xB}	1.50±0.04^{xA}	1.50±0.04^{yA}	1.48±0.05^{y}

N – newtons; mJ – millijoule. $^{x \& y}$: There is no significant difference (P > 0.05) between any two means, within the same column that has the same superscript letter; $^{A, B \& C}$: There is no significant difference (P > 0.05) between any two means, within the same row that has the same superscript letter.

The cohesiveness, a parameter that is strongly influenced by the protein content and the specificity of the internal links of the protein structure that forms the clot. Analysing the data obtained for the texture, for the two yogurt samples, it is observed that the cohesiveness of YGC has an overall value of 0.25, and for the YSC the value is lower, of 0.23 (P < 0.05). Since both values are close to 0 in the analysed samples, it highlights a low resistance to deformation as a result of weak internal bonds.

For the springiness the overall was 0,53 for YGC and 0,60 for YCS (P < 0.05). The hardness of the clot was measured in order to represent the resistance of the clot to the compression load exerted by the probe. Since the parameter largely depends on the product's elasticity, YGC has a higher hardness (1.66 N) than YSC (1.65 N) but with no significant difference (P > 0.05).

For the gumminess, average values of 0.39 N were obtained in the case of YGC and 0.38 N in the case of YCS, the differences being also insignificant (P > 0.05). No changes were reported even during the determinations between the two types of milk used in processing (table 4).

Clot resilience was another characteristic that was being watched, and for YGC, the values were 0.27 and 0.30 for YSC (P < 0.05). The ability of the clot to return to its original height after compression or the resilience of the clot was shown to be generally better for YGC compared to YSC, with both varieties having values close to 0, values that thus show that the analysed samples does not recover its original height.

The adhesiveness of the clot for YGC was -0.19 mJ and -0.16 mJ for the YSC (P < 0.05). For the adhesive force, mean value in case of YGC was -0.29 N and -0.24 N for YSC (P < 0.05). Regarding the clot breaking force, the average values being 1.52 N for the YGC and 1,48 N for the YSC (P < 0.05).

3.2.2. Physiochemical results

The physiochemical properties, pH, the percentage of titratable acidity and the percentages of syneresis of yogurt samples are summarised in Table 5. The average values obtained for the two types of yogurt did not differ enough to exceed any statistically significant threshold (P>0.05).

Table 5. Results regarding the physico-chemical assessments of yogurt**.**

Physical-chemical trait	System of exploatation	Moment of analysis			Overall
		May	**July**	**September**	
pH	YGC	4.42±0.05^{xA}	4.45±0.05^{xA}	4.40±0.05^{xAB}	4.43±0.05^{x}
	YCS	4.41±0.02^{xB}	4.45±0.02^{xA}	4.43±0.02^{xBA}	4.43±0.03^{x}
Acidity (%)	YGC	0.92±0.02^{xB}	0.93±0.02^{xA}	0.90±0.02^{yC}	0.91±0.02^{x}
	YCS	0.89±0.02^{yC}	0.93±0.02^{xA}	0.91±0.02^{xB}	0.91±0.03^{x}
Syneresis (%)	YGC	3.23±0.01^{yB}	3.28±0.01^{xA}	3.21±0.01^{yB}	3.24±0.03^{y}
	YCS	3.26±0.04^{xB}	3.30±0.04^{xA}	3.28±0.04^{xBA}	3.28±0.04^{x}
Total solids (TS) (%)	YGC	14.74±0.21^{xA}	14.79±0.21^{xA}	14.83±0.21^{xA}	14.79±0.20^{x}
	YCS	14.48±0.09^{yA}	14.52±0.09^{yA}	14.50±0.09^{yA}	14.50±0.09^{y}
Fat (%)	YGC	3.60±0.07^{xB}	3.65±0.07^{xB}	3.69±0.07^{xAB}	3.64±0.08^{x}
	YCS	3.58±0.04^{xA}	3.62±0.04^{xA}	3.60±0.04^{yA}	3.60±0.05^{y}
Protein (%)	YGC	3.36±0.05^{xA}	3.40±0.05^{xA}	3.38±0.05^{xA}	3.38±0.06^{x}
	YCS	3.38±0.06^{xA}	3.38±0.06^{xA}	3.38±0.06^{xA}	3.36±0.06^{x}
Ash (%)	YGC	0.80±0.04^{xB}	0.85±0.04^{xA}	0.83±0.04^{xA}	0.82±0.04^{y}

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YCS	0.82±0.03^{xB}	0.86±0.03^{xA}	0.84±0.03^{xBA}	0.84±0.03^{x}

$^{x\ \&\ y}$: There is no significant difference (P > 0.05) between any two means, within the same column that has the same superscript letter; $^{A,\ B\ \&\ C}$: There is no significant difference (P > 0.05) between any two means, within the same row that has the same superscript letter.

Regarding the syneresis process in the case of YGC, differences are also observed in the control months, the highest value being obtained in July (3.28%) compared to 3.23% obtained in May or 3.21% obtained in September (P < 0.05). The same effect was noticed in the case of YCS. The final comparison of means revealed an average value for YGC of 3.24% and of 3.28% for YCS, values indicating significant differences (P < 0.05).

Significant differences were also reported in the case of TS where for YGC the average was 14.79% and for YCS an average value of 14.50% was obtained (P < 0.05). Regarding the fat content, the data analysis revealed fluctuations in the case of YGC, the averages being 3.60% in May, 3.65% in July and 3.69% in September. The overall fat content in cases of YGC was 3.64% and for YCS was 3.60% (P < 0.05).The protein level, both for YGC and YCS, remained constant during the entire period of determinations, the final average values being 3.36% and 3.38% respectively (P > 0.05). In the case of ash content, the average value recorded at YGC was 0.82% and at YCS 0.84% (P < 0.05).Data on the characterization of the fatty acid profile of yogurts obtained from the two types of milk revealed several differences (Table 6)

Table 6. The main fatty acids in yogurt (g/100 g Fatty Acids Methyl Esters).

Physical-chemical trait	Type of nutrition	Moment of analysis			Overall
		May	**July**	**September**	
Butyric acid - C4:0	YGC	2.90±0.22^{xA}	2.95±0.22^{xA}	2.99±0.22^{xA}	2.95±0.22^{x}
	YCS	2.57±0.28^{yA}	2.61±0.28^{yA}	2.59±0.28^{yA}	2.59±0.27^{y}
Caprionic acid - C6:0	YGC	2.09±0.26^{xA}	2.14±0.26^{xA}	2.18±0.26^{xA}	2.14±0.25^{x}
	YCS	2.05±0.09^{xA}	2.09±0.09^{xA}	2.07±0.09^{xA}	2.07±0.09^{x}
Caprylic acid - C8:0	YGC	1.32±0.20^{xA}	1.37±0.20^{xA}	1.41±0.20^{xA}	1.36±0.20^{x}
	YCS	1.34±0.08^{xA}	1.38±0.08^{xA}	1.36±0.08^{xA}	1.36±0.07^{x}
Capric acid - C10:0	YGC	3.12±0.22^{yA}	3.17±0.22^{yA}	3.21±0.22^{yA}	3.16±0.22^{y}
	YCS	3.86±0.11^{xA}	3.90±0.11^{xA}	3.88±0.11^{xA}	3.88±0.11^{x}
Lauric acid - C12:0	YGC	3.45±0.21^{yA}	3.50±0.21^{yA}	3.54±0.21^{yA}	3.50±0.20^{y}
	YCS	3.86±0.11^{xA}	3.90±0.11^{xA}	3.88±0.11^{xA}	3.88±0.11^{x}
Myristic acid - C14:0	YGC	11.50±0.21^{yA}	11.55±0.21^{yA}	11.59±0.21^{yA}	11.55±0.20^{y}
	YCS	12.59±0.10^{xA}	12.63±0.10^{xA}	12.61±0.10^{xA}	12.61±0.10^{x}
Myristoleic acid - C14:1	YGC	0.92±0.21^{xA}	0.97±0.21^{xA}	1.01±0.21^{xA}	0.97±0.20^{x}
	YCS	0.93±0.08^{xA}	0.97±0.08^{xA}	0.95±0.08^{xA}	0.95±0.08^{x}
Pentadecylic acid - C15:0	YGC	1.22±0.21^{yA}	1.27±0.21^{yA}	1.31±0.21^{yA}	1.27±0.20^{y}
	YCS	1.43±0.07^{xA}	1.47±0.07^{xA}	1.45±0.07^{xA}	1.45±0.07^{x}
Palmitic acid - C16:0	YGC	27.85±0.75^{yA}	27.90±0.75^{yA}	27.94±0.75^{yA}	27.89±0.72^{y}
	YCS	35.96±0.44^{xA}	36.00±0.44^{xA}	35.98±0.44^{xA}	35.98±0.42^{x}
Palmitoleic acid - C16:1	YGC	0.71±0.21^{yA}	0.76±0.21^{yA}	0.80±0.21^{yA}	0.76±0.20^{y}
	YCS	1.13±0.08^{xA}	1.17±0.08^{xA}	1.15±0.08^{xA}	1.15±0.08^{x}
Margaric acid - C17:0	YGC	0.50±0.20^{xA}	0.55±0.20^{xA}	0.59±0.20^{xA}	0.54±0.20^{y}
	YCS	0.61±0.07^{xA}	0.65±0.07^{xA}	0.63±0.07^{xA}	0.63±0.07^{x}
Stearic acid - C18:0	YGC	11.73±0.31^{xA}	11.78±0.31^{xA}	11.82±0.31^{xA}	11.77±0.30^{x}

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	YCS	8.91±0.68^{yA}	8.95±0.68^{yA}	8.93±0.68^{yA}	8.93±0.66^{y}
Vaccenic acid - C18:1 trans-11	YGC	2.90±0.28^{xA}	2.95±0.28^{xA}	2.99±0.28^{xA}	2.95±0.27^{x}
	YCS	1.07±0.08^{yA}	1.11±0.08^{yA}	1.09±0.08^{yA}	1.09±0.08^{y}
C18:2	YGC	1.73±0.22^{xA}	1.78±0.22^{xA}	1.82±0.22^{xA}	1.78±0.22^{x}
	YCS	1.60±0.08^{xA}	1.64±0.08^{xA}	1.62±0.08^{yA}	1.62±0.08^{y}
C18:3	YGC	1.00±0.21^{xA}	1.05±0.21^{xA}	1.09±0.21^{xA}	1.04±0.21^{x}
	YCS	0.57±0.09^{yA}	0.61±0.09^{yA}	0.59±0.09^{yA}	0.59±0.09^{y}
Arachidic acid C20:0	YGC	0.43±0.20^{xA}	0.48±0.20^{xA}	0.52±0.20^{xA}	0.48±0.20^{x}
	YCS	0.44±0.06^{xA}	0.48±0.06^{xA}	0.46±0.06^{xA}	0.46±0.06^{x}
Rumeric acid - CLA	YGC	1.51±0.22^{xA}	1.56±0.22^{xA}	1.60±0.22^{xA}	1.56±0.22^{x}
	YCS	1.27±0.08^{yA}	1.31±0.08^{yA}	1.29±0.08^{yA}	1.29±0.08^{y}
Monounsaturated fatty acid - MUFA	YGC	4.53±0.62^{xA}	4.68±0.62^{xA}	4.80±0.62^{xA}	4.67±0.61^{x}
	YCS	3.14±0.17^{yA}	3.26±0.17^{yA}	3.20±0.17^{yA}	3.20±0.17^{y}
Polyunsaturated fatty acid - PUFA	YGC	4.24±0.61^{xA}	4.39±0.61^{xA}	4.51±0.61^{xA}	4.38±0.60^{x}
	YCS	3.44±0.23^{yA}	3.56±0.23^{yA}	3.50±0.23^{yA}	3.50±0.23^{y}
Saturated fatty acid - SFA	YGC	66.10±2.30^{yA}	66.65±2.30^{yA}	67.09±2.30^{yA}	66.61±2.26^{y}
	YCS	73.64±1.15^{xA}	74.08±1.15^{xA}	73.86±1.15^{xA}	73.86±1.13^{x}
Unsaturated fatty acids - UFA	YGC	8.78±1.21^{xA}	9.08±1.21^{xA}	9.32±1.21^{xA}	9.06±1.19^{x}
	YCS	6.58±0.38^{yA}	6.82±0.38^{yA}	6.70±0.38^{yA}	6.70±0.38^{y}
DFA	YGC	20.50±1.43^{xA}	20.85±1.43^{xA}	21.13±1.43^{xA}	20.83±1.40^{x}
	YCS	15.49±0.96^{yA}	15.77±0.96^{yA}	15.63±0.96^{yA}	15.63±0.93^{y}
OFA	YGC	42.80±0.88^{yA}	42.95±0.88^{yA}	43.07±0.88^{yA}	42.94±0.85^{y}
	YCS	52.41±0.45^{xA}	52.53±0.45^{xA}	52.47±0.45^{xA}	52.47±0.43^{x}
DFA/OFA	YGC	0.48±0.03^{xA}	0.49±0.03^{xA}	0.49±0.03^{xA}	0.48±0.03^{x}
	YCS	0.30±0.02^{yA}	0.30±0.02^{yA}	0.30±0.02^{yA}	0.30±0.02^{y}

DFA = desirable hypocholesterolemic fatty acids, OFA = hypercholesterolemic fatty acid, DFA/OFA = desirable hypocholesterolemic fatty acids/ hypercholesterolemic fatty acid.

$^{x \& y}$: There is no significant difference (P > 0.05) between any two means, within the same column that has the same superscript letter; $^{A, B \& C}$: There is no significant difference (P > 0.05) between any two means, within the same row that has the same superscript letter.

4. Discussion

4.1. Raw Material Milk Quality

The results of this study were interested in investigating variations in milk content in relation to feeding procedures and seasonality (May through October). Special attention was paid to chemical makeup and fatty acid profile. We also wanted to understand if changes in raw milk quality and cow care procedures affected the physical, chemical, textural, and nutritional aspects of the processed product (yogurt).

The feeding system and its relationship with seasonal fluctuation had an impact on the fat concentrations. All seasons have a similar chemical make-up for the MCS system. On the other hand, between spring and autumn, MGC showed significant seasonal fluctuations in chemical composition. In contrast to the spring and summer, autumn showed higher fat percentages; no discernible differences in protein percentages were found between the seasons.

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It is possible that the consumption of unsaturated fatty acids, which are normally found in forage, is what caused the MGC spring milk to have the lowest level of lipids that was measured. Some studies found that a high concentration of these fatty acids in the rumen can inhibit some microbial species in the rumen, with the production of CLA isomers produced in the rumen inhibiting fatty acid synthesis, thereby inducing a low concentration of fat in milk. These findings were found in some of the studies [47,48].

However, the majority of these studies only make straightforward comparisons between pasture-based systems and zero-grazing systems. This is due to the fact that diet plays a significant role in determining the FA composition of bovine milk, which has resulted in a greater number of studies being reported in comparison to other factors [49, 50]. According to the results of our research, pasture-based rations (MGC) had higher concentrations of PUFA than MCS. Ellis et al. [51] discovered that the MCS group had a greater SFA than the MGC.

It was to be expected that milk concentrations of C14:0 and C16:0 would be higher in MCS, behaving differently than C18:0. Similar findings were made in earlier research, which found that when compared to alfalfa silage, grass silage, and fresh pasture, corn silage increased proportions of C14:0 and C16:0 while decreasing C18:0 (and also C18:1) [52–54].

Furthermore, a different study found that replacing corn silage with more fresh pasture (mostly ryegrass) boosted the concentration of unsaturated fatty acids (UFA) at the expense of saturated fatty acids (SFA) [55]. Several authors have discovered bigger differences between cows consuming grazed grass compared to diets high in preserved forages, revealing that milk from grazing cattle had higher proportions of UFA, C18:0 and C18:1 acids and lower amounts of SFA, C16:0 and C14:0 acids [56-59].

Considering the season, our findings revealed that C14:0, C16:0, and SFA were higher in the summer, C18:0, C18:1, and MUFA and PUFA were primarily higher in the spring. It is significant to note that seasonal fluctuation in milk composition is notably connected to dietary elements related to variations in pasture availability and quality throughout the year. Results from earlier studies on this subject were inconsistent. According to Auldist et al., [60] winter and spring were the seasons with the highest concentrations of MUFA, SCFA and PUFA, respectively.

When compared to winter milk, Collomb et al. [61] and Frelich et al. [62] showed that summer milk had larger contents of MUFA and PUFA, notably C18:1, and lower concentrations of SFA. The proportion of roughage to concentrates has an impact on these results.

4.2. Yogurts quality

4.2.1. Texture analysis

The structural makeup and protein network microstructure of fermented dairy products determine their rheological and textural characteristics [63]. The most crucial factor in defining yogurt texture is hardness or firmness. It is regarded as the amount of force necessary to cause a specific deformation and is used to determine how hard the yogurt is.

The amount of protein in raw milk directly affected how hard the yogurt samples we looked at were. The samples' YGC hardness levels were therefore greater than YCS. Our findings agreed with those found by Wen et al. [64] and Sah et al. [65]. There are studies that have indicated that hardness can be influenced by other factors such as the level of starter cultures used or the incubation temperature. Therefore, the culture level used in production can also affect hardness in the technological process of creating yogurt. According to Mudgil et al. [66], the hardness of the yoghurt increases with culture level, which demonstrated the highest amount of hardness in samples at about 2-2.5%.

Cohesiveness measures how well a food can withstand deformation without breaking and the strength of the internal links that make up its body. In comparison to values found in YCS, the YGC cohesiveness was higher. The ratio of the positive force area during the second penetration to that during the first penetration is the definition of cohesiveness. It can be calculated as the rate of material disintegration caused by mechanical force. Cohesiveness is expressed in tensile strength. Cohesiveness is a measure of how well a thing holds together.

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The YGC and YCS samples' gumminess values revealed a generally higher value for MGC-produced products. Gumminess is the result of cohesion and hardness. High gumminess yogurt also has a high hardness value. Foods that are semisolid and have a high degree of cohesion but little hardness are said to be "gumily".

Resilience is another texture characteristic of yogurt sample data identified by TPA. It has to do with the product's capacity to return to its initial position following application of deformation. For this parameter, the average value obtained at YGC was significantly lower than it was at YCS.

As a result, the technological processes used to produce the yogurt are regarded as being a deciding factor by the TPA results. However, given that the technological processes used to produce the yogurt we produced were the same, we can conclude that the differences between YGC and YCS were provided by the raw milk composition. Yildiz et al., [67], Chandra and Shamasundar [68] provide evidence to support the idea that the chemical makeup of milk may have an impact on the textural profiles of yogurt samples.

4.2.2. Physicochemical analysis

The titratable acidity is expressed as percentage of lactic acid present in the yogurt samples. The data analysis did not show any differences between the two types of milk used to make yogurt in terms of pH or acidity, respectively. The values found in the YGC and YCS results are consistent with findings from earlier studies [69].

Protein serves as a catalyst for bacterial growth during fermentation, while lactose serves as the carbon source that will be converted into lactic acid and lower pH

Due to their essential role in the coagulation, ripening, and shelf life of curd, pH regulation and acidity are unquestionably crucial factors in the manufacturing of yogurt. LAB's fermentation of lactose to lactic acid lowers the pH of yogurt, which diminishes the electrostatic attraction between casein micelles and changes the distribution of calcium between the micelle and serum phases [70]. As a result, several milk combinations are required in industry to provide effective acidity and pH. Additionally, these mixes will help avoid yogurt syneresis [71].

Low solid content, high incubation temperatures, insufficient storage temperatures, high acidity, etc. are the main causes of syneresis [72]. According to to Rani et al. [73], the stabiliser in the yogurt samples binds free water molecules and traps them in the casein network, according. This activity will make the sample more viscous, which will lead to a reduction in syneresis. Intense syneresis in yogurt is a bad quality trait, that might cause consumers to reject it. However, the physical and sensory properties of yogurt gels are greatly influenced by the total solids content of the yogurt milk, especially the protein content.

According to the TS content data, a higher value was obtained in the case of YGC compared to YSC. Aly et al., [74] and Haj et al., [75] reported values that were comparable to those we found.

The animals' feeding regimen also had an impact on the fat content of the milk and, in turn, that of the yogurt. As a result, YGC's fat content was higher than YCS's in both cases. These values were in accordance with the literature data [76].

One of the most significant parts of milk is the fat. From a practical standpoint, fat influences customer preference for dairy products, especially when it constitutes a significant portion of the dairy product.

Because milk fat contains a wide range of fatty acids (FA) with various chain lengths, the majority of which are saturated fatty acids (SFA), and only a small amount of mono unsaturated fatty acids (MUFA) and poly unsaturated fatty acids (PUFA) (2%–5%) [77, 78], the composition of milk fat is incredibly complex. In the current study, it was shown that diet affects milk's FA content, which has been highlighted in cases where milk-based products are involved.

Regarding OFA, a higher content was noted in the fat from YSC (la toate perioadele analizate) compared to YGC. The ratio between DFA/OFA, a very important parameter for consumers, revealed significant differences between the two types of yogurt. Lactic cultures had a beneficial effect in increasing, through fermentative processes, the proportion of DFA in comparison with that measured in raw milk and subsequently, in improving the DFA/OFA ratio, due to the increase of

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hypocholesterolemiant fatty acids proportion. It is interesting to notice that the beneficial effect reflected on the DFA/OFA ratio had more amplitude in the milk with lower fatty acid profile quality (milk yielded by cows in stabulation). This aspect is encouraging and the subsequent metabolic phenomena of fermentation and of microorganisms for certain lipidic profile of raw milk worth to be investigating, to find out ways in rendering higher nutritional quality and more sanogenic products even from milk yielded by animals that could not benefit of rearing on pasture.

Also, it is known that sensory and textural attributes of dairy products derived from milk produced by cows fed on pasture are better than those issued from milk produced by cows under total optimised feeding conditions [79]. Moreover, a direction of research to follow can be the investigation of antioxidant properties of certain molecules on milk and dairy products stability and sanogenic effects on consumers, supposing that carotenes and tocopherols should be found in higher proportions in milk produced by cows fed mostly on pasture. Also, the effect of cows feeding system on the volatile and aroma generating compounds in milk and yogurt should be investigated, knowing that other studies reported higher concentrations of such compounds [80]. Apart from milk origin, the type of probiotic starter culture has its own effect on yogurt sensory properties, especially on developing flavour compounds (aldehydes, ketones, carboxylic acids) and a mixed research model (dairy cows feeding × yogurt starter culture) must be investigated to find-out an optimal solution to bring to market some products more appealing and yet healthier, to consumers.

5. Conclusions

The findings of this study showed that the time between milk collection and feeding had an impact on the components of cow milk, particularly fat and implicit FA. The study's findings also enable us to draw the generalization that the MGC beat the MSC in terms of both traditional and holistic criteria. There were statistically significant variations in DFA, OFA, and the DFA/OFA. If these discoveries have an impact on human health, more investigation is needed. Because of the fermentation processes caused by the injected lactic cultures, the fatty acid profile in yogurt was improved over the initial profile in raw milk.

Textural, physical, and chemical analyses of YGC samples were superior to those of YSC samples, demonstrating how grazing by cows affects the quality of raw milk and ultimately processed yogurt.

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