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Influence of Somatic Cell Removal on Milk Quality and Yield

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Abstract: This investigation aimed to assess how the somatic cell count (SCC) impacts milk production and the physicochemical quality of milk, including the effects of centrifugation and microfiltration on SCCs and the yield of fresh cheese. Milk production was analysed at different somatic cell counts (SCCs) to observe how centrifugation and microfiltration affected the removal of SCs from the milk and the yield of fresh cheese. Tukey's test was employed at a 5% significance level to compare the chemical composition of the milk, milk production, and fresh cheese yield when using microfiltered and/or centrifuged milk. Milk with an SCC of ≤200,000 somatic cells (SCs) per mL exhibited higher yields. Although centrifugation and microfiltration influenced milk fat content, total dry extract and SCC, they did not impact fresh cheese yield. It is important to note that these processes reduced the fat content and SCC, making skim milk a potential option for future research studies.

Keywords: centrifugation; fresh; microfiltration; refrigerated

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1. Introduction

The increase in somatic cell count (SCC) in milk can significantly impact various dairy products, such as cheese yield, the level of lipolysis in yoghurt, the level of proteolysis in pasteurised milk, and even the hydrolysis of casein through proteases [1]. This condition is also associated with potential flavour and odour issues [2].

In this context, it is crucial to adopt advanced techniques in the dairy processing industry to remove spores of microorganisms and undesirable cells without compromising the characteristics of the final product. Techniques such as centrifugation and microfiltration come into play, where centrifugation allows for the recovery of milk solids and, notably, the removal of undesirable microorganisms, especially those that may be pathogenic [3].

On the other hand, standalone microfiltration has the capability of removing approximately 75.0% of the somatic cells present in skim milk. This removal occurs either by retaining them in the filtering membrane or by inactivating them due to the shear force applied during processing [4].

However, the combination of centrifugation and microfiltration proved to be even more effective. This combination resulted in remarkable reductions of 92.6% to 99.5% in milk SCCs [5]. While similar research has been conducted in the past, most of it has focused on cheddar or cottage cheeses. Few studies have explored the effects of these techniques on products such as mozzarella, fresh cheese, and cheese slices. Nonetheless, Santos et al. [6] demonstrated that an increase in milk SCCs directly impacts industrial yield, regardless of the type of cheese produced.

Thus, the main objective of this study was to assess how the SCC influences milk yield and how the application of centrifugation and microfiltration affects the physicochemical quality of milk, the SCC, and the yield in fresh cheese production. By understanding and optimising these processes, the dairy industry can enhance the quality and efficiency of its products while mitigating potential issues associated with elevated SCC levels in milk.

2. Materials and Methods

2.1. Search Location and Description

The project was approved by IF Goiano's Animal Ethics Committee (CEUA) by protocol no. 024/2015. Fresh milk samples from crossbred animals with different SCCs were collected to evaluate the effect of SCC on cheese yield. Chilled milk was collected for the evaluation of centrifugation and microfiltration as methods for reducing the SCC in milk, as well as its influence on the physicochemical quality of milk and the fresh cheese yield.

2.2. Physicochemical Analysis of Milk

To perform the physicochemical analysis, the milk was collected during morning milking using WESTFALIA mechanical milking equipment (fishbone model). After collection, the milk was sent to the Laboratory of Animal Products of IF Goiano, Campus Rio Verde, for analysis.

To evaluate milk yield with different SCCs, milk samples were collected in a way that represented the individual daily milk production of the animals (2/3 in the morning milking + 1/3 in the afternoon milking), with the support of an individual meter coupled to the teat assembly. At the bottom of the meter, a valve was set to the "shake" function for 30 s before the collection of samples, performing the correct homogenisation of the milk. After homogenisation, the valve was positioned in the "drain out" option, transferring the contents of the meter to the collection vials.

The milk was collected in the expansion tank located at the IF Goiano, Campus Rio Verde, Beef Cattle Laboratory to evaluate the centrifugation and microfiltration of the chilled milk. The collection was performed in a plastic drum with a 30 litre capacity. After collection, the milk was sent to the Animal Products Laboratory for analysis.

Milk samples were collected aseptically in approximately 40 mL plastic bottles containing Bronopol® preservative for chemical composition and SCC analyses. The milk samples were sent for infrared spectroscopy analysis of fat, protein, lactose, defatted dry extract (DDE), total dry extract (TDE), urea, and casein [7], and the SCC was analysed according to ISO-IDF [8].

2.3. Milk Yield

The cows used during the experiment were crossbred and weighed on average 550 kg. At the beginning of the experiment, fresh milk samples were collected from all lactating animals to evaluate their physicochemical quality. From the evaluation of the physicochemical quality, three animals were selected according to their SCC: one animal with an SCC less than 200,000 SCs per mL, one animal with an SCC between 201,000 and 400,000 SCs per mL and another with an SCC above 401,000 SCs per mL.

The experimental period lasted four weeks, and within each week, a sample of 2.25 L of milk was collected from each animal with an SCC less than 200,000 SCs per mL, between 201,000 and 400,000 SCs per mL and above 401,000 SCs per mL. Four milk samples were collected from each animal throughout the experimental period, and 9.0 L of milk was used for each treatment, amounting at the end of the study for four repetitions per treatment.

To evaluate the yield, the milk was heated to 50.0 °C, and the 9.0 L of milk from each treatment was divided into 50 mL portions in disposable cups, amounting to 180 repetitions for each treatment. Then, the milk was acidified to pH 5.7 with the addition of 2.5 mL of 10.0% (m/v) citric acid solution and 20.0 µL of calcium chloride. This pH value (5.7) was selected to simulate the production of cheese with lactic pre-maturation according to Vasconcelos et al. [9]. After the acidification of the milk, it was left rest for 10 min and then

the glass was inverted on a tiled surface to remove the whey, remaining inverted for one hour until the whey was completely drained. Table 1 shows the average values of chemical composition of milk with different somatic cell counts.

Table 1. Mean values and standard deviation of fat, protein, lactose, total dry extract (TDE), defatted dry extract (DDE), and casein levels of milk with different somatic cell counts.

Parameters	Somatic Cells/mL		
	≤200 Thousand	201 to 400 Thousand	≥401 Thousand
Fat (%)	3.84 ± 0.37	3.04 ± 0.85	2.45 ± 0.72
Protein (%)	3.07 ± 0.07	3.13 ± 0.18	3.13 ± 0.22
Lactose (%)	4.42 ± 0.04	4.29 ± 0.07	4.18 ± 0.19
TDE (%)	12.34 ± 0.31	11.45 ± 1.14	10.75 ± 0.74
DDE (%)	8.50 ± 0.09	8.41 ± 0.29	8.30 ± 0.18
Casein (%)	2.38 ± 0.08	2.34 ± 0.07	2.41 ± 0.18
SCC (×1000 SCs per mL)	47 ± 30.00	348 ± 54.00	585 ± 79.00

SCs = somatic cells.

2.4. Evaluation of Centrifugation for Different Periods

From the IF Goiano, Campus Rio Verde, Beef Cattle Laboratory, 17.5 L of chilled milk was collected. After collection, it was sent to the Animal Products Laboratory and stored under refrigeration at 4.0 °C for further analysis.

A centrifuge from ITR (Model 8BT) with eight test tube holders was used. The milk was distributed into 30.0 mL test tubes and centrifuged at a speed of 1100 rpm. The evaluated centrifugation periods were 5, 10, 15, and 20 min. At the end of the study, 80, 77, 79, and 77 samples of milk centrifuged for 5 min, 10 min, 15 min and 20 min, respectively, and 242 non-centrifuged milk samples (control) were evaluated.

After centrifugation, the test tubes were removed from the centrifuge and the milk was transferred to a vial containing Bronopol® preservative for analyses of chemical composition and SCC. However, during the transfer of milk to the bottles, around 5.0 mL was left at the bottom of each test tube to produce a pool of samples already centrifuged, since after centrifugation, it is believed that the SCs remain at the bottom of the test tube due to the difference in density, so the pool was collected for later comparison. At the end of the study, 20 pooled samples of the centrifuged milk were collected during different periods.

2.5. Evaluation of the Effect of Centrifugation on Fresh Cheese Yield

At the IF Goiano, Campus Rio Verde, Beef Cattle Laboratory, thirty-six litres of chilled milk was collected. After collection, it was sent to the Animal Products Laboratory. Of the 36.0 L of milk, 18.0 L was centrifuged at a speed of 1100 rpm in a Model 8BT centrifuge with eight test tube holders, and the other 18.0 L was not centrifuged. The samples were then stored in BOD at 4.0 °C.

The 18.0 L of centrifuged and non-centrifuged milk was divided into nine portions of 2.0 L each, from which nine pieces of fresh cheese were produced for each treatment.

Fresh cheese production followed the methodology described by Furtado [10], with some adaptations. The milk was pasteurised at 72.0 °C for 20 s and then cooled to 4.0 °C. After cooling, 0.8 mL of calcium chloride, 0.5 mL of lactic acid and 1.8 mL of rennet (enzymatic coagulation) were added. After 30 min, the curd was cut, and after waiting for 5 min, it was stirred for 30 min.

After stirring, the curd was shaped, left for 15 min and turned over. Turning was performed twice, and then the cheese was weighed for yield analysis. The gross yield of the cheese was determined by the following formula: $Y\ (\%) = CW/MW \times 100$, where Y = yield; CW = cheese weight; MW = weight of milk used to make cheese.

2.6. Microfiltration Assessment as a Somatic Cell Removal Method

At the IF Goiano, Campus Rio Verde, Beef Cattle Laboratory, 10 L of refrigerated milk was collected. After collection, the milk was sent to the Animal Products Laboratory. From the 10.0 L milk, 5.0 L was micro-filtrated. Microfiltration was performed with the aid of a FANEM vacuum pump (DIAPUMP® model) coupled to a 2.0 L capacity Buchner flask and the upper part of a kitassato. A Buchner funnel was used together with an 80.0 g filter membrane. The milk was deposited in the Buchner funnel, and then the pump was turned on and the microfiltered milk was stored inside the Buchner flask.

After microfiltration, 124 samples of microfiltered milk were fractionated into 40.0 mL vials containing Bronopol® for chemical composition and SCC analyses. The 5.0 L of milk that did not undergo the microfiltration process was divided into 126 conditioned packages in 40.0 mL bottles containing the Bronopol® preservative.

2.7. Evaluation of the Effect of Microfiltration on Fresh Cheese Yield

To evaluate the influence of SCC on fresh cheese yield, 36.0 L of refrigerated milk was collected at the Federal Institute of Goiás's Beef Cattle Laboratory. The 36.0 L of milk was divided into two portions, one of 18.0 L microfiltered milk and the other of 18.0 L unfiltered milk. For each treatment, nine fresh pieces of cheese were made. Fresh cheese production followed the methodology described by Furtado [10].

2.8. Statistical Analysis

The results of the chemical composition of milk, milk mass yield and gross yield of fresh cheese made from microfiltered milk and/or centrifuged milk were compared by Tukey's test at 5.0% probability using SISVAR® software, Version 5.6 [11].

3. Results and Discussion

Table 2 displays the average chemical composition and SCC values of refrigerated milk, both centrifuged and non-centrifuged, used in the production of fresh cheeses. It is noticeable that when centrifugation was performed, there was a reduction in the fat content of the refrigerated milk.

Table 2. Mean values and standard deviation of fat, protein, lactose, total dry extract (TDE), defatted dry extract (DDE), casein, and somatic cell count (SCC) content of centrifuged and non-centrifugated chilled milk.

Parameters	Chilled Milk	
	Not Centrifuged	**Centrifuged**
Fat (%)	3.3 ± 0.12	2.9 ± 0.2
Protein (%)	3.1 ± 0.01	3.2 ± 0.1
Lactose (%)	4.4 ± 0.02	4.32 ± 0.2
TDE (%)	11.8 ± 0.2	11.27 ± 0.4
DDE (%)	8.5 ± 0.1	8.36 ± 0.1
Casein (%)	2.30 ± 0.1	2.290 ± 0.2
SCC (×1000 SCs per mL)	221 ± 8.0	122 ± 7.0

The milk yield with an SCC of ≤200,000 SCs per mL was higher than the other treatments; however, milk with an SCC ≥ 401,000 SCs per mL showed a higher yield when compared to milk with an SCC between 201,000 and 400,000 SCs per mL (Table 3).

Table 3. Yield of fresh milk with different somatic cell counts.

CSs per mL	Yield (%)
≤200 thousand	25.37 ± 0.1 a
201 to 400 thousand	21.10 ± 0.2 c
≥401 thousand	23.81 ± 0.2 b

Different letters in the column differ from each other at the 5% level according to Tukey's test. SCs = somatic cells. CV = coefficient of variation.

The yield of milk with an SCC between 201,000 and 400,000 SCs per mL was lower due to the low casein content, since any reduction in milk casein content will lead to losses of up to 15.0% in cheese yield [12]. According to Silva et al. [13], the use of milk with an SCC above 250,000 SCs per mL for cheese production directly affects the yield by the action of the plasmin enzyme that hydrolyses milk caseins, causing them to be lost to whey.

Verdi and Barbano et al. [14] confirmed the results of the present study, when they found a 2.0% reduction in the yield of cheese made with high-SCC milk, as also described by Matioli et al. [15], who observed a lower yield in fresh cheeses made with high-SCC milk (500,000 SCs per mL). Unlike the results observed in this study, Mazal et al. [16] found no influence of the SCC on cheese yield.

Table 3 shows that the highest yield was observed in milk with an SCC of ≤200,000 SCs per mL, while Coldebella et al. [17] observed the effect of SCs on cheese yield when milk had an SCC of 17,000 SCs per mL, and Melilli et al. [18] observed a decrease in milk yield with an SCC of 11,000 SCs per mL.

Milk yield is influenced by the composition and incorporation of solid components of the raw material into the curd during the coagulation process, mainly protein and fat [19]. This fact explains the existence of other factors influencing the industrial yield of milk; among them, the difficulty of acidification of the mass, the loss of nutrients to the whey during the stirring, the stirring time, the pasteurisation temperature of the cheese and the cheese whey removal are factors that may have influenced the results of the present study.

Fat, TDE and SCCs varied at different centrifugation times (Table 4). With an increased centrifugation time, there was a reduction in fat, TDE and SCC. Variation in fat content as a function of centrifugation time may be related to the lower density of fat globules; the lack of homogenisation of the sample during collection may lead to variations in milk fat content.

Table 4. Mean values and standard errors of fat (%), protein (%), lactose (%), total dry extract (TDE) (%), defatted dry extract (DDE) (%), casein (%), and somatic cells count (SCC) (×1000 SCs per mL) of chilled milk centrifuged for 0, 5, 10, 15 and 20 min.

Parameters	Spin Time (Minutes)				
	0	5	10	15	20
Fat (%)	3.48 ± 0.2 a	3.00 ± 0.2 b	2.70 ± 0.3 c	2.40 ± 0.3 d	2.30 ± 0.4 d
Protein (%)	3.00 ± 0.1 a	3.20 ± 0.1 a	3.10 ± 0.1 a	3.10 ± 0.1 a	3.10 ± 0.1 a
Lactose (%)	4.30 ± 0.2 a	4.30 ± 0.1 a	4.36 ± 0.1 a	4.40 ± 0.1 a	4.39 ± 0.1 a
TDE (%)	11.80 ± 0.3 a	11.29 ± 0.3 b	11.10 ± 0.3 b	10.80 ± 0.3 c	10.67 ± 0.4 c
DDE (%)	8.30 ± 0.2 a	8.34 ± 0.1 a	8.40 ± 0.1 a	8.40 ± 0.1 a	8.40 ± 0.1 a
Casein (%)	2.30 ± 0.1 a	2.30 ± 0.1 a	2.34 ± 0.1 a	2.30 ± 0.1 a	2.30 ± 0.1 a
SCC	960 ± 25.4 a	649 ± 40.8 b	547 ± 33.1 b	544 ± 33.9 b	510 ± 33.6 b

Different letters in a row differ at 5% probability level according to Tukey's test.

During the milk centrifugation process, a phenomenon occurs where its components, each with distinct densities, separate distinctly. Denser substances, like fat molecules and proteins, tend to move to specific areas, while the less dense ones, like water, occupy their own space. This separation is crucial, as it allows for the assessment of the effectiveness of milk homogenisation. The way the homogenisation process is carried out will

directly impact the distribution of these components after centrifugation, as observed by Ransmark et al. [20].

On the other hand, centrifugation has its limitations, as our study revealed that the centrifugation time, whether for 15 or 20 min, does not significantly influence the reduction in milk fat content, as indicated in Table 4. This finding challenges previous expectations about the impact of time on this process, suggesting that other factors may be more influential in altering fat content than just the duration of centrifugation.

Variations in milk fat content are positively correlated with TDE values since the TDE is the sum of all milk solids, so any reduction in fat content will lead to a reduction in TDE values.

The centrifugal force imposed on milk reduced the SCC of chilled milk by 46.0%. With centrifugation, the reduction in somatic cells can vary from 34.6% to 75.6% during the centrifugal creaming process. Centrifugation, besides reducing milk SCs, helps to reduce the number of microorganisms, especially pathogenic ones [3]. The use of centrifugation accompanied by the microfiltration process resulted in a reduction of 92.6% to 99.5% in milk SCs, as reported by Santos et al. [5], showcasing superior results when compared to the present study.

Santos et al. [6] also observed that during milk centrifugation, there was a reduction in the SCC, thus corroborating the results of the present study. However, there was no variation in proteolysis and lipolysis rates in pasteurised and skimmed fluid milk, explaining that after removal in dairy products, there are variations in the yield of dairy products, mainly due to the enzymes released by dairy products before the milk undergoes the centrifugation process. This is another factor to consider when evaluating the industrial yield of cheese.

The reduction in SCC and, consequently, in the number of enzymes present in milk directly influences the solid content and consequently the yield of dairy products, thus prolonging their shelf life. However, the weighting of lipolysis and proteolysis rates should be considered to evaluate whether enzymes have been released before, during or after centrifugation, knowing that the centrifugation process does not eliminate enzymes present in milk.

There was no variation in the yield of fresh cheeses made from non-centrifuged chilled milk (Table 5). Chilled and centrifuged milk, despite having a lower SCC, did not show a higher yield. After the removal of SCs, there may be the action of enzymes, mainly proteases and lipases, which were released in milk before the centrifugation process. Centrifugation can reduce the SCs, but does not prevent the action of enzymes already present in the milk.

Table 5. Yield of fresh cheeses made from centrifuged chilled milk and non-centrifuged chilled milk.

Refrigerated Milk	Yield (%)
Non-centrifuged	22.10 ± 0.3 a
Centrifuged	22.71 ± 0.2 a

Different letters in the column differ at 5% probability level according to Tukey's test.

Marino et al. [21] described different results from the present study when they observed variations in the yield of dairy products made from milk with a high SCC due to the action of antimicrobial substances released by the SCs present in milk, which were not completely eliminated during the pasteurisation process.

This downward trend in the yield of cheese made from high-SCC milk was also observed by Andreatta et al. [22], who stated that the decrease in cheese yield was influenced by the action of the plasmin enzyme found together with the inactive precursor, plasminogen, increasing the rate of proteolysis in milk and thus reducing the industrial yield, confirming the results described by Leitner et al. [23] and differing from the results of this study.

The cheese made with non-centrifuged milk presented a lower yield despite the milk having a higher total solid content, as described in Table 2, mainly in relation to the casein

content, indicating that the milk suffered the action of the enzymes released by SCs in the milk. This fact was also observed by Cooney et al. [24], who found that milk with a high SCC presented a lower total solid contents when compared to milk with a low SCC, thus influencing the total solids, protein and cheese yield.

The increase in protein content of milk with a high SCC does not represent an increase in the yield of dairy products; this increase in protein content occurs through increased vascular permeability, and serum proteins migrate from the bloodstream to the interior of the mammary gland, causing a decrease in milk casein due to plasminogen activation in plasmin, thus causing casein hydrolysis.

The variation in protein content, especially milk casein, will directly affect the yield of dairy products, since casein is the main parameter used to estimate the yield of dairy products in the processing industry.

Chilled milk fat, TDE, and SCCs varied as a function of the microfiltration process (Table 6). The reduction in fat content and the 10.0% reduction in SCs of microfiltered milk may be related to their retention in the filter membrane during the microfiltration process, and the reduction in fat content directly affected the TDE values of microfiltered milk.

Table 6. Mean values and standard errors of the fat, protein, lactose, total dry extract (TDE), defatted dry extract (DDE), casein, and somatic cell count (SCC) contents of non-microfiltered chilled milk.

Parameters	Refrigerated	Refrigerated and Microfiltered
Fat (%)	3.55 ± 0.1 a	3.53 ± 0.1 b
Protein (%)	3.30 ± 0.1 a	3.30 ± 0.1 a
Lactose (%)	4.50 ± 0.1 a	4.50 ± 0.1 a
TDE (%)	12.37 ± 0.1 a	12.30 ± 0.2 b
DDE (%)	8.81 ± 0.1 a	8.80 ± 0.2 a
Casein (%)	2.50 ± 0.1 a	2.53 ± 0.1 a
SCC (×1000 SCs per mL)	160 ± 0.7 a	143 ± 0.7 b

Different letters in a row differ at a 5% probability level according to Tukey's test.

Jukkola et al. [25] conducted an analysis of bovine milk and observed that the use of the microfiltration technique played a significant role in reducing the average size of fat globules. This phenomenon was explained by the deflocculation process and the shear effect promoted during microfiltration. These findings point to a potential improvement in milk quality, emphasising the relevance of applying these techniques in the dairy industry. Furthermore, the authors infer that when carefully optimised, microfiltration offers a high separation efficiency with minimal damage to the fat globules.

Elwell and Barbano [4] observed a reduction of 75.0% in the SCs present in milk after the microfiltration process, mainly because they are retained in the filtration membrane or even eliminated by the shear force imposed on them. Corroborating the results of Li et al. [26], when Elwell and Barbano evaluated the recovery of somatic cells by microfiltration technologies, they found that there was a reduction in milk SCs and their viability from 38.9% to 7.6%.

Milk microfiltration reduced SCCs and fat contents, which was to be expected because of particle size, causing them to be trapped in the filtration membrane. Thus, the drop in SCC, milk fat and TDE may affect the quality of dairy products, especially in relation to the sensory characteristics, quality and firmness of the clot during cheese processing, leading to reduced profitability of the processing industries.

The fresh cheese yield was not affected by the milk microfiltration process (Table 7). Although microfiltration does not affect the yield of fresh cheese, Table 6 shows a reduction in SCC, which suggests that microfiltration alone cannot be considered a decisive factor in the assessment of fresh cheese yield, given that other factors must be taken into account, especially in relation to the cheese manufacturing process. Although there is no effect of the reduction in SCs of microfiltered milk on fresh cheese yield, derivatives made from low-SCC milk may have a longer shelf life.

Table 7. Yield of fresh cheeses made from chilled milk and microfiltered chilled milk.

Refrigerated Milk	Yield (%)
Refrigerated	22.5 ± 0.2 a
Microfiltered	22.3 ± 0.2 a

Different letters in the column differ at a 5% probability level according to Tukey's test.

Albuquerque and Macedo [27] stated that cheese yield, quality and composition can be influenced by the physicochemical and microbiological quality of the milk and the manufacturing process, including the choice of coagulant, as well as the steps during processing that determine the coagulation efficiency and therefore the manufacturing yield.

Another factor related to the industrial cheese yield can be explained by the proteolytic effect of SCs in cheese being masked by the presence of the coagulant, mainly the action of the enzyme chymosin. Studies indicate that the major enzymes from SCs, especially cathepsin B and D, have cleavage sites similar to those of chymosin [28].

Yield variation as a function of SCC was also studied by Erdem et al. [29], who found that an increase in SCC directly affected milk production and composition, providing a significant reduction in the yield of dairy products, thus differing from the results presented in Table 7.

The centrifugation and microfiltration processes affected the fat content and somatic cell count, so new studies may use skim milk as an alternative for the production of cheese, especially considering the performance of new yield analyses with a higher number of repetitions.

Considering that the use of microfiltration and centrifugation can help reduce related problems during cheese making, especially in the firmness and quality of the clot, the process of obtaining the raw material within the property should be the primary factor for maintaining the quality of milk and milk products.

A low SCC, better hygiene and cooling of milk at 4.0 °C after milking ensure the quality of milk for cheese production and thus the reduction in additional costs in the processing industries [30].

To evaluate the yield of fresh cheese through the use of centrifugation and microfiltration as milk removal techniques, further research should be conducted to validate the results of the present study, considering the use of a higher number of repetitions, especially in relation to microfiltered milk, due to the reduced removal of somatic cells.

4. Conclusions

The somatic cells in milk negatively impact the yield of fresh milk. However, the quality of the raw material used in cheese production, especially concerning casein content, must be considered. Centrifugation and microfiltration are methods that remove somatic cells from milk, yet they affect the milk solid content, reducing fat and total dry matter. These procedures can directly affect cheeses that do not require pasteurisation (without plasmin inactivation), leading to reduced protein sedimentation and reduced losses of casein in the whey.

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