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Sensorial characteristics and fatty acid mozzarella cheese from milk of crossbred cows fed with palm oil and coconut fat

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ABSTRACT. The aim was to improve nutritional quality of cows' milk and use it as raw material for mozzarella cheese. Three treatments were tested with 23 healthy animals ranging power: control, palm oil and coconut oil. Collection was performed in 21 days and another after 36 days. Proximate composition (moisture, ash, fat, protein, carbohydrates), sensory, color (CIE L*, a*, b*) and texture were made for mozzarella cheese. The fatty acids (FA) present in mozzarella cheese were determined by chromatography. Saturated fatty acids (SFA) were the most abundant in cheese. The results point that it is feasible to add various fat sources in animal feed for milk and milk products in dairy cows.

Keywords: dairy milk, fatty acids, sensory analysis.

Características sensoriais e ácidos graxos de queijo mussarela do leite de vacas mestiças alimentadas com óleo de palma e gordura de coco

RESUMO. O objetivo deste trabalho foi melhorar a qualidade nutricional do leite de vaca e usá-lo como material fresco para produção do queijo mozzarella. Três tratamentos foram usados com 23 vacas sadias variando as dietas: controle, gordura de palma e gordura de coco. A coleta de leite foi realizada aos 21 e 36 dias após a introdução das dietas. A composição química (umidade, cinzas, gordura, proteína e carboidratos), a análise sensorial, a cor (CIE L*, a*, b*) e textura foram realizadas no queijo mozzarella. A composição em ácidos graxos do queijo foi determinada por cromatografia. Os ácidos graxos saturados foram mais relevantes no queijo. Os resultados mostram que é possível adicionar várias fontes de gordura na alimentação animal para aumentar a produção de leite e produzir leite de boa qualidade.

Palavras chave: vaca leiteira, ácidos graxos, análise sensorial.

Introduction

Milk production systems in countries such as Argentina, Australia, New Zealand and many other countries in Europe are the basis to use pasture for lactating cows (SCHROEDER et al., 2004). The authors in this review identified eighteen experiments with supplemental fat to the diet of grazing dairy cows involving 25 comparisons and more than 480 multiparous cows. The type of fat usually used in animal feed is oilseeds (sunflower, cottonseed, soybeans and canola) (SCHROEDER et al., 2004). Coconut fat and palm oil were used in this study; such products have fatty acid (FA), a kind of fat that is essential for human body to function. They are not produced by the organism and that is why they must be present in food. Milk production is generally increased by adding fat into confined feeding systems (WU; HUBER, 1994). Food also changes milk composition, thereby this study intends to use this milk with different composition while preparing cheese.

Cheese is defined as a fresh or matured product obtained by draining the whey (the moisture or serum of the original milk) after casein coagulation. Casein is coagulated by acid produced by selected microorganisms, by coagulating enzymes, or by adding food-grade acidulates (PLANZER JR. et al., 2008). The great diversity in technological processes used in such manufacture results in different physical, chemical, and microbiological cheese qualities, Mozzarella is a type of cheese. Mozzarella is a semisoft/semi hard, plastic-curd cheese. Mozzarella was originally produced from buffalo milk, but it is now made from cow´s milk as well. It is a pasta filata cheese, which means that it goes through cooker-stretcher steps while being processed (KINDSTEDT et al., 1996). Mozzarella cheese is an essential ingredient of pizza (TANWEER; GOYAL, 2011).

The increase in consumption and production of cheese around the world is continually and directly proportional to food safety´s aspects related to this product (PLANZER JR. et al., 2008). Therefore, this study aims to conduct a diet supplementation with palm oil and coconut fat in 23 animals and obtain milk in two different periods (21 and 36 days); to produce Mozzarella cheese from the collected milk as well as carrying out physical-chemical and sensory analyses for the products.

Material and methods

Cow feeding and milk selection

The experiment was carried-out at the Marques Farm, located in Mirador city, Paraná State (Geographical location: Latitude: -23.2561, Longitude: -52.7745, 23° 15′ 22″ South, 52° 46′ 28″ West), in December (summer season). Three different diets were conducted according to the formulation application described in Table 1.

Table 1. Centesimal composition of experimental diets.

	Diets		
Ingredients	CON[a]	PAL[b]	COC[c]
Soybean meal	30.0	30.0	30.0
Corn	57.0	57.0	57.0
Salt mineral	3.00	3.00	3.00
Caulin	10.0	-	-
Palm oil	-	10.0	-
Coconut fat	-	-	10.0

[a]CON - Control diet; [b]PAL - Diet with palm oil; [c]COC - Diet with coconut fat.

The treatments were applied to 23 healthy crossbred animals (half Holstein x zebu) by the 60th day of their third lactation. They were milked once a day and randomly distributed in three groups in which three isoenergetic treatments were evaluated, CON (Control – 8 animals), PAL (Palm – 8 animals) and COC (coconut – 7 animals). In addition to the treatments offered to animals once a day they were also fed with pasture. The first collection was carried-out 21 days after the diet started and the second one 36 days after.

The collected milk was transported in brasses under refrigeration to the State University of Maringá, where the cheese samples were immediately processed.

Preparation of mozzarella cheese

Mozzarella cheese was manufactured separately for the three treatments. Such procedure was performed in the Milk Laboratory of Food Engineering Department, State University of Maringá all on the same day. The flowchart of cheese manufacturing can be seen in Figure 1 and the formulation in Table 2.

Table 2. Formulation of mozzarella cheese.

Ingredients	%
Milk	99.9
Ferment	0.06
Calcium chloride	0.05
Rennet	0.003

Mozzarella physical chemical analysis

The physical chemical analyses were carried out right after the production in the Food Engineering laboratory at State University of Maringa (UEM). The samples were homogenized and analyzed in triplicate. Milk moisture and ash contents were determined according to AOAC (1998). The crude protein content was obtained through the Kjeldahl method (AOAC, 1998). The total lipids were extracted using the Bligh and Dyer (1959) method with a chloroform/methanol mixture.

Mozzarella microbial analyses

The samples were microbiologically evaluated in duplicate and randomly separated (between two periods), at this stage were used for sensory analysis, that is, two samples from each treatment. The presence of thermo tolerant coliforms, coagulate-positive Staphylococcus and Salmonella was investigated according to Vanderzant and Splittstoesser (1992).

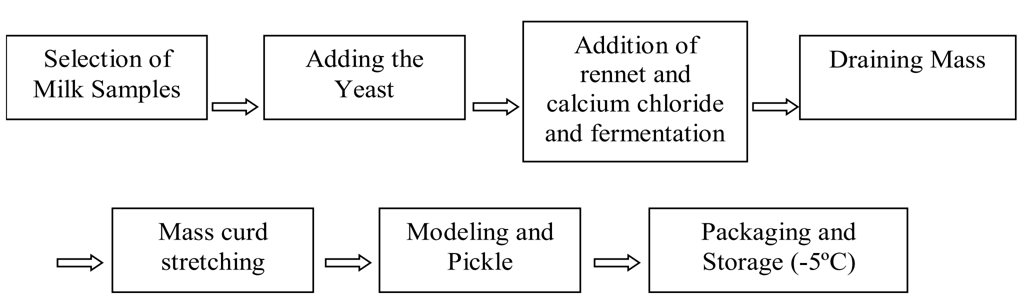

Figure 1. Flowchart of the production of mozzarella cheese.

Mozzarella colour evaluation

Colour was evaluated through a portable Minolta® CR10 colorimeter, with integrating sphere and viewing angle of 3º, that is, D3 lighting and illuminant D65. The system used was CIEL*a*b*, in which the measured coordinates were: L* = black (0) to white (100); a* = green (–) to red (+); b* = blue (–) to yellow. Other parameters obtained were color saturation rate (C*) and tone angle (H*). All determinations were made in duplicate.

Melting capacity

The melting capacity for Mozzarella cheese was determined by adapting the method of Schreiber's to processed cheese, described by Pizaia et al. (2003). With the help of a 36 mm diameter cylinder the sample was cut into slices of 7 mm thickness, the first one and last one were discarded. Each slice was placed in the center of a petri dish, covered and left at room temperature for 30 minutes. Plates were previously labeled with four lines arranged at angles of 45º. The diameter of each sample was calculated as the diameters average in four directions, measured before and after melting for 7 minutes in an oven at 107ºC. All analyzes were performed in triplicate. The average diameter was calculated from the percentage melting of cheese slices according to the equation:

$$\%\text{Melt} = \frac{A_f - A_i}{A_i} \times 100 \quad (1)$$

where:

A_f: slice area after melting (calculated using the average diameter).

A_i: slice area before melting (calculated using the average diameter).

Yield evaluation

The crude yield of cheese obtained in the treatments was determined by the formula:

$$R(\%) = (P_q / P_f) \times 100 \quad (2)$$

where:

R = crude yield,

P_q = finished cheese weight,

P_f = formulation weight (milk plus ingredients) according Yunes and Benedet (2000).

Texture analysis

This analysis was carried out in a Stable Micro Systems Texture Analyser TAXT Plus Texturometer (Texture Technologies Corp, England). The testing characteristics were: Accessory: Probe HDP/WBV; Mode: strength measured in compression; Pre-test speed: 2.0 mm s^{-1}; Test speed: 3.0 mm s^{-1}; post-test speed: 7.0 mm s^{-1}; Distance: 10 mm.

Sensorial analysis

For sensorial analysis two cheeses from each treatment with the best physical chemical and microbial results from milk were randomly selected at both production stages. The analysis was carried out at the Sensorial Analysis Laboratory in the State University of Maringa (UEM), with an approving position by the UEM Ethics Committee numbered 703/2011 e CAAE: 0415.0.093.000-11.

The acceptance test was applied using a nine-point hedonic scale, from 1-Highly disliked it to 9-highly liked it. The formulations were evaluated considering the attributes of color, smell, texture and taste using a team of nearly 50 randomly selected non-trained tasters both male and female. Samples of nearly 20 g were presented to the tasters in a balanced manner, in disposable white plastic containers codified with three-digit random numbers. The tasters received a glass of water to be consumed between samples.

Equation 3 was adopted to calculate the acceptability rate for the product.

$$IA\ (\%) = A \times 100/B \quad (3)$$

where:

A = average score for the product

B = highest score for the product

Chromatographic analyses

According to the method ISO-R-5509 (ISO, 1978) a triacylglycerols transesterification was carried out in order to obtain methyl esters from fatty acids. The fatty acids esters were separated in a Thermogas chromatograph, model trace ultra 3300, equipped with a flame-ionization detector and fused-silica capillary column CP – 7420 Select FAME, 100 m will be of 1.2 mL $min.^{-1}$, with 30 mL $min.^{-1}$ of N2 (make up); and 35 and 300 mL $min.^{-1}$, for H2 and synthetic air and for flame detection. The volume injected was nearly 2.0 μL, using a sample division of 1:80, with injector and detector temperatures of 220 and 230ºC, respectively, and the column of 65ºC during 4 minutes then increased to 185ºC at a rate of 4ºC $min.^{-1}$, kept for 0.75 minutes. The percentage was set by integrating peak areas through Chronquest Software version 5.0.

Statistical analysis

The data statistical analysis was carried out by using variance analysis (ANOVA) and average calculus by Bonferroni at 5% significance level through Statistics 7.0 software (SAS, 2004). The treatments for each parameter were compared in two different periods.

Results and discussion

Mozzarella composition and physical chemical parameters

The Mozzarella cheese samples centesimal composition from different treatments is presented in Table 3. There was no meaningful difference ($p > 0.05$) for all parameters analyzed. The average values of physico-chemical characteristics are within the average composition for mozzarella cheese according to Ferreira et al. (2006). Therefore, the sources of fat can be added into animal feed without changing mozzarella cheese standard quality.

Mozzarella microbial analysis

The results from mozzarella cheese microbial analysis are shown in Table 4. This results point that cheeses are produced in good microbiological conditions, i.e., around < 1.0 x 101 CFU g^{-1} for thermo tolerant coliforms, 1.0 x 102 CFU g^{-1} for coagulate-positive Staphylococcus and no Salmonella 25 g. Sanitation processes and milk pasteurization are fundamental to control pathogenic bacteria and also result in a significant reduction of natural bacterial populations involved in cheese production.

Mozzarella colour analysis

Table 5 relates the averages from values found for Luminosity (L^*), for chrome a^* chrome b^*, saturation rate (C^*) and tone angle (H^*) for cheese samples in both periods. For statistical analysis, it is noticeable that there was no significant difference between the three samples of cheese treatments for L^*, chroma a^* and H^* in both manufacture periods for such parameters. We realize that for all cheeses that to reflect more light is to present a more positive value for the white tone ($L^* \pm 61$), which may rank mozzarella cheese as a translucent food due to the ability to reflect most of the light.

MaCdougall (2002) attributes the processing time and exposure to light a tendency to browning or at least to the maturation degree of this sample, when relative to the other. The L^* values tend to increase as higher temperatures are used.

For Chroma a^* parameter all cheeses tended to negative green color. Regarding Chroma b^*, with meaningful difference between cheese samples for the three treatments in both manufacturing periods,

Table 3. Results from mozzarella cheese physical chemical analyses

Item	Period I			Period II		
	Diets			Diets		
	CON[a]	PAL[b]	COC[c]	CON[a]	PAL[b]	COC[c]
Moisture	46.0 ± 2.97	45.9 ± 2.95	43.8 ± 1.78	46.2 ± 2.96	45.1 ± 3.61	43.8 ± 2.21
Protein	21.4 ± 0.87	21.0 ± 0.80	21.0 ± 0.95	21.3 ± 1.12	21.0 ± 1.25	21.2 ± 0.99
Fat	24.1 ± 0.85	24.0 ± 1.53	23.8 ± 1.89	25.0 ± 1.41	24.4 ± 1.34	24.2 ± 1.80
Carbohydrate	3.87 ± 0.51	4.55 ± 0.65	5.01 ± 0.71	4.14 ± 0.95	4.64 ± 0.86	5.93 ± 0.89
Ash	4.66 ± 0.28	4.52 ± 0.33	4.47 ± 0.30	5.36 ± 1.24	4.93 ± 1.24	4.84 ± 1.07

[a]CON - Control diet; [b]PAL, - Diet with palm oil; [c]COC - Diet with coconut fat. Means and standard deviation from analyses in triplicate. Means followed by different letters in the same line are different into each period by Bonferroni test at a 5% probability.

Table 4. Mozzarella cheese microbial.

Mozzarella Cheese	*Thermotolerant* coliforms CFU g^{-1}	Cogulase-positive *Staphylococcus* CFU g^{-1}	*Salmonella* 25g
CON[a]	< 1.0 x 10^1	< 1.0 x 10^2	Out
PAL[b]	< 1.0 x 10^1	1.0 x 10^2	Out
COC[c]	< 1.0 x 10^1	1.0 x 10^2	Out
RDC nº 12 Anvisa	1 x 10^3	1 x 10^3	Out

[a]CON - Control diet; [b]PAL - Diet with palm oil; [c]COC - Diet with coconut fat.

Table 5. Results from mozzarella cheese colorimetric analysis.

Item	Period I			Period II		
	Diets			Diets		
	CON[a]	PAL[b]	COC[c]	CON[a]	PAL[b]	COC[c]
L^*	63.1 ± 5.14	61.9 ± 3.80	60.6 ± 2.86	61.9 ± 2.51	61.3 ± 4.04	62.4 ± 4.32
a^*	1.93 ± 0.52	2.58 ± 0.58	1.98 ± 0.80	2.20 ± 0.59	1.77 ± 0.44	1.69 ± 0.24
b^*	19.2^{a} ± 1.49	21.4^{ab} ± 2.60	22.8^{b} ± 1.68	23.5^{A} ± 1.45	24.7^{AB} ± 1.26	22.6^{AC} ± 1.72
C^*	20.0^{a} ± 1.36	21.6^{ab} ± 2.59	22.9^{b} ± 1.78	23.7 ± 1.38	24.4 ± 1.70	22.7 ± 1.38
H^*	94.0 ± 1.65	95.1 ± 8.87	94.5 ± 8.39	94.2 ± 3.12	91.5 ± 2.93	93.0 ± 2.61

[a]CON - Control diet; [b]PAL - Diet with palm oil; [c]COC - Diet with coconut fat. Means and standard deviation from analyses in triplicate. Means followed by different letters in the same line are different into each period by Bonferroni test at a 5% probability.

and for samples produced in 21 days there was difference between coconut and control treatment samples ($p < 0.05$) and samples produced in 36 days there was a significant difference between treatments and coconut palm ($p < 0.05$), tending to a positive staining yellow color.

While mozzarella cheese at curd stretching step cheese is subjected to a temperature around 85ºC, which is the breakdown of sugars (lactose) with heating and swelling by the action of water, which may have triggered the Maillard reaction where there is a tendency to brown and caramelize the product.

Matuska et al. (2006) reported that a process using high temperatures (> 50°C) results in color degradation in accordance with time. There is thus a positive and meaningful relationship between colors, types of heating, sugar content and darkening measurement, in the samples. For C^* parameter there was a meaningful difference between cheese samples for three treatments in 21 days occurring in coconut samples and control treatment ($p < 0.05$). For cheeses made in 36 days no meaningful difference between the three treatments samples was found. The rate of saturation (C^* points that in curd stretching process where there is impregnation of water greater saturation pigments tend to brown and to have the highest average. The variability values in the cheese hue (H^*) increase because of thermal treatment (curd stretching).

Melting capacity for mozzarella cheese

Assessing the percentage for melting capacity for mozzarella cheese (Table 6) it was found to be irrelevant ($p > 0.05$). The longer the mozzarella settling time, the better it will melt as there will be greater proteolysis. However, the higher the pH, the higher the mass calcium content, to be submitted firmer and less prone to melting.

Table 6. Analysis of the melting capacity of the mozzarella cheese

	Diets		
	CON[a]	PAL[b]	COC[c]
Hability to Melt (%)	18.7 ± 2.15	19.6 ± 2.02	18.5 ± 1.58

[a]CON - Control diet; [b]PAL, - Diet with palm oil; [c]COC - Diet with coconut fat. Means and standard deviation from analyses in triplicate. Means followed by different letters in the same line are different into each period by Bonferroni test at a 5% probability.

Yield and texture

Table 7 relates the mean values found for mozzarella cheese yield and texture manufactured in both periods. The mozzarella cheeses showed a yield mean of 9.52%. The cheese yield is mainly influenced by milk composition, cheese composition and cutting losses. Other factors such as milk pasteurization, curd and kind of psychrotrophic count, can also affect cheese yield. Simultaneous losses of dry extract components in stretching water with particular emphasis on fat and protein incorporation occurs in this water mass, with more or less retention of these components in cheese, consequently affecting the manufacturing performance (VALLE et al., 1996). Mozzarella cheese made within 21 days with milk from cows fed with coconut oil had higher firmness values (75.10 kgf) when compared to other cheeses, showing that there was a meaningful difference compared to the other treatments ($p > 0.05$).

For the second period (36 days) there was a significant difference between palm and coconut treatments, where coconut also presented the greatest firmness (64.55 kgf). Valle et al. (1996) analyzed the different fat contents in functional analysis and verified that with fat content firmness, elasticity and chewiness increase as fat content rises.

Mozzarella cheese sensory analysis

Table 8 presents the results for attributes evaluated in mozzarella cheese samples. It was observed that all treatments presented scores from moderately liked it to really liked it, indicating good acceptance from tasters (acceptance index ≥ 70%). Comparing instrumental texture and sensory results it is noted that coconut fat treatment presented the highest instrumental and sensory means.

Mozzarella chromatographic analysis

In Table 9 links fatty acids (FA), where the majority was of palmitic acid (16:0), stearic (18:0) and myristic (14:0). Palmitic acid is the predominant saturated fatty acid in all samples analyzed. As in previous reports (SECKIN et al., 2005) saturated fatty acids were the most abundant in cheese.

Table 7. Mozzarella cheese samples yield and texture.

Item	Period I			Period II		
	Diets			Diets		
	CON[a]	PAL[b]	COC[c]	CON[a]	PAL[b]	COC[c]
Yield, %	8.13 ± 1.86	8.05 ± 3.68	8.61 ± 1.66	10.2 ± 1.91	10.1 ± 1.66	8.80 ± 1.30
Texture, Kgf	42.9a ± 5.67	44.3a ± 12.9	75.1b ± 9.05	50.8a ± 7.14	39.3a,b ± 6.23	64.5a,c ± 15.4

[a]CON - Control diet; [b]PAL - Diet with palm oil; [c]COC - Diet with coconut fat. Results in percentage as average standard deviation of results from analyses in triplicate. Averages followed by different letters in the same line are meaningfully different by the Bonferroni test, at a 5% probability level.

Table 8. Results from mozzarella cheese sensorial analysis.

Sensorial Characteristics	CON[a]	PAL[b]	COC[c]
Smell	6.46 ± 1.36	6.38 ± 1.35	6.74 ± 1.32
Taste	5.96 ± 2.13	6.44 ± 1.90	6.48 ± 1.73
Color	6.62 ± 1.59	6.44 ± 1.67	6.84 ± 1.67
Texture	6.76a ± 1.89	5.74b ± 2.16	6.08a,b ± 1.84
Acceptance rate	70.0%	71.6%	72.0%

[a]CON - Control diet; [b]PAL - Diet with palm oil; [c]COC - Diet with coconut fat. Results in percentage as average standard deviation of results from analyses in triplicate. Averages followed by different letters in the same line are meaningfully different by the Bonferroni test, at a 5% probability level.

Table 9. Result from mozzarella cheese chromatographic analysis (% relative area).

Fatty Acid	Period I			Period II		
	Diets			Diets		
	CON[a]	PAL[b]	COC[c]	CON[a]	PAL[b]	COC[c]
12:0	3.16a ± 0.56	2.64a ± 0.46	5.94b ± 2.05	3.41A ± 0.82	2.62A ± 0.39	4.76B ± 0.90
14:0	11.9a ± 0.82	10.6a ± 0.87	17.2b ± 4.84	11.9A ± 1.04	10.9AB ± 0.63	13.2AC ± 1.27
16:0	36.2 ± 3.93	34.6 ± 2.15	33.7 ± 1.51	35.4± 4.21	35.4 ± 4.33	33.5 ± 2.95
18:0	12.2 ± 2.07	12.6 ± 2.28	15.1 ± 2.95	12.5± 1.25	12.7 ± 2.79	12.8 ± 2.45
18:1n-9t	0.21a ± 0.17	0.26a ± 0.01	0.44c ± 0.26	0.21 ± 0.16	0.18 ± 0.16	0.18 ± 0.20
18:1n-9c	2.91 ± 0.61	3.15 ± 1.78	2.91 ± 0.52	2.98 ± 0.71	3.28 ± 0.57	2.64 ± 0.32
18:1n-7	19.1a ± 2.76	22.6ab ± 2.77	24.1b ± 4.88	19.8 ± 2.76	21.2 ± 4.20	19.9 ± 2.41
18:3n-3	1.00 ± 0.20	1.02 ± 0.13	1.01 ± 0.27	1.02 ± 0.17	1.14 ± 0.18	0.85 ± 0.28
18:2 c9t11	0.20 ± 0.02	0.20 ± 0.03	0.23 ± 0.04	0.19 ± 0.02	0.19 ± 0.03	0.18 ± 0.02
Others	13.2 ± 0.15	12.6 ± 0.12	12.1 ± 0.13	12.9 ± 0.17	12.4 ± 0.14	12.0 ± 0.15
AGS	70.3 ± 3.41	66.9 ± 2.73	63.94 ± 7.56	69.5± 3.02	68.0± 4.31	70.4 ± 3.13
AGMI	27.6 ± 3.20	30.8 ± 2.36	33.8 ± 7.04	28.4 ± 2.89	29.7 ± 4.46	27.7 ± 2.90
AGPI	2.10 ± 0.23	2.31 ± 0.46	2.29 ± 0.56	2.08 ± 0.26	2.25 ± 0.24	1.89 ± 0.28
ω-6	0.89 ± 0.08	1.08 ± 0.50	1.05 ± 0.31	0.87 ± 0.13	0.91 ± 0.11	0.86 ± 0.10
ω-3	1.00 ± 0.20	1.03 ± 0.13	1.01 ± 0.27	1.02 ± 0.17	1.14 ± 0.18	0.85 ± 0.28
ω-9	5.84 ± 0.36	5.80 ± 0.80	6.34 ± 1.36	5.88 ± 0.45	6.04 ± 0.32	5.22 ± 0.47
ω-6/ω-3	0.92 ± 0.16	1.09 ± 0.56	1.06 ± 0.20	0.87 ± 0.13	0.81 ± 0.14	1.09 ± 0.37
AGS/AGPI	33.9 ± 5.44	29.8 ± 5.24	30.0 ± 10.7	33.9 ± 5.77	30.3 ± 2.41	38.1 ± 6.52

[a]CON - Control diet; [b]PAL - Diet with palm oil; [c]COC - Diet with coconut fat. Means and standard deviation from analyses in triplicate. [b]Results in percentage as average standard deviation of results from analyses in triplicate. Averages followed by different letters in the same line are meaningfully different by the Bonferroni test, at a 5% probability level. [d]Fatty acid: 4:0; 6:0; 8:0; 10:0; 14:1n-11; 14:1n-9; 14:1n-7; 15:0; 15:1n-9; 16:1n-11; 16:1n-9; 16:1n-7; i17:0; 17:0; 17:1n-9; 18:2n-6t; 18:2n-6c.

Saturated fatty acids remained almost the same for both periods. Recommended fatty acids intake such as omega-3 family essential to the body and also those bringing health benefits such as the CLAs (SIMIONATO et al., 2010). For rumenic acid, as it is called conjugated linoleic acid (CLA, 18:2 c9t11), found in both periods, yet there was no meaningful difference ($p < 0.05$) between samples. It is known that several factors affect the CLA amount in milk, such as season and physiological factors (SIMIONATO et al., 2010).

A meaningful difference ($p < 0.05$) was found for the following fatty acids: 12:00, 14:00, 14:1 n-11, 14:1 n-9, 14:1 n-7, 15:00, 15: 1n-9 16:1 n-7, i17: 00, 17:00, 18:1 n-9t and 18:1 n-7, the highest levels being in general in coconut fat application into the diet.

Lauric acid is present in greater quantity in coconut oil (43 - 51%), and this increase was observed in both treatment periods using coconut fat cheese. The same observation used for oleic acid (18:1 n-9c), present in larger amount in palm oil (36 - 47%), where there was an increase for both treatment periods using palm oil in cheese.

Conclusion

It was possible to produce mozzarella cheese with excellent sensory characteristics, presenting a great acceptability in attributes.

Quantification of fatty acids present in mozzarella cheese showed homogeneity, since the cheese manufacturing involves adding lactic ferments and precipitating agents as well as the use of temperature.

We thus conclude that it is possible to add different fat sources while feeding animals for milk and milk products of good quality.

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