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Milk properties of ewes fed with soybean seeds and the sensory evaluation of the produced Roquefort type cheese

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Abstract. The objectives of this research were to evaluate properties of milk from 1/2 Lacaune 1/2 Ile de France ewes fed diets, formulated according to their nutritional requirements, with (7 and 14%) and without soybean seeds, with further elaboration of Roquefort type cheese. Ewes were milked from the third to the 59th day postpartum, and milk samples were collected for quantitative and physico-chemical analysis and preparing Roquefort type cheese for subsequent sensory analysis. Milk production (443.61 mL/day), density (1.035 g/mL), acidity (19.33°D) and pH (6.41) were not affected by the inclusion of soybean seeds in feeding the ewes; in the days of evaluation, effects were observed in the pH of milk (6.35 at 42 and 56 days of lactation). The Roquefort type cheese had excellent acceptance by the panel (notes 7.6 for color, 7.5 for flavor, 8.4 for tenderness and 7.6 for overall acceptability). The milk from ewes fed the diet containing 7% of soybean seeds had the best yield for cheese production (18.03%). Adequate physico-chemical properties of milk and sensory in Roquefort type cheese were observed with inclusion of soybean seeds, which are a source of unsaturated fat that may be used for lactating ewes.

Keywords. Milk secretion – Physico-chemical parameters – Roquefort type cheese – Sensory analysis.

Propriétés du lait de brebis recevant graines de soja et la qualité sensorielle du fromage de type Roquefort

Résumé. Les objectifs de cette recherche étaient d'évaluer les propriétés physico-chimiques du lait de brebis ½ Lacaune ½ Ile de France recevant des régimes alimentaires formulés en fonction de leurs besoins nutritionnels, sans et avec (7 et 14%) graines de soja, avec l'élaboration postérieure du fromage de type Roquefort. Les brebis ont été traitées du troisième jour post-partum au 59^e jour, des échantillons de lait ont été collectés pour des évaluations quantitatives et physico-chimiques et élaboration du fromage de type Roquefort. La production de lait (443,61ml/jour), la densité (1,035g/ml), l'acidité (19,33°D) et le pH (6,41) n'ont pas été influencés par l'inclusion de graines de soja dans l'alimentation des brebis; au temps de l'évaluation, il a été constaté l'action de celles-ci sur le pH du lait (6,35 aux jours 42 et 56 de lactation). Le fromage de type Roquefort a obtenu une acceptation excellente des dégustateurs (notes de 7,6 pour la couleur; 7,5 pour le goût; 8,4 pour la douceur et 7,6 pour l'acceptation globale), ayant été le rendement fromager plus élevé provenant du lait des brebis qui ont reçu des régimes alimentaires avec 7% de graines de soja (18,03%). Certaines propriétés physico-chimiques du lait et sensorielles du fromage de type Roquefort ont été observées quand l'inclusion de graines de soja a été faite, donc celles-ci sont des sources de matières grasses insaturées qui pourront être utilisées pour les brebis en lactation.

Mots-clés. Sécrétion lactée – Paramètres physico-chimiques – Fromage de type Roquefort – Analyse sensorielle.

I – Introduction

The Brazilian dairy sheep industry is growing rapidly, although research in this area is still incipient. Even though lamb meat is currently the main focus. Also, there is a great interest in dairy sheep, an area that needs research and development of production processes, especially due to the high added value of its products. The high fat content (5.5 to 8.5%) of ewes milk gives a higher yield in cheese production compared to cow and goat milk, which positively reflects on the dairy industry and producer, who may charge a higher price for this milk (Ochoa-Cordero *et al.*, 2002).

The Lacaune breed, originated from France, is able to produce, in general, 150-200 kg milk/lactation, an average of 1.5 liters daily with 8% fat, which is used for producing the Roquefort cheese. On the other hand, Ile de France breed, also originally from France, is suitable for meat production. They are precocious, productive, easy to adapt to different climates and farming systems. The breeding of Lacaune and Ile de France sheep aims at producing a crossbreed that combines the desirable characteristics of both breeds.

Soybean seeds added to the animal diet increase its energetic density, influencing milk production by increasing absorption of fat-soluble compounds and forming essential fatty acids, with different composition. Urano *et al.* (2006) recommends including soybean seeds up to 14% of the dry matter, considering its cost relative to other ingredients.

II – Material and methods

1. Diets, milking and laboratory analysis

After lambing, the 24 crossbreed ewes (1/2 Lacaune 1/2 Ile de France) were divided into three groups and fed diet containing (0, 7 and 14%) soybean seeds (SS), formulated according to the animal requirements (NRC, 2006). The treatments were as follows: SS (0) – 40% sugarcane, 23.3% corn, 24.6% soybean meal, 9.9% citrus pulp and 2.2% mineral core with 13.93% crude protein and 2.67 Mcal/kg of gross energy; SS (7) – 40% sugarcane, 7% soybean seeds, 22.2% corn, 19.2% soybean meal, 9.4% citrus pulp and 2.2% of mineral core with 13.24% crude protein and 2.69 Mcal/kg of gross energy and SS (14) – 40% sugarcane, 14% soybean seeds, 21.0% corn, 14.0% soybean meal, 8.8% citrus pulp and 2.2% mineral core with 12.64% crude protein and 2.70 Mcal/kg of gross energy.

For the experiment milk was collected from the third day of postpartum until day 59, totaling 8 weeks of lactation. Milking was performed at 8 am daily, using a DeLaval milking machine at a rate of 120 beats/minute and 36 kPa vacuum level. The expressed milk was filtered, pasteurized (65°C for 30 minutes) packaged in plastic bottles and stored at -15°C in a freezer, for a maximum period of 30 days, for the production of Roquefort type cheese. The ewes were individually milked and the milk was cooled down to 15°C to quantify milk production.

Subsequently, milk volume was measured using a graduated cylinder; density, with a milk-gauge and 250 mL beaker; acidity by titration of 10 ml of milk using 0.1N alkaline solution with 2% phenolphthalein indicator, and expressed as degrees Dornic; and, pH with a TESTO 205 digital pH meter, coupled to an immersion electrode (Instituto Adolfo Lutz, 2008).

2. Experimental design and statistical analysis

The design was completely randomized with three treatments (0, 7 and 14% soybean seeds) and eight replicates. The treatments were compared by orthogonal contrasts, using the SAS (2003) software for the statistical analysis. For the sensory analysis of Roquefort cheese, the experimental design was completely randomized with 3 treatments (0, 7 and 14% soybean seeds) and 100 repetitions (tasters).

3. Processing of Roquefort type cheese

The frozen milk was thawed and used to manufacture the Roquefort type cheese according to the flowchart proposed by Scholz (1997). Cheese yield was calculated in liters of milk/kg of cheese, using the formula: $Y\% = (Mc/Mm) \times 100$, where $Y\%$ = percentage yield; Mc = cheese mass and Mm = milk mass. Cheese sensory analysis consisted of an acceptance testing performed by 100 tasters, who assessed the attributes of color, taste, texture and overall acceptance using the 9-point hedonic scale as follows: 1 – dislike extremely, 2 – dislike very much, 3 – dislike moderately, 4 – dislike slightly, 5 – neither like nor dislike, 6 - like slightly, 7 - like moderately, 8 – like very much and 9 – like extremely.

III – Results and discussion

1. Physico-chemical properties of the milk

Density (1.035 g/mL), acidity (19.33°D) and pH (6.41) were not affected by the treatments ($P > 0.05$). On the other hand, pH varied over time, milk became slightly acidic with advancing lactation (6.35 at 42 and 56 days) (Table 1). The data shown in Table 1 are lower than those reported by Brito *et al.* (2006). These authors evaluated the milk from Lacaune ewes for up to 60 days of lactation and found density of 1.037 g/mL; acidity 24.02°D; and pH 6.64.

Oilseeds are added to the diet fed to dairy sheep to increase energy density of the diet while aiming to increase milk production, as well. The response to supplementation in dairy animals can be affected by factors such as the fat source, the amount provided and lactation stage. The addition of moderate oil amounts can increase milk production due to feeding efficiency, while high amounts can reduce feeding consumption and, therefore, production due to depression of rumen function.

Breeding programs have been crossing dairy breeds, such as Lacaune, with meat breeds, such as the Ile de France, to produce crossbred females capable of higher milk production.

Table 1. Production and physico-chemical parameters of milk from crossbreed ewes (1/2 Lacaune 1/2 Ile de France), fed soybean seeds supplemented diet

Soybean seeds (SS)	Parameters			
	Milk production (mL/day)	Density (g/mL)	Acidity (°D)	pH
0%	509.29 ± 320.30	1.034 ± 0.003	18.09 ± 5.96	6.42 ± 0.24
7%	418.47 ± 189.60	1.036 ± 0.002	21.50 ± 3.53	6.29 ± 0.13
14%	400.47 ± 184.47	1.035 ± 0.003	18.41 ± 4.38	6.51 ± 0.27
<i>P value</i>	0.5913	0.1391	0.0916	0.1003
Evaluation days (D)				
14 days	496.52 ± 220.07	1.035 ± 0.003	18.74 ± 5.16	6.49 ^a ± 0.25
28 days	430.35 ± 193.66	1.035 ± 0.002	19.52 ± 5.22	6.43 ^{ab} ± 0.23
42 days	435.13 ± 268.55	1.035 ± 0.003	19.22 ± 4.76	6.36 ^b ± 0.21
56 days	397.39 ± 264.87	1.036 ± 0.002	20.07 ± 4.55	6.34 ^b ± 0.26
<i>P value</i>	0.1122	0.3131	0.6924	0.0030
F test for SS x D	0.81	0.49	0.79	0.48
P	0.5654	0.8123	0.5835	0.8203
CV (%)	29.98	0.20	21.27	2.13

^{a-b} Within the same factor, means followed by different letters in the column, differ by Tukey test; CV - coefficient of variation.

2. Roquefort type cheese

The Roquefort type cheese made with ewe's milk had excellent acceptance by the taster panel, given that scores ranged from 7.15 to 8.54 for the evaluated sensory attributes in a structured 9-point hedonic scale. The milk from ewe fed the diet containing 7% of soybean seeds had the best yield for cheese production (Table 2). Ribeiro *et al.* (2007) who produced Roquefort cheese matured for 90 days, using the milk of Santa Inês ewes, reported a cheese yield of 16.70%, a value close to those observed in this study (Table 2).

Table 2. Yield and sensory analysis of Roquefort type cheese made from milk of ewes fed soybean seeds supplemented diet

Variable	Soybean seeds (%)			P value	CV (%)
	0	7	14		
Yield (%)	14.15 ^b ± 3.00	18.03 ^{ab} ± 2.35	16.85 ^b ± 1.41	0.0130	14.06
Color	7.62 ± 1.19	7.77 ± 0.83	7.46 ± 0.88	0.7282	12.88
Flavor	7.46 ± 1.20	7.77 ± 0.93	7.15 ± 1.34	0.4155	15.67
Consistency	8.46 ± 0.52	8.54 ± 0.66	8.23 ± 0.60	0.4001	7.08
Global Acceptance	7.54 ± 1.39	7.85 ± 0.99	7.31 ± 1.18	0.5226	15.84

^{a, b} Means followed by different letters in the line differ by Tukey test. CV – coefficient of variation.

IV – Conclusions

The milk from ewes fed the diet containing 7% of soybean seeds had the best yield for cheese production (18.03%). Adequate physico-chemical properties of milk and sensory in Roquefort type cheese were observed with inclusion of soybean seeds, which are a source of unsaturated fat that may be used for lactating ewes.

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