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Fatty acids, vitamins and cholesterol content, and sensory properties of cheese made with milk from sheep fed rapeseed oilcake

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ABSTRACT

The aim of the present study was to evaluate the influence of rapeseed oilcake used for feeding sheep on the content of fatty acids (FA), tocopherols, retinoids, and cholesterol of milk and cheese, and on the sensory properties of cheese. Indoor animal feeding (in winter) is the highest cost of production for cheesemakers, and the inclusion of locally produced rapeseed oilcake in the concentrate feed formulation can reduce the cost of cheese production, as long as the quality of the cheese is not altered. The experiment was carried out in March (mid lactation) with 72 Latxa sheep from an experimental farm located in the Basque Country (northern Spain). Two homogeneous groups of animals ($n = 36$) were set to receive each a different diet based on commercial or rapeseed concentrate, respectively, and forage (*Festuca* hay). Animal production parameters were individually recorded for each feeding group, whereas bulk milk from each group was used for cheesemaking trials. The rapeseed concentrate had higher amounts of unsaturated FA (mainly C18:1 *cis* isomers, C18:2 *cis*-9, *cis*-12 and C18:3 *cis*-9, *cis*-12, *cis*-15) and tocopherols than the commercial concentrate. The inclusion of rapeseed oilcake in the diet of dairy sheep did not compromise animal production parameters or milk gross composition. Bulk milk and cheese from sheep fed rapeseed concentrate showed higher content of unsaturated FA and tocopherols than those from sheep fed commercial concentrate. No differences were observed in the content of retinoid in milk and cheese between feeding groups, whereas the cholesterol content was slightly lower in cheese made with milk from sheep fed rapeseed concentrate. Thus, milk and cheese from sheep fed rapeseed concentrate had a healthier lipid profile. In addition, the inclusion of rapeseed oilcake in the diet

of sheep did not change the typical sensory attributes of Protected Denomination of Origin Idiazabal cheese. Therefore, rapeseed concentrate could be a good local resource for feeding sheep to improve the nutritional quality of dairy products and to provide higher returns to farms.

Key words: rapeseed oilcake, sheep milk and cheese, fatty acid, vitamin

INTRODUCTION

Currently, the high cost of commercial feed prepared mainly from imported soy protein is one of the main problems for smallholder sheep livestock in northern Spain. The demand of the sector for local resources that can substitute soy protein is continuously increasing in order to improve the profitability of dairy farms. At the same time, animal feeding is one of the main factors that can modify the nutritional quality of milk, particularly its lipid profile linked to fatty acid (FA) composition and other minor compounds, such as tocopherols, retinoids, and cholesterol.

Linseed, soybeans, safflower, sunflower, and rapeseed are commonly used as lipid supplements to enhance the content of CLA and UFA in milk and cheese (Nudda et al., 2014). Although little is known about the effect of these lipid supplements on animal cholesterol metabolism, it has been reported that dietary supplementation of rapeseed oil significantly reduced the cholesterol content of cow milk (Altenhofer et al., 2014).

Few studies have focused on changes in the content of tocopherols, retinoids, and carotenoids in milk due to animal feeding, or on the transfer of these compounds from feeds to milk and cheese (Lucas et al., 2008; Vargas-Bello-Pérez et al., 2013). Previous studies found that α -tocopherol is the main isomer component of vitamin E in milk, and reported higher content in sheep than in cow and goat milk (Revilla et al., 2014). Retinol and xanthophylls have been detected in low concentrations in sheep and goat milk, but not β -carotene (Martin et

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al., 2004), because this compound is fully converted to retinol in sheep and goat intestine (Raynal-Ljutovac et al., 2008).

Regarding the effect of management practices on the variability of lipid composition of milk and cheese, an interesting study conducted by Lucas et al. (2008) reported that the nature of the basic fodder ration mostly affected the content of retinol, α -tocopherol, and xanthophylls of goat milk and cheese. However, the FA composition was mainly affected by the composition of the concentrate and the lactation stage of the herd.

In the Basque Country of northern Spain, Latxa sheep milk production is mostly used to make Protected Denomination of Origin (PDO) Idiazabal cheese. Annual cheese production is around 1,000 t, and about half of it is produced by sheepherders with milk from their own flocks. Indoor animal feeding (in winter) represents the highest cost of production for cheesemakers, and the inclusion of locally produced rapeseed oilcake in the concentrate feed formulation can reduce the cost of cheese production, as long as the quality of the cheese is not altered. Previous studies reported that oilcakes can replace soya in the formulation of concentrates for sheep feeding, and that the use of oilcakes increased the concentration of nutritionally interesting FA in milk (Amores et al., 2014). However, it is necessary to study the effect of oilcakes on the nutritional and sensory quality of the final cheese produced. Thus, the aim of the present study was to assess the changes in the content of FA, tocopherols, retinoids, and cholesterol, and in the sensory properties of Idiazabal PDO cheese made with milk from rapeseed oilcake fed sheep.

MATERIALS AND METHODS

Animals, Feeds, and Experimental Design

The experimental design consisted of 2 different parts. The first was conducted with 72 Latxa sheep of the experimental flock of NEIKER-Tecnalia (Arkaute,

Spain), in accordance with the European Council (1986) Directive 86/609/ECC. At the start of the experiment, the experimental flock was divided in 2 homogeneous groups of animals (36 sheep per group) according to the month of lactation (1/1.5 mo), daily milk production (DMP; $1.9 \pm 0.6/1.8 \pm 0.5$ L/sheep per day), live weight ($61.0 \pm 7.0/59.0 \pm 9.0$ kg), and BCS ($2.4 \pm 0.5/2.5 \pm 0.5$ points). Average age of the sheep was 4.0 ± 1.5 yr in both groups. One of the 2 groups was fed a standard diet based on commercial concentrate and forage (*Festuca* hay). Soya and cereals were the main protein and energy sources in the commercial concentrate. The other group of animals received a concentrate formulated with rapeseed oilcake along with *Festuca* hay. This rapeseed concentrate was formulated with 225 g of rapeseed oilcake per kilogram of DM instead of the soya in the commercial concentrate. Oilcake was the by-product of the cold extraction of oil from locally produced rapeseed seeds. Table 1 shows the gross nutritional composition of rapeseed oilcake, commercial and rapeseed concentrates, and forage. Animals were milked twice a day at 0730 and 1830 h. For both feeding groups, the concentrate was divided into 2 halves and provided during milking, whereas the forage was offered ad libitum after each milking. The daily intake per feeding group was calculated by weighing the feed supply and the refusal in each of the milkings, and it was considered that the animals ate ad libitum when the refusal was less than 10% (by weight).

The experiment consisted of an unreplicated design of feeding groups as experimental units. The experiment was carried out in March (mid lactation) for a total of 3 wk, allowing the first week as adaptation time. Sheep were weighed (live weight) once a week and, simultaneously, BCS was monitored using a 5-point scale, with 1 for a thin animal and 5 for an obese animal (Russel et al., 1969). Average DMP was determined for individual animals from the 2 daily milkings.

The second part of the experiment consisted of cheesemaking trials made with bulk milk from each feeding

Table 1. Gross nutritional composition of rapeseed oilcake, commercial and rapeseed concentrates, and forage (*Festuca* hay)

Item	Rapeseed oilcake	Commercial concentrate	Rapeseed concentrate	<i>Festuca</i> hay
DM (%)	89.27	88.79	89.53	85.9
CP (%)	24.76	14.58	14.85	12.9
Crude fat (%)	20.08	3.89	6.56	1.80
Crude fiber (%)	<5	6.93	7.21	
ADF (%)				30.9
NDF (%)				55.7
Energy (UFL ¹)	1.1	1.03	1.08	0.80

¹UFL = unité fourragère lait.

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