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Effect of sheep breed on milk yield and composition in the geographical area of production of Nisa PDO cheese

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Abstract. The traditional Portuguese cheeses have been produced for a long time from autochthonous sheep breeds' milk, namely Saloia and Merino breeds in the geographical area of PDO Nisa cheese. Aiming to improve farm profitability, exotic breeds, mainly Assaf, were introduced in the region. The objective of the project was to investigate the effect of sheep breed, lambing season and phase of lactation on milk production, milk composition and technological properties for cheese production. Farms rearing Lacaune, Assaf, Saloia, Merino and Serra da Estrela sheep, have been studied in two winter/spring and summer lactations. This work reports the milk yield and the chemical properties. Exotic breeds produced more milk than the Portuguese ones and it was observed that late parturition in winter and summer has a detrimental effect on milk production. The milk from the Merino breed has the highest fat, protein and total solid contents. However, considering milk production, the exotic breeds produced more total solids, an important factor for cheese yield.

Keywords. Assaf – Saloia – Merino – Milk yield – Milk composition – PDO Nisa cheese.

Effet de la race sur le rendement et la composition du lait de brebis dans la zone de production du fromage AOP de Nisa

Résumé. Les fromages portugais traditionnels sont produits depuis très longtemps à partir du lait de brebis de races autochtones, notamment les races Saloia et Merino dans la zone de production du fromage AOP de Nisa. Dans le but d'améliorer la rentabilité des élevages, des races exotiques, comme la race Assaf, ont été introduites dans cette région. L'objectif de ce projet était l'évaluation de l'effet de la race, de la saison d'agnelage et de la phase de lactation sur la production, la composition et les propriétés technologiques du lait de brebis pour la production de fromage. Les races Lacaune, Assaf, Saloia, Merino et Serra da Estrela ont été étudiées au cours de deux lactations hiver/printemps et été. Cette étude concernait le rendement laitier et les propriétés chimiques du lait. Les races exotiques ont produit plus de lait que les races portugaises et il a été observé que l'agnelage tardif, aussi bien en hiver qu'en été, a eu un effet négatif sur la production laitière. Le lait de brebis de la race Merino a présenté les taux les plus élevés de gras, de protéine et de solides totaux. Cependant, pour ce qui est de la production laitière, les races exotiques ont présenté des taux plus élevés de solides totaux, un facteur important pour le rendement fromager.

Mots-clés. Assaf – Saloia – Merino – Rendement laitier – Composition du lait – Fromage AOP de Nisa.

I – Introduction

The demarcated region of the PDO Nisa cheese (protected denomination of origin) extends for an area of 3000 km². The soil is granitic or derives from schist with low productive capacity. The breeds exploited in the region have varied throughout the time due to their importance in dairy sheep production. The Merino Branco breed predominated at a time where the production of cheese was still a subsidiary activity of sheep meat production and producers only used the remaining milk produced after the late weaning of their lambs. Saloia breed ewes emerged in

the Nisa cheese region when small ruminants' milk production became autonomous with the use of feeding resources grown specifically to dairy sheep, as opposed to using the surplus agriculture resources, as it happened with production involving the Merino sheep. More recently, with the increased consumption of traditional cheeses that led to an increase of the price paid for milk, producers began replacing local breed ewes for exotic breeds as Lacaune and Assaf breeds. The PDO Nisa cheese is one of the 13 PDO cheeses produced in Portugal and one of the 8 produced solely from ewe's milk. In this region it is also produced a cheese made from both ewe and goat's milk, the Mestiço de Tolosa.

In relation to the first year of production (1995/96), the number of cheese dairies that manufactured the PDO Nisa cheese, remained as 12 up to 2001/2002 and went down to 8 by 2006/2007, with a production of about 105,000 kg representing 7.43% of the total traditional cheeses produced in Portugal. Also in relation to the cheese "Mestiço de Tolosa", the number of cheese dairies attained a maximum of 5 on 2002/2003, and by 2006/2007, only one cheese dairy remained and produced 128,000 kg of cheese.

This project was related to the milk and cheese production from the region of Nisa, and milk characteristics were evaluated from the 5 breeds used by producers dedicated to PDO cheese production. The main objective was to undertake experimentation and demonstration trials, on the geographical region for the production of Nisa cheese, in different aspects of the production system for PDO Nisa cheese, namely the evaluation of the effect of the production factors such as breed, lambing season and lactation stage, on milk technological characteristics and manufacture and quality of cheese making. Another objective was to improve the hygienic and sanitary quality of milk, as a food safety factor since cheese is manufactured from raw milk, through the implementation of good practices in cheese making systems and the evaluation of its impact on analytical values and quality of the final product. This paper presents milk chemical characteristics as influenced by breed, lambing season and lactation stage.

II – Material and methods

Milk production and quality was evaluated on 10 ewes per flock and lambing season. The animals were randomly selected from a group that, on previous milk records, presented higher values than the flocks' average. Milk produced on the following seasons: Winter/Spring 2002/2003 and 2003/2004 as well as Summer 2003 and 2004, was tested for its content on protein (P), fat (F), lactose (L) and total solids (TS) (Milk-o-Scan 4000). Seven different samplings were performed per season, between 30 and 120 days of lactation.

On the first lactation, Winter/Spring 2002/2003, four dairy farms were randomly chosen for the study, designated as A, B, C and D. Farm A raise Lacaune ewes; on farm B, the ewes were Assaf; on farm C, ewes were from Saloia breed; and on farm D, data were obtained from Merino ewes.

In relation to the Winter/Spring lactation of 2003/2004, data were collected from B, C and D farms. On this lambing season, farm D presented two breeds, Merino and Saloia (the latter will be designated as E). Farm A was dropped from the project since it was sold out. However, two more farms were added to the data collection, designated as farm F (Serra da Estrela ewes) and farm G (with Assaf ewes).

During the lactations from Summer 2003 and 2004, information was only collected on farm B.

The animals' feeding management was similar for all flocks, considering grazing, concentrated feed during milking and hay distributed in the evening inside the barn. However, ewes from farm G were kept in confinement most of the lactation period. On farms B and G, lambs were artificially reared. On farms A, C, D and E, milking began before 30 days of lactation, simultaneously with the rearing of the lambs. On farm F, milk produced by ewes was exclusively suckled by lambs up to 45 days of lactation.

Linear mixed models (Littell *et al.*, 2006) were used for analyzing individual repeated records of milk yield and composition across lactation weeks. Analyses were made within Winter/Spring lactation seasons separately testing for breed effects. Season effects were evaluated on Assaf ewes considering both Winter/Spring and Summer lactations.

III – Results and discussion

Milk production obtained from the 2002/2003 Winter/Spring season (Fig. 1), as expected, shows higher values for ewes from farms A and B, then Saloia ewes from farm C and the lower values from Merino ewes (farm D) averaging 261 ml/d by 120 days of lactation. It should be noted that ewes from farms B and C show an increase in milk production by the end of the study period (120 days) surely due to the lambing season, November (farm B) and December (farm C), and the increased pasture availability observed on Spring. This did not happen for ewes on farms A and D, also grazing, but lambing on October.

On the 2003/2004 Winter/Spring season (Fig. 1) the milk production was higher for the exotic breeds, while the milk produced by the Assaf ewes from the farm B increased from an average of 864 ml (2002/2003 Winter/Spring season) to 1910 ml (2003/2004 Winter/Spring season), the milk production from the Saloia and Merino breeds decreased. Ewes from farm B, showed a good milk potential, similar to that of farm G, since on 45th day the milk production was the same, decreasing afterwards because they were certainly affected by the lower feeding value of the pasture during winter.

Ewes from farms C, D and E (Merino and Saloia breeds) showed similar milk productions while ewes from farm F (Serra da Estrela breed) produced more although having a larger suckling period, which affects the total of milk production. All these flocks, lambing on October, do not show an increase in milk production since the last data collected coincided with winter.

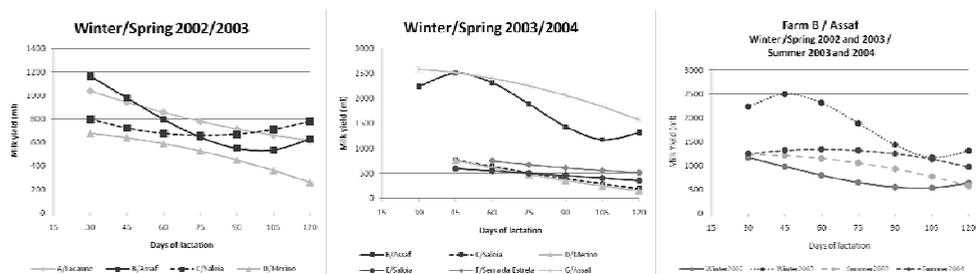


Fig. 1. Lactation curves from the ewes of the different farms during 2002/2003 and 2003/2004 Winter/Spring, 2003 and 2004 Summers.

Milk production from farm B ewes, observed during the summer breeding seasons (2003 and 2004), was intermediate to the milk produced during the Winter/Spring seasons of 2002/2003 and 2003/2004 (Fig. 1).

On the 2002/2003 Winter/Spring season, the milk fat content (F) was higher for Merino ewes, increasing from 6.26% to 8.42% between the 30th and the 120th day of lactation (Fig. 2). Results emphasize milk fat levels of Lacaune ewes, similar throughout the lactation period (mean 6.95%) and of Saloia sheep, low at the beginning of lactation (5.33%) possibly due to the type of nursing followed. Milk protein content (P) was also higher for Merino ewes, between 5.44% and 6.76%, than that for Lacaune ewes whose variability was lower. Milk total solids (TS) content on fig. 2 show that Merino and Saloia ewes had higher but similar values, averaging from 16.98% to 20.67%.

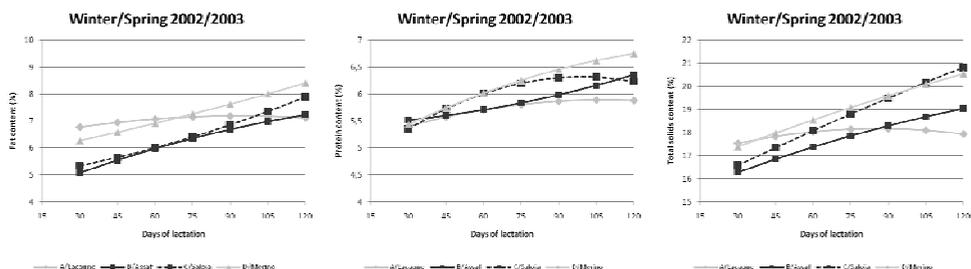


Fig. 2. Milk fat, protein and total solids contents from the ewes of the different farms during Winter/Spring 2002/2003 lactation.

In relation to the 2003/2004 Winter/Spring season, milk composition content was similar to that indicated for the previous Winter/Spring lactation on farms sampled on both years (B, C and D). There was only a slight increase in milk fat for Saloia ewes from farm C, from 6.70% to 7.33%, and also for Merino ewes, from 7.22% to 7.41%. Milk protein and total solids contents were similar on both Winter/Spring lactations.

When comparing milk composition results from farm B (Assaf ewes) on the 4 seasons under study, milk fat values did not vary significantly between years (mean 5.82%; $P > 0.05$). However, milk protein content was significantly higher ($P < 0.0001$) on the 2002/2003 Winter/Spring lactation (5.76%) while the mean value for the remaining lactations was 5.11%. Milk total solids content were significantly higher ($P < 0.0001$) and similar between Winter/Spring lactations (17.10%) as compared to the Summer lactations (16.33%). On those farms only sampled during the 2003/2004 Winter/Spring lactation, results showed that Saloia ewes from farm E and Assaf ewes from farm G presented little variation throughout lactation although having distinct levels (from 6.93 % to 7.47% for Saloia breed and from 5.65% to 5.13% for Assaf breed).

In spite of the higher milk fat and protein content for the Portuguese breeds, the larger quantities of milk produced by Assaf ewes, on every farm, resulted in higher amounts of fat, protein and total solids produced throughout the 2003/2004 Winter/Spring lactation.

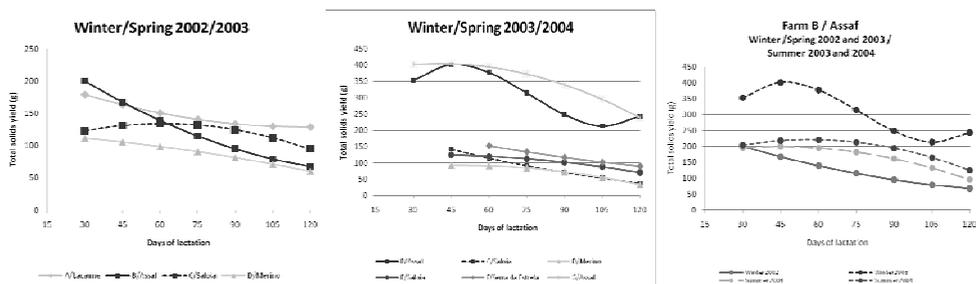


Fig. 3. Total solids yields from the ewes of the different farms during 2002/2003 and 2003/2004 Winter/Spring, 2003 and 2004 Summers.

Results for milk total solids, on the 2002/2003 Winter/Spring lactation, show close yields for the different breeds (Fig. 3). On the following Winter/Spring lactation of 2003/2004, the difference on TS totals is evident when comparing Assaf and Saloia ewes at 45 and 120 days of lactation, respectively 402.81 g vs 133.7 g and 239.12 g vs 54.69 g. Milk TS from Merino ewes is even lower, respectively 92.97 g and 33.28 g on the same sampling occasions. On farm B, it stands out the quantity of TS obtained during the 2003/2004 Winter/Spring lactation (318.10 g),

significantly higher than that obtained on the other lactations. Data obtained for the two Summer lactations were similar (196.84 g; $P>0.05$), but higher than the average obtained on the 2002/2003 Winter/Spring lactation (145.81 g; $P<0.0001$).

This data should then be confronted to that obtained by Martins *et al.* (2005) for bulk milk from the flocks referred till now, considering cheese yield relative to dry matter. Milk from Merino ewes, resulted in higher yields when compared to Saloia and Assaf breeds, over 17% and 49% respectively. This shows the influence of milk composition and breed on cheese yield stating the importance of considering the behaviour of milk during coagulation and posterior cheesemaking stages, on methodologies used in cheesemaking facilities.

Martins *et al.* (2009), on a work on coagulation properties using bulk milk from these flocks, showed better results for the milk from the two portuguese autochthonous breeds. The lower solids content of Assaf milk led to lower curd firmness and the milk from the two portuguese breeds showed superior firming rates and reached higher final curd firmness in agreement with milk composition data.

IV – Conclusions

Autochthonous breeds presented higher contents for milk fat, protein and total solids. However, the milk production level for Assaf and Lacaune breeds was decisive for the total production of important components for cheesemaking from ewes' milk.

For the production levels reported for the Saloia, Serra da Estrela and Merino breeds, it will be important to provide feeding based on quality fibrous feeds, while for the exotic breeds, the amount of concentrated feeds provided will be a determining factor for its profitability.

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