Beyond milk yield: a rationale for a gradual introduction of more productive and functional traits in the Latxa sheep breeding program.

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Abstract

The Latxa dairy sheep breeding program has been selecting for milk yield during the last 20 years. Nowadays there is a continuous improvement and it is arrived time to undertake the inclusion of another traits in the breeding objective. Two groups of traits are considered. Those related to cheese yield (fat and protein contents) and those related to udders (udder shape scoring traits and somatic cell score). The economic weights for all of them are unknown and their recording is very expensive.
An experimental recording involving all these traits in some flocks has been in place since 2000. Estimated genetic correlations of milk yield with fat and protein contents, udder depth and teat placement are undesirable, while those of milk yield with fat and protein yields, udder attachment and somatic cell score are desirable or null. Therefore, a worsening would be expected for some traits. However, population genetic trends and EBVs of the AI rams show that in practice there is an improvement in all udder traits, which it is thought to come from "on farm" phenotypic selection of the prospective AI rams in regard of his mother's udder shape. As for fat and protein contents, trends and EBVs indicate a worsening.
The breeding objective should include fat and protein contents as in other breeds, while the inclusion of udder shape and somatic cell score is not so urgent.

Introduction

As described as an optimum strategy by Barillet (1997), most dairy sheep breeding programs started with a selection aim towards increasing milk yield per lactation. The reasons are that it is a trait easy to record and to select and its economic relevance is clear (see for example Gabiña et al., 2000). However, as in another species, there are many potential productive and functional traits suitable for selection. Among these traits are: milk composition, meat production, health (scrapie, mastitis and other diseases), reproductive traits (mainly fertility) and morphology (body and udder). In this paper we will try to explain the process of decision of the traits likely to be included in the next years in the selection objective for the Latxa breed.

Most dairy sheep breeding schemes are subsidised in some way. The aim of these subsidies is to keep the dairy milk sheep production, as an activity with low economical relevance, but with high ecological relevance. Therefore the responsibles of the extension services and the breeding schemes promote a rational, sustainable production system. With those concerns in mind, such a system should include in its breeding objective traits different from production such as morphological traits and animal health. Still, the budget is of course limited and it is wise to consider which traits and how are they to be improved.

Some requirements need to be fulfilled for a trait to be successfully improved by selection:

1) It has to be heritable; that is, we need genetic variation to select from.
2) It needs to be efficiently measured (or predicted from another trait) in a number of animals so that some selection pressure is possible.
3) It needs to be efficiently included in the testing and selection scheme.

The second point is a crucial point in all livestock species. In dairy sheep, the high number of animals in each flock and the low profit per animal makes trait recording relatively expensive. Say that we are to record milk contents in a flock with 200 ewes milked by hour in a 12 x 2 milking parlour. Most likely two technicians will be needed to record milk yield, take milk samples and record animal identifications. The same situations arise for the recording of morphological traits, diseases, etc.

A short description of the most interesting traits

As for milk yield, economically it is the most important trait, as shown in Latxa in an analysis of the profit of several farms by Gabiña et al. (2000). However, opposite to cow milk, sheep milk is almost exclusively used for production of high-quality cheeses. It is known that cheese yield is crudely approximated by fat and protein yield, and for these reasons cheese processing factories pay milk as a linear function of (contents x milk yield). However, changes in the relation fat to protein in the milk may cause changes in the final cheese fat content and its quality. Both contents need to be kept within certain levels and this leads to a non-linear profit function in a long term. This non-linear function has been dealt with in the Lacaune breed by a desired gains selection index (Barillet et al., 1986).

Concerning meat production traits (either weight or daily gain), lambs make a very important income (around 25% of total incomes). However, Latxa breeders do not pay much attention to these traits, feeling that these traits are already at an optimum at present market conditions.

As for health traits, high somatic cell counts worsen both cheese yield and quality (and they are thus penalised by cheese factories). In addition high somatic cell counts are indicator of subclinical mastitis. This disease leads to lower milk production (or none if the infection is severe), additional expenses (i.e. veterinary treatments), and a shortening of animals productive life. This trait is being selected for in the Lacaune breed (Rupp et al., 2002).

Another health related trait is resistance to scrapie, a transmissible spongiform encefalopathy. Resistance to scrapie is determined by the genotype of the PrP gene (Elsen et al., 1999). Due to the speculated relations between scrapie, bovine spongiform encefalopathy and the human form of this one, there is an EU directive suggesting selection towards scrapie-resistance genotypes in sheep. This has not yet been applied in Latxa due to the magnitude of the task, and the fact that scrapie outcomes in Latxa are very sporadic and of no economic relevance.

Other health (disease) traits are not much considered because of their low economic relevance, difficulty to measure and especially the possibility of control through management practices. Longevity is an omnibus measure of health and productive ability but it has not yet been studied in the Latxa breed. Besides, its implementation in practice as a breeding objective is awkward due to its late expression in life (Essl, 1998).

Fertility, the more important reproductive trait, is economically very important due to the seasonal lambing of the breed. A non-pregnant ewe might stay in the flock for the next full year without producing neither milk nor lambs. However it is possible to improve fertility to a greater extent through management practices.

Among the morphological traits the more interesting for dairy sheep, as in dairy cattle, are udder shape traits. Udder traits do not have a direct economic weight. Nevertheless, they are related to traits with economic weight: health (mastitis and udder diseases in general), milkability and therefore longevity. Moreover, this is also a trait with a "subjective" weight, because most Latxa breeders are very concerned with udder shape.

Present situation in the Latxa breed

The Latxa breeding scheme started in 1984 with recording, genetic evaluation and selection for milk yield (120-days standardised milk yield). Rates of genetic progress are nowadays smooth and continuous. Therefore it is thought that the moment is optimal to consider the inclusion of more traits in the selection objective. From 2000 on, the Latxa breed scheme is making an experimental recording of a number of traits in a small (around 30) group of farms. Those traits are milk composition (fat, protein and somatic cell count) and udder morphology as described by De la Fuente et al. (1996). Four udder morphology traits are included, but the most important are udder attachment and teat placement.
It is clear that an optimum scheme (in an economic sense) for all these traits would be that whose breeding objective was determined by the economic weights for the traits of interest in the production system of the breed. There is a research project concerning this aspect but it is not finished yet.

A practical approach

Nowadays we are in 2004, we have an extensive experimental recording for many traits and it is feasible to estimate breeding values for many (but not all) artificial insemination (AI) rams. Should we start selecting for these traits, even if we do not know their economic relevance? Should we extend milk composition and udder morphology recording to more farms? It is important to notice that both actions have been done in dairy cattle for several years on an intuitive or desired gains basis. Our rationale to answer this question was:

1) Milk yield is obviously the most important trait as explained before. Especially now that foreign breeds like Lacaune and Assaf are making a high commercial pressure based on their greater yields (Ugarte et al., 2002). It is important to show that the Latxa breeding scheme provides a smooth improvement such that it is possible to obtain good yields while maintaining a pasture-based and sustainable system. Thus the selection objective *will* include milk yield.
2) It is important to keep control on the other traits, avoiding worsening. This was done in two ways: estimating genetic parameters and their relation with milk yield, and estimating genetic trends.

The answer to this question resulted in quite interesting findings. We will present here results for the Black-Faced strain of the breed. Blond-faced strain gave similar results.

Situation of the different traits in the Latxa breed

During 2003 and 2004 genetic parameters have been estimated for all the traits included in the experimental recording (fat and protein content, somatic cell count, and udder traits). Their heritabilities and genetic correlations with milk yield are shown in Table 1 for the Black-Faced strain. Somatic cell count has been included on a lactational basis as the MLSCS (mean lactational somatic cell score, which is the mean of the lactational log-transformed -or score- somatic cell count, corrected by stage of lactation). A test-day approach is perhaps more adequate in dairy sheep (Barillet et al., 2001; Serrano et al., 2003).

Table 1. Heritabilities and genetic correlations of different traits with milk yield.

	Heritability	Genetic correlation	st.err. of the correlation
Milk	0.22		
Fat Yield	0.17	0.83	0.05
Protein Yield	0.20	0.95	0.05
Fat content	0.24	-0.47	0.05
Protein content	0.45	-0.41	0.05
MLSCS*	0.13	-0.11	0.06
Udder depth	0.25	0.48	0.05
Udder attachment	0.25	0.15	0.06
Teat placement	0.40	-0.25	0.05
Teat position	0.37	-0.13	0.05

*MLSCS: mean lactational somatic cell score

Estimates are similar to those obtained in another European breeds, excepting estimates for MLSCS which are rather different among breeds (Barillet et al., 2001; Othmane et al., 2002; Serrano et al., 2003). Some breeds (Churra and Manchega) show favourable (more milk, lower somatic cell count) estimates while dairy cattle and Lacaune show unfavourable ones.

The most critical point in this table is the high negative correlation between milk and contents. The genetic correlations imply that, by selection for milk yield, a worsening is expected in udder depth, teat placement and milk contents, and an improvement in somatic cell score, udder attachment and fat and protein yields.

Based on the middle-term that the experimental recording has reached, we have also estimated genetic trends for some of the traits. Figures 1 to 3 show the genetic trends of all these traits for the black-face ecotype of the breed. There is a clear descending trend for contents, but it is not so neither for udder traits nor for MLSCS. Genetic trend for udder attachment and teat placement clearly disagrees with genetic parameters estimates. The most likely explanation is on-farm selection of prospective AI rams based on the phenotype of their dams. This is done by breed technicians and farmers but it is hard to know its efficiency.

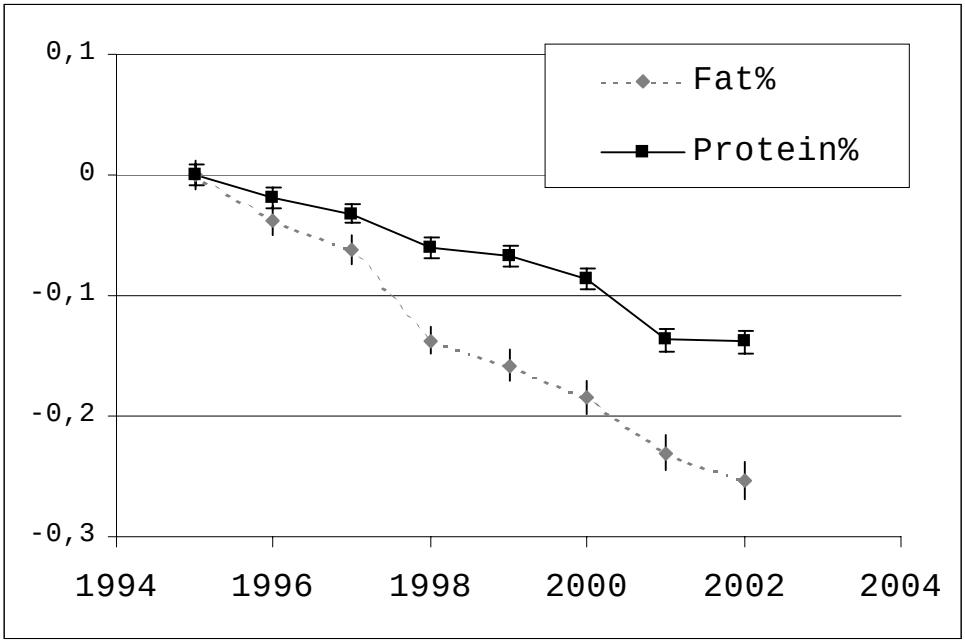

Figure 1. Genetic trend (generation means and 95% confidence intervals) for fat and protein contents in the Black-Faced Latxa strain.

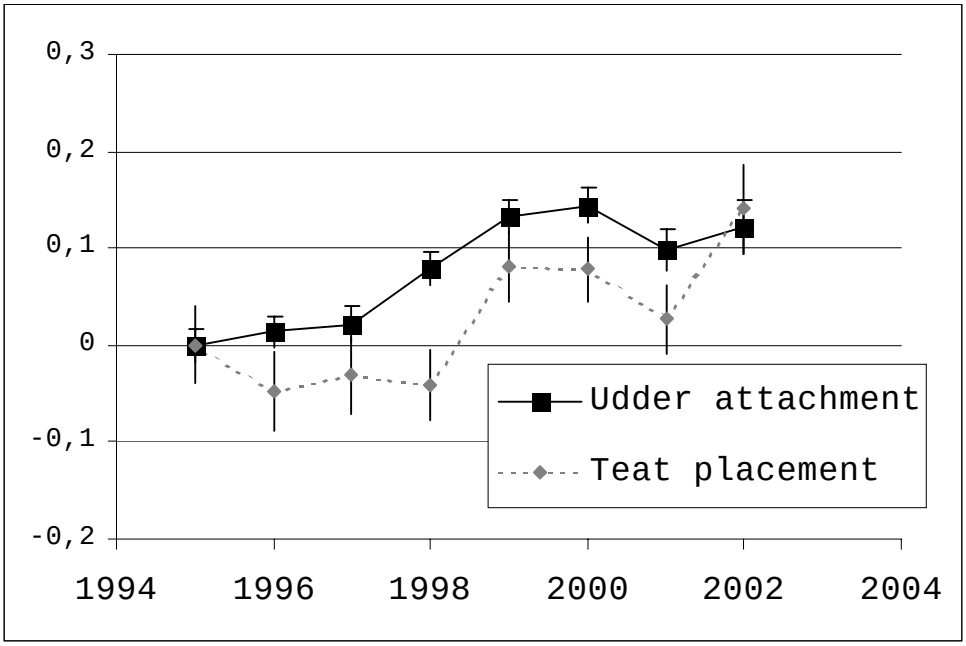

Figure 2. Genetic trend (generation means and 95% confidence intervals) for udder attachment and teat placement in the Black-Faced Latxa strain.

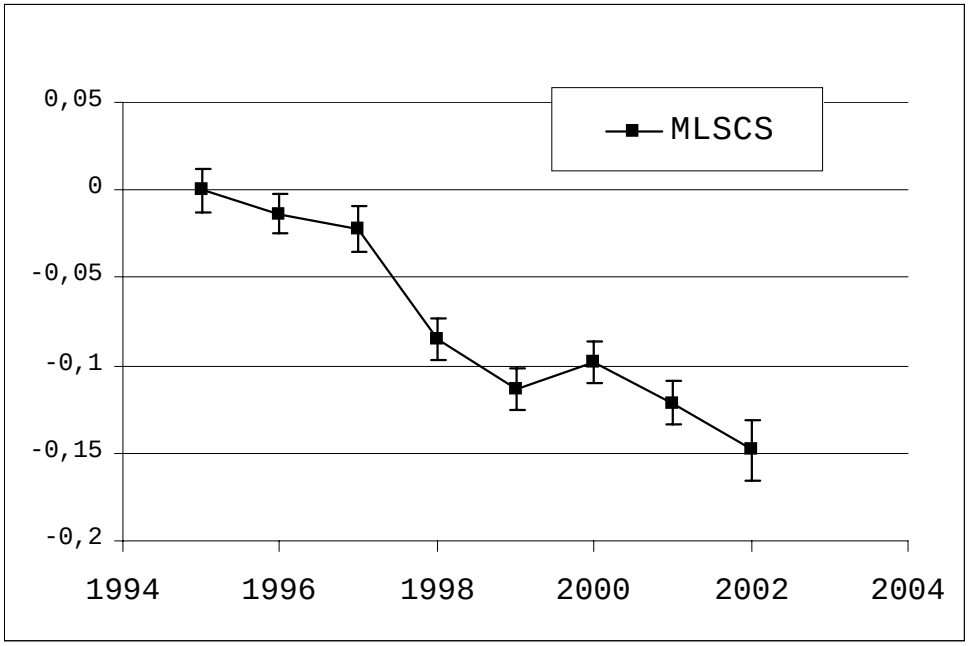

Figure 3. Genetic trend (generation means and 95% confidence intervals) for MLSCS (mean lactational somatic cell score) in the Black-Faced Latxa strain.

The last analysis was a study of present (2004) AI rams estimated breeding values for fat and protein content, udder attachment and teat placement. For fat and protein contents, 50% and 27% of the rams, respectively, were among the 20% worst of the population. This fully agrees with genetic parameters estimates. As for udder attachment and teat placement, 68% and 42 % of the rams are among the 20% best of the population. Thus, this confirms the trends but not the genetic parameters.

Discussion and conclussions

The situation for somatic cell count and udder traits is not problematic. Neither of them shows any clear worsening trend. It seems that on-farm phenotypic selection is a valid method to keep udder traits from worsening. Future actions will include annual surveys like the present one, and a deeper study in the case of somatic cell count.
The most difficult situation is that of fat and protein contents. All analysis agree that in the long run there will likely be a decrease with implications in both farmers income and cheese quality. Therefore milk contents will soon be included in the selection objective and index, and milk composition recording will be extended to more farms. There remains the problem of milk recording simplification. Among the alternatives are the selective recording of the ewes (e.g. first lambing ones) and the use of test-day measures (hence recording only a few test-days) instead of full-lactation estimates.
This year (2004), in addition to milk yield, AI rams published evaluation also included estimated breeding values for fat and protein contents, udder attachment and teat placement. The purpose is not that farmers select for these new traits, but to show the current situation in the breed and promote a discussion on objectives and the ways to reach them.

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