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Scientific background of the selection program in the Latxa breed

E. Ugarte and A. Legarra
NEIKER, A.B. (Basque Institute of Agricultural Research and Development),
Granja Modelo de Arkaute, Apdo 46, 01080 Vitoria-Gasteiz, Spain

SUMMARY – This paper presents the genetic parameters of the new traits that have been studied in the Latxa breed: milk composition traits (fat and protein contents), udder morphology traits (udder depth and attachment and teat size and length) and Somatic Cell Count (SCC). Except for protein content that shows an estimated heritability of 0.47, for milk composition traits the heritabilities are slower (0.17-0.18) that those obtained in other breeds like Churra, Manchega, Sarda and Lacaune. For udder traits, the heritabilities (0.20-0.36) are in the same range as those obtained for other breeds and for SCC the estimated heritabilitiy (0.10) is lower that those obtained in other breeds (0.12-0.15). In general there are large differences between results obtained in different breeds. The obtained results show that, in the Latxa breed, the new traits have genetic variance that can be exploited. The control of composition traits, SCC and udder morphology will continue but with different aims for each type of trait.

Key words: Dairy sheep, Latxa, milk composition traits, udder morphology, somatic cell count.

RESUME – *"Contexte scientifique du programme de sélection de la race Latxa". Cet article présente les paramètres génétiques des nouveaux caractères qui ont été étudiés chez la race Latxa : caractères de composition du lait (teneur en matière grasse et protéines), caractères de morphologie mammaire (profondeur et attache de la mamelle et taille et longueur des trayons) et comptage des cellules somatiques (SCC). Sauf pour la teneur en protéines qui montre une héritabilité estimée de 0,47, les héritabilités des caractères de composition du lait sont plus faibles (0,17-0,18) que celles obtenues dans d'autres races comme Churra, Manchega, Sarde et Lacaune. Pour les caractères de la mamelle, les héritabilités (0,20-0,36) sont du même ordre que celles obtenues dans d'autres races et pour le SCC l'héritabilité estimée (0,10) est plus faible que celle obtenue dans d'autres races (0,12-0,15). En général il existe de fortes différences entre les résultats obtenus chez différentes races. Les résultats obtenus montrent que chez la race Latxa les nouveaux caractères ont une variance génétique qui permet de les exploiter. Le contrôle des caractères de composition, SCC et morphologie mammaire se poursuivra mais selon différents objectifs pour chaque type de caractères.*

Mots-clés : *Brebis laitières, Latxa, caractères de composition du lait, morphologie mammaire, comptage de cellules somatiques.*

Introduction

The Latxa breeding program started in 1984. It is focused to increase the milk yield produced per ewe and it has a genetic gain of around 3% (Ugarte, 2001). Nowadays, milk yield is the most important aspect in the economical output of Latxa breed (Gabiña *et al.*, 1999). 95% of milk yield produced in the Spanish Basque Country and Navarra (where Latxa breed is located) is transformed into cheese. The 60% of this cheese is protected by the *Idiazabal cheese* Mark of Origin which fix some constraints like the breed and the geographic area of production. The production system of the Latxa breed is based on the use of mountain pastures during some months of the year (Ruiz *et al.*, 1997). This management adds ecological and social values to the economical values of this production system. Unfortunately, these values are very difficult to measure.

It is known that an exclusive selection for yield milk production can produce changes in genetically correlated traits. Although during the first steps of a genetic program it is more important to select only for milk yield production, when the scheme is well implemented and with constant genetic progress, it is convenient to consider other aspects as milk composition or functional traits. Moreover, the economical relevance of these functional traits has increased quickly in the last years.

With the general objective of increasing general profitability of the Latxa flocks, while maintaining the same production system, the persons in charge of the Latxa breeding program decided to study the introduction of the following new traits: milk composition, udder morphology and Somatic Cell Count (SCC) into the objectives. This paper presents the genetic parameters of these traits in this particular population.

Scientific aspects

Milk composition: Fat and protein content

The genetic correlations between milk yield with fat and protein content are negatives (Barillet, 1997; Sanna *et al.*, 1997). Consequently, due to genetic improvement for milk yield, fat and protein contents will decrease with time affecting the capacity to cheese transformation. Moreover, as covariances between milk yield and fat and protein contents are different, its ratio in the raw milk will be affected. This ratio is strongly related with the fat/total dry matter ratio in the final cheese, which has to be higher than 45% to accomplish *Idizabal cheese* regulation.

Therefore, cheese factories (which collect 50% of milk production) include fat and protein contents in the price of milk. As we have mentioned, the genetic program of Latxa breed has produced a genetic improvement of milk yield around of 3% per year (0.18 genetic standard deviation) during the last years. We can see on Fig. 1 the slight decrease of fat and protein contents during this time.

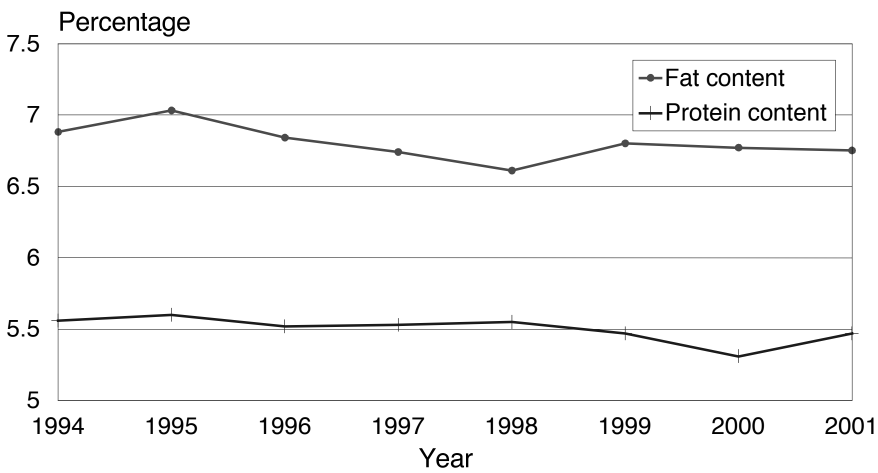

Fig. 1. Evolution of tank fat and protein content.

Considering this change, the genetic progress of milk yield and the consolidation of the genetic program, a qualitative milk recording program was set up in 1999 in order to control milk composition in Black- and Blond-faced ecotypes. Genetic parameters were estimated (Legarra, 2002) using the data proceeding from the 26 Latxa Black-faced flocks involved in this program (26 Black-faced and 8 Blond-faced ecotype flocks). Table 1 shows the data description.

Table 1. Description of composition milk data (average ± sd)

Average standardised milk yield (l)	148.10 ± 52.4
Average fat yield (kg)	8.15 ± 2.9
Average protein yield (kg)	7.58 ± 2.6
Average fat content (%)	5.67 ± 1.1
Average protein content (%)	5.23 ± 0.4
Number of lactations	7,599
Number of ewes in data	5,990
Number of animals in pedigree	13,204

The model used to analyse milk, fat and protein yield takes into account herd-year-season combination; the combination between age and parity; the number of live lambs and the interval between lambing and first milk recording as fixed effects. The additive genetic effect; permanent effect and the error associated to each observation were considered as random effects.

A slightly different model that takes into account the combination of controls inside each lactation where an individual milk sample been taken (Barillet, 1989) was used for fat and protein contents.

The analyses were made using VCE software (Neumaier and Groeneveld, 1998) through REML methodology. We used a multiple trait model including 5 variables: milk, fat and protein yield and fat and protein contents. Table 2 shows the obtained estimates.

Table 2. Heritabilities (diagonal) and genetic correlations between milk yield and composition traits

	Milk yield	Fat yield	Protein yield	Fat content	Protein content
Milk yield	*0.19*	0.85	0.93	–0.27	–0.35
Fat yield		*0.17*	0.89	0.25	–0.09
Protein yield			*0.18*	–0.057	0.01
Fat content				*0.17*	0.56
Protein content					*0.47*

Table 3 shows the estimates obtained in other European breeds.

Table 3. Heritabilities of milk composition traits obtained in different breeds

	Fat yield	Protein yield	Fat content	Protein content	Source
Machega			0.23	0.35	Serrano *et al.*, 1996
Churra				0.17	El-Saied *et al.*, 1999
Lacaune	0.28	0.29	0.35	0.46	Barillet, 1997
Sarda	0.24	0.26	0.48	0.55	Sanna *et al.*, 1997
Manech	0.32	0.35	0.31	0.48	SICA-CREOM, 1999

We can see that excepting for protein content, the estimates obtained for Latxa breed are lower than those obtained in other breeds. This can be linked with the use of partial sampling. However, this does not happen in other works made under similar conditions (Barillet and Boichard, 1987, 1994; Barillet, 1989, 1997). Other possibility is a higher environmental variability associated to the production system.

The estimates of genetic correlations are quite similar to those obtained in other breeds and indicate that fat and protein contents might decrease in the long term. For this reason these traits should be taken into account in the selection criterion. The high genetic correlation between fat and protein contents gives the possibility of including only protein content into the selection criterion.

Udder morphology

The increasing implementation of milking machines, aimed in decreasing the tedious work of daily milking work, needs to study the relationships between milking machines, udder morphology and milking ease. Fernández (1995) and more recently Marie-Etancelin *et al.* (2001) have described several of these aspects. Marie *et al.* (1998), showed that the udder morphology traits are not very related to milking traits (milking time, milking speed) and that they can be considered as different groups of traits. However, and independently with its relation with other traits, udder morphology is interesting by its own and it should be improved in order to ease the milking labour of shepherds. This will help to improve their quality of life and, as a consequence it will help to the maintenance of the activity.

In relation with the economical values, the udder traits have influence on milk yield, milking ease, udder health and length of productive life. We must not forget that with the increasing use of machine parlours the udder morphology is becoming more important. The percentage of flocks using milking machine in the Latxa breed is increasing across the years. Nowadays the percentage of flocks with milking machines in the breeding program is 65% and the shepherds have a higher interest in udders well adapted to mechanical milking.

In the Latxa breed, the first works dealing with udder morphology started in 1988 (Arranz *et al.*, 1989). More recently, in 1997, and together with other Spanish dairy sheep breeds the Latxa breed started to work using the linear score system defined by de la Fuente *et al.* (1996) that moves between 1 and 9. De la Fuente *et al.* (1998), Legarra *et al.* (1999, 2001) and Ugarte *et al.* (2001) showed some of the obtained results.

In 2001, the Latxa breeding program started a recording program in order to evaluate udder traits over 26 flocks (18 Black-faced ecotype and 8 Blond-faced ecotype). Four traits are being measured: udder depth and attachment and teat attachment and size.

Table 4 shows data corresponding Black-faced ecotype.

Table 4. Description of udder morphology data (average ± sd)

Average udder depth	6.2 ± 1.1
Average udder attachment	4.8 ± 1.3
Average teat attachment	4 ± 1.7
Average teat size	4.8 ± 1.3
Number o qualifications	13,038
Number of lactations	7,893
Number of ewes in data	6,010
Number of animals in pedigree	12,171

The model used to analyse (influence of environmental effects and genetic parameter) udder traits considers the following fixed effects: (i) flock-year combination; (ii) combination between age and parity; (iii) stage of lactation; and (iv) the effect of the milk production in the day of udder scoring that was included as covariable.

VCE software (Neumaier and Groeneveld, 1998) was used in order to obtain the genetic parameters using a multitrait model. Table 5 describes the results of genetic analysis (Legarra, 2002).

Table 5. Heritabilities (diagonal) and genetic correlations between milk yield and udder traits

	Milk yield	Udder depth	Udder attachment	Teat attachment	Teat size
Milk yield	*0.22*	0.57	0.07	–0.39	–0.11
Udder depth		*0.23*	–0.43	–0.33	0.01
Udder attachment			*0.20*	0.29	0.14
Teat attachment				*0.40*	0.38
Teat size					*0.36*

Table 6 shows results obtained in other breeds.

In general, heritabilities are in the same range that those obtained in other breeds. Some aspects can explain the differences: inclusion in the model of the milk production effect, the subjectivity of the qualification system, the fact that qualification systems are not identical between breeds (Marie-Etancelin *et al.*, 2001) and, of course, differences between udder morphology of different breeds. About the correlations with milk yield, all breeds show as highest the correlation between milk yield and udder depth.

Table 6. Heritabilities of udder traits obtained in other breeds

	Udder depth	Udder attachment	Teat attachment	Teat size	Source
Machega	0.19	0.06	0.20	0.10	Serrano *et al.*, 2001
Churra	0.16	0.17	0.24	0.18	Fernandez *et al.*, 1997
Lacaune	0.32		0.49		Marie-Etancelin *et al.*, 2001
Sarda	0.26	0.27	0.37		Carta *et al.*, 2001

Taking into account the present situation of udder traits in the Latxa breed and the correlated genetic response that we expect focusing the selection on increasing milk yield, at the present moment we have decided not to include these traits into the selection criterion. However, we keep collecting this information in order to: control its evolution, use this information as an additional information when future AI males are selected (according to their pedigree index for milk production) and, eventually, detect males that transmit bad udder morphology.

Somatic Cell Count (SCC)

In dairy sheep, the mastitis is one of the main causes for culling and the economical consequences have also been showed (Fthenakis and Jones, 1990). They include loss in production, alteration of cheese properties (Pellegrini *et al.*, 1994), increase of culling rate and increase of cost and labour.

Moreover, the price of milk can decrease due to high level of SCC. In the *Idizabal cheese* area the industry reduces the price of milk litre 0.012 euro when it has more than 750,000 cell/ml and it pays 0.018 euro more per milk litre if the milk has less tan 400,000 cell/ml.

The individual threshold value defined by the Latxa breed in order to detect subclinical mastitis is 350,000 cell/ml although the value defined according to productive criteria is lower (Romeo *et al.*, 1998). Moreover, as a result of the improvement in management practices the average values of SCC is decreasing (Gonzalo *et al.*, 2000).

Despite the literature in dairy sheep is limited comparing with dairy cattle, some of the works show that the selection for mastitis based on SCC is feasible (Barillet *et al.*, 2001). However, the genetic correlations between mastitis, SCC and milk yield are still not very well known. Inside the Latxa breeding program, SCC data are being recorded systematically from 1999 on at the same time that the milk composition data are being recorded. Table 7 shows description of data collected in Black-faced flocks.

Table 7. Description of SCC data

Average somatic cell count (cell/ml)† ± sd	339,000
Average LRCST†† ± sd	3.06 ± 1.4
Number of records	32,620
Number of lactations	8,268
Number of ewes in data	7,412
Number of animals in pedigree	14,023

†Arithmetic average of all test-days.
††LRCST = lactation arithmetic average of $\mathrm{Log}_2(\mathrm{SCC}/100{,}000)+3$ (corrected by stage of lactation).

The same models were used for environmental effect analysis and for genetic analysis. A multitrait model including milk production and lactational value of somatic cell count (LRCST) was used.

VCE package (Neumaier and Groeneveld, 1998) was used to estimate genetic parameters. The equation used to analysis LCRST (corrected by stage of lactation) takes into account the herd-year-season combination, the combination between age and parity and the number of live lambs as fixed effects.

Table 8 shows the heritabilities and genetic correlations obtained.

Table 8. Heritabilities (diagonal) and genetic correlations between milk yield and LRCST

	Milk yield	LRCST
Milk yield	*0.18*	–0.04
LRCST		*0.10*

Table 9 shows the values obtained in other European breeds.

Table 9. Heritabilities obtained in other breeds

	LRCST	Source
Machega	0.04	Serrano *et al.*, this volume
Churra	0.12	El-Saied *et al.*, 1999
Lacaune	0.15	Barillet *et al.*, 2001

Taking into account the results obtained, the problematic relation between mastitis and SCC and the high influence of management in decreasing SCC we consider that for the Latxa breeding program it is still more convenient to focus the efforts on improving management practices. The collect of these data will permit to control the evolution of this trait and supposes a big help for detection of problematic ewes.

Discussion

The studies carried out in the Latxa breed show that the new traits have genetic variance suitable to be exploited and that these traits could be improved through a genetic breeding program.

The estimates of genetic parameters are very different between breeds. Although the previous experiences of other breeds can be of high interest, our work clearly also shows that it is necessary to study the situation of each breed. The production system, the methodology employed and breed characteristics can produce big differences between breeds. The interest and convenience of the introduction of new traits into breeding programs is also different between breeds and it is evident that each breeding program must take their proper decisions. The economical relevance of these traits in each breed must determine the introduction or not introduction and their importance in the selection criterion.

We consider that further studies are necessary in order to confirm and validate our results in Latxa breed. At the present time the Latxa breeding program is looking for new criteria to include the composition milk traits in the selection criterion. Udder traits and SCC will be also recorded in order to control its evolution. Moreover, the genetic evaluation for udder morphology will be taken into account when the AI males are selected.

In order to take into account directly economical aspects into the breeding program, a study with the goal of calculating the economic weights of different traits will start soon.

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