α_{s1}-casein genetic variants in Sarda goat breed

G.M. Vacca[1], L. Chianese[2], A. Ghibellini[1], V. Carcangiu[1], R. Mauriello[2], P.P. Bini[1]

[1] Dipartimento di Biologia Animale – Università di Sassari, Italy.
[2] Dipartimento di Scienza degli Alimenti – Università di Napoli, Italy.

RIASSUNTO – Varianti genetiche dell'α_{S1}-caseina nella capra di razza Sarda – *Allo scopo di studiare la distribuzione degli alleli all'α_{S1}-caseina nella razza-popolazione caprina della Sardegna, è stata condotta un'indagine su 600 soggetti appartenenti a 24 aziende dislocate nelle aree dell'Isola dove il suo allevamento è maggiormente diffuso. La fenotipizzazione è stata effettuata mediante IEF, PAGE ed Immunoblotting, su campioni di caseina intera. L'elaborazione dei risultati ha mostrato una distribuzione degli alleli, significativamente differente tra le diverse zone. Nel complesso è emersa una prevalenza dell'allele B (74,4%) sugli alleli A (19,2%), E (3,7%), F (2,3%) ed I (0,5%). Si conferma come questa razza produca prevalentemente un latte "forte", pur conservando un'eterogeneità dalla quale si può attingere per selezionare linee genetiche per indirizzi produttivi diversificati.*

KEY WORDS: Sarda goat, milk, genetic polymorphism, α_{S1}-casein.

INTRODUCTION – Sardinia plays an important role in Italian goat breeding; this is due not only to the high extent of its patrimony and production, but also to the fact that the main breed, the Sarda goat, represents an interesting biodiversity source. As regards the morphologic variability, marked differences between subjects reared in the coast and mountain areas were found (Macciotta *et al.*, 2002). These differences are due to the genetic selection on the autochthonous patrimony, set up by breeders and based on coat colour, horn presence and/or on functional criteria (udder shape). The need to improve milk yields also induced various breeders, mainly in those areas with better pasture conditions, to crossbreed the Sarda goats with more productive breeds. The present situation (Pazzola *et al.*, 2002) shows how in the East coastal region (Sarrabus, Ogliastra and Baronia) and in the central mountain areas of Sardinia (Barbagia), subjects with more rural traits are reared (smaller size, small ears, presence of horns, etc.); while in the South and West areas (Sulcis and Guspinese) the influence of the Maltese breed is more evident. Both the productive traits variability (Brandano *et al.*, 1978), and the morphologic aspect, is of great interest. Genetic variability can influence the survival of a sector hindered by the opening of the markets and by the strong competitiveness of zootechnical areas technologically more advanced. According to this point of view, considering that casein fractions are closely related to milk technological characteristics (Grosclaude *et al.*, 1994), and to its possible productive differentiation (Remeuf, 1993), a study on α_{S1}-casein allelic frequency was carried out, related also to the breeding region. The aim of the study is to acquire useful information in order to suggest an appropriate utilization of milk, to detect possible new alleles and to test the correlation between casein phenotype and morphology of the animals.

MATERIAL AND METHODS – The main areas of diffusion of Sarda goat were investigated: Baronia, Nuorese-Barbagie, Ogliastra, Sarrabus-Gerrei, Guspinese-Iglesiente and Sulcis. In each zone, four farms were examined, in which anamnestic data concerning the genetic selection, set up in the last decades, were collected and 25 lactacting goats were randomly chosen. For each of the 600 selected ani-

mals, a descriptive schedule was filled in with the following morphologic characters: coat color, ear size, udder shape, horn presence. Moreover, the daily milk production was recorded and a milk sample was submitted to laboratory analyses. Whole casein was prepared by acid precipitation of skim milk (Aschaffenburg *et al.*, 1959), then dialysed and lyophilised. Phenotypical analysis of α_{S1}-casein was performed by UTLIEF in the 2.5-5.4 pH range (CEE 690/92), vertical disc-PAGE at pH 8.6 and immunoblotting (Chianese *et al.*, 1996). The comparisons of frequencies were made by χ^2 test.

RESULTS AND CONCLUSIONS – Table 1 shows the phenotype frequencies at α_{S1}-casein locus in different areas of Sardinia.

Table 1. Phenotype frequencies at the α_{S1}-casein *locus* in Sarda goat breed.

	AA	AB	AE	BB	BF	EE	EF	EI	FF	IF
Sulcis	11	28		58			3			
Iglesiente-Guspinese	9	36		54	1					
Sarrabus-Gerrei	7	21		66	3		2		1	
Ogliastra	8	14		75			2		1	
Nuorese-Barbagia	14	10	2	57	1	2	7	1	2	4
Baronia	5	11		70	8		5	1		
Total	54	120	2	380	13	2	19	2	4	4

Chi-square test of independence (P<0.001)

The χ^2 test indicates the significant differences (P<0.001), in allelic frequencies, both within and between the areas examined. Considering all the data, the most represented phenotype is BB (63.3%), followed by AB (20%), AA (9%), EF (3.2%), BF (2.2%), FF and IF (0.7%), AE, EE and IE (0.3%) phenotypes, whose genotype frequencies are: B (74.4%), A (19.2%), E (3.7%), F (2.3%) and I (0.5%). Comparing to data reported by Iametti *et al.* (1999) and Ghibellini *et al.* (2000) on the same breed, a larger frequency of the B allele (74.4%) and the absence of the null allele were detected. Finally, the I allele (0.5%) was also identified in Sarda breed, as well as Ionica, Garganica, Maltese and Siriana (Chianese *et al.* 1996). The B allele prevalence is the most important result, in particular for the high quantitative expression (5.3 g/l for allele) associated with this allele in Sarda goat (Ghibellini *et al.*, 2001). The B allele prevails in the East coast, while the farms where goats were crossbred mostly with Maltese breed displayed the highest frequencies of the A allele. In the milk of goats reared in the Sardinia centre, in addition to "strong" alleles (A and B) with high α_{S1}-casein content, "intermediate" (E and I) alleles and "weak" allele (F) with lower content of α_{S1}-casein were detected, showing a higher genetic variability in the goats reared in this zone. In Table 2 the morphologic trait frequencies for each casein phenotype are shown.

Table 2. Distribution of morphological traits (%) within groups of Sarda goats with different α_{S1}-casein phenotype.

		AA	AB	AE	BB	BF	EE	EF	EI	FF	IF
Horns	Absence	31.5	27.3	50	25.9	23.1		26.3	25	100	50
	Presence	68.5	72.7	50	74.1	76.9	100	73.7	75		50
Udder conformation	Pyriform	20.4	26.4		25.9	15.4		21.1	25		
	Intermed.	22.2	23.1		17.7	15.4		15.8	25	50	25
	Globose	57.4	50.4	100	56.5	69.2	100	63.2	50	50	75
Ear size	Small	9.26	8.26		25.9	7.69	50	10.5	0		
	Middle	63.0	61.2	100	55.7	61.5	50	42.1	50	50	
	Big	27.8	30.6		18.5	30.8		47.4	50	50	100
Coat colors	White	35.2	41.3	50	36.4	30.8		26.3		50	75
	Black	7.41	6.61		5.01	7.69		15.8			
	Red	5.56	11.6		10.8	23.1	100	5.26	50		
	Grey	9.26	11.6		10.8	7.69		15.8	50		
	Spotted	42.6	28.9	50	36.1	30.8		36.8		50	25

Chi-square test of independence (P<0.001)

Significant correlation between casein phenotype and morphological traits was found. In particular, the frequency of the "small ears" trait was lower in the subjects with AA, AB and AE casein phenotype with respect to the mean of population (9.3%, 8.3% and 0% vs 19.5%). These data are in agreement with the observation of high frequency of A alleles in the Maltese goats found by Greppi *et al.* (1996). In conclusion, these results clearly point out the appropriate utilization of goat milk made in Sardinia, where it is mainly utilised in cheesemaking, since the best technological properties of the milk are associated with the "strong" alleles. Moreover, they also represent an input for further investigation, in order to improve knowledge about this genetic patrimony and to safeguard its biodiversity.

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