STUDY OF THE GENETIC VARIABILITY OF THE NEGRA SERRANA GOAT BREED

ESTUDIO DE LA VARIABILIDAD GENETICA DE LA RAZA CAPRINA NEGRA SERRANA

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Palabras clave adicionales
Raza minoritaria. Polimorfismo bioquímico sanguíneo. Heterocigosidad.

SUMMARY

The *Negra Serrana* goat breed is considered to be endangered by extinction because of its reduced stocks. In this kind of populations with high risk of reproductive problems due to high consanguinity, is interesting to know the genetic variability; thus, we used biochemical blood polymorphisms to determine its genetic status and calcule the heterozygosity and imbreeding coefficients both, in the total population as well as in three subpopulations.

We have observed that two of the subpopulations are very similar and show few genetic differences, but they do differ from the third group that shows the greatest heterozygosity and the least inbreeding.

RESUMEN

La población caprina *Negra Serrana* está considerada como una raza en peligro de extinción, por su reducido número de ejemplares y su reciente reconocimiento oficial. El interés de conocer la variabilidad genética en poblaciones de este tipo, con alto riesgo de problemas reproductivos derivados de una alta consanguinidad, nos indujo a utilizar los polimorfismos bioquímico sanguíneos para determinar su *status* genético.

A partir de las frecuencias génicas, se han calculado los coeficientes de heterocigosidad y consanguinidad para el total de la población y cada uno de los tres rebaños que la componen; dos de ellos son similares, el tercero muestra mayor heterocigosidad y menor consanguinidad.

El conjunto poblacional presenta gran déficit de heterocigotos, pero no el tercer rebaño.

INTRODUCTION

The Negra Serrana goat breed recognized by the Junta of Andalucía as an endangered breed, is eminently apt for meat production (Delgado *et al*, 1992). It survives because of its adaptation to a difficult mountainous

habitat, such as we find in the Jaén region of the Sierra Morena mountains.

Previous knowledge of its zootecnical features are complementary and its conservation fits within the necessary pautas according to Primo (1987), Alderson (1985) and Clarke *et al.* (1989). The study should be intensified because of it deals with a breed threatened by extinction on account of its racial indefinition due to its lack of recognition during so many years.

The Negra Serrana breed, in spite of being pointed out (Cobos, 1950) as a Guadalquivir breed situated in that geographic region, was not included in the official catalogue of Spanish autochtonous breeds until its second edition (Esteban y Tejón, 1986), in which its general traits were described and it was referred to in the popular term of *castiza*, as it was known by the local people. Afterwards it was studied by Alia (1982) from a production and morphological point of view. Production studies on the growth of the breed in kids was later broadened by González (1989).

The present work aims to complete the knowlege of this breed from a base of blood polymorphism as well as, evaluating by this method the status of genetic variability in a breed with such a reduced population.

MATERIAL AND METHODS

We studied a total of 138 animals both male and female of the Negra Serrana breed located in Vilches (Jaén) but geographically well separated and so, without reproductive relationship.

Through starch gel electrophoresis 6 polymorphic blood systems were studied:

- In erythrocytes: Haemoglobin (Hb) (Huisman *et al.*, 1958); Catalase (Cat) (Kelly *et al.*, 1971); Protein X (Prot X) (Tucker *et al.*, 1967; Carbonic Anhidrase (CA) (Tucker *et al.*, 1967)
- In plasma: Albumins (Alb) (Rodero *et al.*, 1977); Transferrins (Tf) (Efremov and Braend, 1965).

We also measured the level of Na^+ and K^+ in erythrocytes, by flame spectrophotometry.

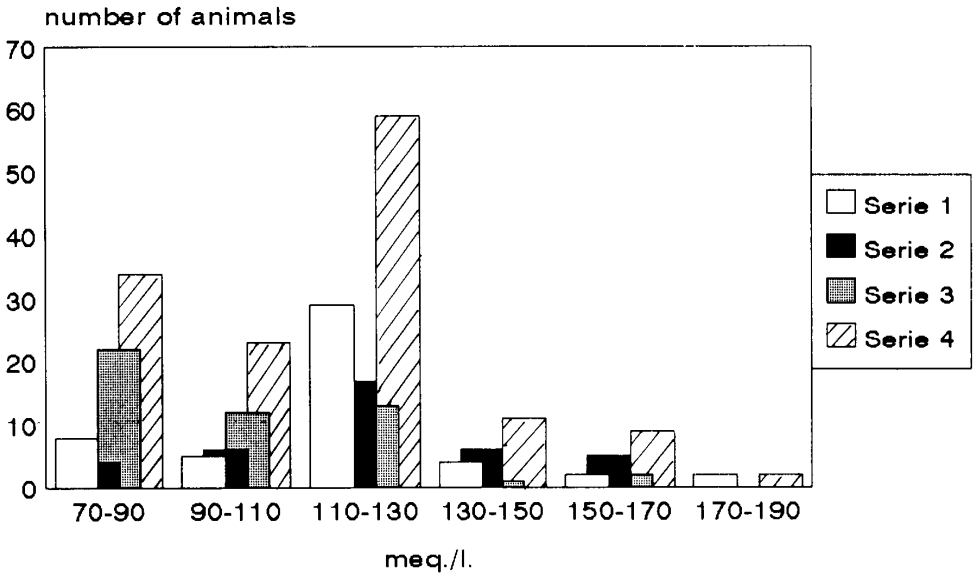
We obtained the genotype and allelic frequencies, both in the total population and separate flocks. We considered the population to be on the Hardy-Weinberg equilibrium.

With the data obtained were able calculate the coefficients of identity among the possible couples within the flock, and from this, estimate the matrix of genetic distances among the populations by which we obtained the philogenetic representation of the three populations (flocks).

Using the calculation of heterozygousity we got the coefficients of inbreeding (Wright, 1965) in each flock (farm) as well as in the overall total of the animals studied.

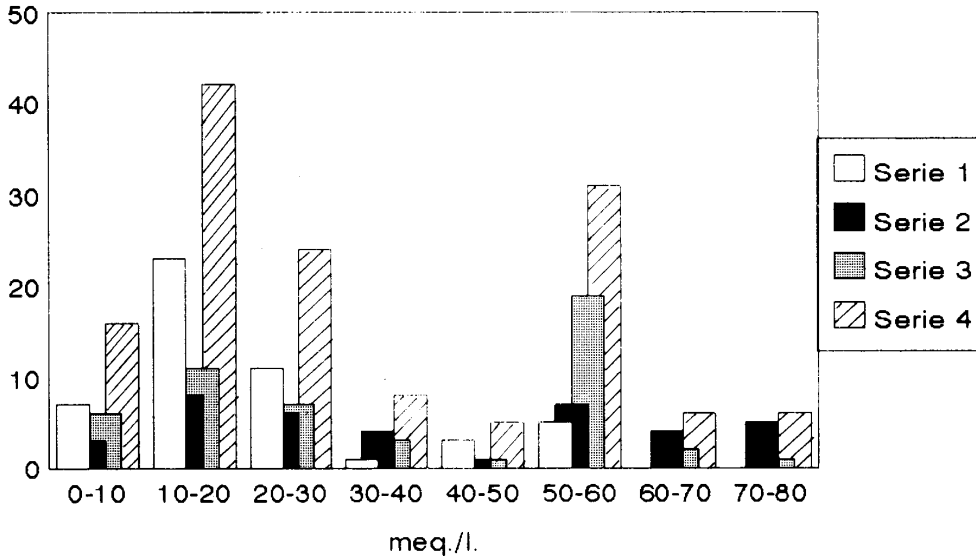
RESULTS AND DISCUSSION

In figures 1 and 2 we show by striped histograms the level of Na^+ and K^+, respectively, for each flock and the overall population. It is notable that the 1st and 3rd flocks, differ greatly in their levels of K^+ in red cells. Animals with low potassium predominated in the 1st flock, while in the 3rd flock, animals with high



SERIE1=FLOCK1, N=50; SERIE2=FLOCK2, N=38; SERIE3=FLOCK3, N=5(
SERIE4=OVERALL POPULATION, N=138.

Figure 1. *Levels of Na+ for each flock and the overall population.* (Niveles de Na+ eritrocitario en cada rebaño y en la población total).



SERIE1=FLOCK1, N=50; SERIE2=FLOCK2, N=38; SERIE3=FLOCK3, N=5(
SERIE4=OVERALL POPULATION, N=138.

Figure 2. *Levels of K+ for each flock and the overall population.* (Niveles de K+ en cada rebaño y en la población total).

Table I. *Allele frecuencies of each system for each flock and the total of the animals (N= number of animals).* (Frecuencias alélicas en los 3 rebaños y en el total de la población (N= número de animales).

Systems	Alleles	Flock1	Flock2	Flock3	Total
Hb	A	1.00	1.00	0.83	0.94
	B	0.00	0.00	0.17	0.06
(N)		50	38	32	120
Tf	A	1.00	1.00	0.99	0.99
	B	0.00	0.00	0.01	0.01
	C	0.00	0.00	0.00	0.00
(N)		50	38	47	135
Alb	S	0.96	0.885	0.98	0.94
	F	0.04	0.115	0.02	0.06
(N)		50	38	50	138

levels of potassium predominated. In flock No. 2 there is a more moderate distribution in the levels.

With respect to the Na^+ levels, it should be pointed out that the histogram for the 1st flock is that which best fits the representation of the frequencies for the total population.

Table I shows the gene and allele frequencies of each system for each flock and for the total of the animals.

The Hb and Tf systems were monomorphic for the 1st and 2nd populations but not for the 3rd. Furthermore, no polymorphism showed, in any case, the system of Carbonic Anhidrase.

Tables II and **III** show the matrixes of identity and genetic distances whose results are shown in the dendogram of **figure 3**. From all of this, we can appreciate the greatest similarity between the 1st and 2nd flocks, that showed the maximun distance with respect to the 3rd, even though this is closer to the 1st than the 2nd. This last flock (2) had the highest coefficient of inbreeding and the greatest number of heterocygotes, as is observed in the results shown in **table IV**.

CONCLUSIONS

We have observed in the 3rd group of animals both through visual appreciation of the animals as well as through the analysis of blood polymorphism a great distance with respect to the other flocks, we have inferred

Table II. *Identity matrix between flocks.* (Matriz de identidad entre rebaños).

	Flock 1	Flock2	Flock3
Flock1	1		
Flock2	0.9938	1	
Flock3	0.9926	0.9907	1

Table III. *Matrix of genetic distances between flocks.* (Matriz de distancias genéticas entre rebaños).

	Flock 1	Flock2	Flock3
Flock1	0.0000		
Flock2	0.0062	0.0000	
Flock3	0.0074	0.0093	0.0000

that the animals of this group may be the most apt for establishing plans for conservation of this breed, if there exist any problems caused through the high inbreeding and the loss of genes, habitual in reduced flocks. The selection of this group is subject to the condition that the animals fit within the pre-established racial canons, in case that, this diference were not produced by the introduction of rare alleles from other breeds (Clarke *et al.*,1989).

In the overall animals studied, except for the Hb system, it was noted that the heterocygosity was less that what may be expected in a population on the Hardy-Weinberg equilibrium. The high consanguinity obtained in flocks shows a great deficiency in heterocygotes. For this reason, we suppose that there had been a tendency, direct or indirectly attempted, toward mating endogamically.

Having the best consanguinity in the overall average of the flock, seems to indicate the existence of the "F" value between the certain subpopulations (Jordana *et al.*, 1991). Keeping in mind that this value can be taken as a measure of the genetic distances between them. This may be due to the deviation of the 3rd flock.

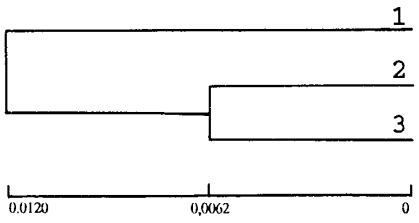


Figure 3. *Dendrogram showing the genetic affinity of goat populations.* (Dendrograma mostrando la afinidad genética de las poblaciones).

Table IV. *Coefficients of inbreeding and number of heterocygotes.* (Coeficientes de consanguinidad y número de heterozigotos).

	Flock1		Flock2		Flock3		Total	
	Het. Obs.	Het. (H.W.)	Het. Obs.	Het. (H.W.)	Het. Obs.	Het. (H.W.)	Het. Obs.	Het. (H.W.)
Hb	0.0000	0.0000	0.0000	0.0000	0.3333	0.2822	0.1176	0.1128
Tf	0.0000	0.0000	0.0000	0.0000	0.0208	0.0139	0.0073	0.0129
Al	0.0800	0.0768	0.1316	0.2035	0.0000	0.0392	0.0652	0.1128
Cat	0.1400	0.1958	0.3422	0.3750	0.2857	0.2656	0.2482	0.2722
CA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
F	0.1216		0.2197		0.0583		0.2829	

REFERENCES

Alderson, L. 1985. The conservation of animal genetic resources in Great Britain . In: AGRI/ FAO Animal Production and Health Paper: 26-36.

Alia, M.J. 1987. Estudio etnológico y productivo de la agrupación caprina "Negra Serrana"; Universidad Complutense de Madrid. Facultad de Veterinaria.Tesis Doctoral.

Clarke, S.W., E.M. Tucker and S.J.G. Hall. 1989. Genetic polymorphisms and their reltionships with inbreeding and breed structure in rare british sheep: The portland, Manx Loghtan, and Hebridean. *Conservation Biology* ; 3: 381-388.

Cobo, E. 1950. El ganado cabrío en la provincia de Jaén; *Bol. Zootec.* 58, 195-198.

Delgado, J.V., E. Rodero, M.E. Camacho y A. Rodero. 1992. Razas autóctonas andaluzas en peligro de extinción. Edit. Consejería de Agricultura y Pesca de la Junta de Andalucía. p.p: 35-36.

Efremov, G. and M. Braend. 1965. Haemoglobins, transferrins and albumins of sheep and goats . IX European Conf. Anim. Blood Groups; pp: 312-313.

Esteban, C. y D. Tejón. 1986. Catálogo de razas autóctonas españolas. I- Especies ovina y caprina. Edit. Ministerio de Agricultura, Pesca y Alimentación. pp: 201-207.

González, A. 1989. Cebo de cabritos de raza Negra Serrana hasta los 90 dias de edad. Universidad de Córdoba. Facultad de Veterinaria. Tesina de Licenciatura.

Huisman, T.H.J., G. Ulliet and T. Van Setens. 1958. Sheep Haemoglobins; *Nature* 182: 171-181.

Jordana, J., J. Piedrafita y A. Sanchez. 1991. Variabiliadad y relaciones geneticas de cinco poblaciones de la raza canina "Gos D'Atura"; *Invest. Agr.: Prod. Sanid. anim.* 6: 211-223.

Kelly, E.P., C. Stormont and Y. Suzuky. 1971. Catalase polymorphism in the red cells of horses. *Animal Blood Groups and Bioch. Genet.*; 2: 135-143.

Primo, A.T. 1987. Conservation of Animal Genetic Resources: Brazil National Programe; In: AGRI/FAO. Animal Production and Healt, Paper 66: 165-173.

Rodero, A., R. Garzón, I. Zaragoza, A. Vallejo, D. Llanes, J. Luque, C. Povedano y J.M. Rodero. Fundamentos históricos y genéticos del Merino Español. Publicaciones del Monte de Piedad y Caja de Ahorros de Córdoba. Córdoba.

Tucker, E.M., Y. Suzuki and C. Stormont. 1967. Three new phenotype systems in the blood of sheep. *Vox Sang.*; 13: 246-262.

Wright, S. 1965. The interpretation of population structure by F-statistics with special regard to systems of mating. *Evolution*; 19: 395-420