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ERITHROCYTE GSH CONCENTRATION IN THE MALAGUEÑA GOAT BREED.*

CONCENTRACIÓN DE GSH ERITROCITARIO EN LA RAZA CAPRINA MALAGUEÑA.

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Summary

A population of the Malagueña goat breed, composed of 33 adult animals (2 males and 31 females) and their 60 offspring, aged 2-2.5 months, was studied for the erythrocyte GSH level. Significant differences between adult and offspring mean values were detected. The estimates of heritability suggest the existence of a strong genetic component for this character. No relation between transferrin types and GSH level was detected.

Resumen

Una población de la raza caprina malagueña, compuesta por 33 animales adultos (2 machos y 31 hembras) y sus descendientes (60 individuos, con una edad de 2-2,5 meses), ha sido estudiada en cuanto al GSH eritrocitario. Se han encontrado diferencias significativas entre los valores medios de adultos y chivos. Las estimas de la heredabilidad muestran la existencia de un componente genético fuerte para este carácter. No se ha detectado asociación estadísticamente significativa entre tipo de transferrina y de GSH.

* En homenaje al Profesor Doctor Don Diego Jordano Barea con motivo de su jubilación.

Introduction

Erythrocyte reduced glutathione (GSH) concentrations have been studied in several domestic animals. In sheep, Tucker and Kilgour (1970 and 1972), showed the existence of two types of animals, one with low (inferior to 60 mg/100 ml RBC) and another with high GSH concentration. They reported that levels of erythrocyte GSH appeared to be controlled by a single pair of autosomal alleles, the GSH^H allele, giving rise to GSH-high type, being dominant in the Finnish Landrace breed and recesive in the Australian Merino. Board et al. (1974), on the other hand, showed that, in the Australian Merino, the gene for the GSH-high type was also dominant. Finally, Abasova et al. (1979) described the two types in the Karakul breed and demonstrated that the allele controlling high concentration was dominant. In cattle, Makaveev (1979), published results in the Holstein-Friesian breed. He found, likewise, both GSH-high and low types, with dominance of the gene determining GSH-high level. With regard to goats, Agar et al. (1974 a) reported the mean erythrocyte GSH levels in 5 breeds. They found GSH-high and low animals in three of them (Saanen, Angora and British-Alpine), the GSH-high type being predominant (91%, 74% and 93%, respectively). The mean values ranged from 88.4 to 110.7 mg/100 ml RBC for the high type, and 52.4 to 55.2 for the low type. They did not give data about the genetic control of these types.

In our work, we present the results obtained concerning the erythrocyte GSH concentration in the Malagueña Spanish goat breed.

Material and methods

A total of 93 animals of Malagueña breed, comprising 2 males and 31 females, 15 of them covered by one of the males and 16 by the other, and their 60 offspring, aged 2-2.5 months, was analyzed. Data about parentage were verified by means of transferrin polymorphism, (Rasmusen and Tucker, 1973), without detecting errors.

Blood samples were collected by jugular puncture into Venoject tubes with heparine as anticoagulant. Erythrocyte GSH concentration was determined, within 10 hours from the time the samples were taken, spectrophotometrically, according to the method of Beutler et al. (1963). The values obtained are given in mg GSH/100 ml red blood cells (RBC).

Heritability estimates were calculated by two methods: offspring on dam regression and half-sib analysis of variance, both according to Falconer (1983).

Results and discussion

Table 1 shows the GSH levels obtained. They are graphically represented in figure 1. As can be observed, there is a difference in the mean value between adults (98.7 mg/100 ml RBC) and offspring (83.6 mg/100 ml RBC). The statistical significance of this difference was calculated by the Wilcoxon test, due to the non normal distribution of values in, at least, the adult animals. We found that the difference is statistically significant ($u=4.276$; $p<0.001$). There are various reports about erythrocyte GSH concentration in the inmediate post-natal period. The results in this regard show the existence of differences between species. For example, Smith and Morril (1974) and Agar et al. (1974b), reported significantly elevated levels in newborn calves compared with adult cattle. However, the latter did not find any difference between newborn and adult goats. In sheep, Agar and Roberts (1971), reported an initial decrease followed by a rise in Merino lambs erythrocyte GSH over the first eight weeks, while Smith (1973), failed to find any significant differences over the first 12 weeks in Corriedale and Southdown lambs.

The mean erythrocyte GSH level that group of adult animals presents falls within the range of values reported by Agar et al. (1974a). On the other hand, the mean levels of males (82.2 mg/100 ml) and females (84.9 mg/100 ml) offspring are not significant. Likewise, their variances are not statistically different.

The values in the group of adult animals range from 61.9 to 133.7 mg/100 ml RBC. If we consider individuals above 60 mg/100 ml as GSH-high type, as previously described for sheep (Tucker and Kilgour, 1972) and goats (Agar et al., 1974a), all of them belong to the GSH-high type. This makes impossible any genetic analysis concerning segregation of erythrocyte GSH level. However, we have found, in the offspring group, two animals with 37.3 and 48.4 mg/100 ml values. Increasing them even by a factor of 1.181 (the quotient between the adult and offspring means), they belong to the GSH-low type. As their parents are both GSH-high type, it follows that the GSH-low type is recesive in this population.

Table II contains the estimates of the erythrocyte GSH level heritability, by two methods. The first one, offspring on dam regression, includes a possible presence of maternal effects. The value obtained was $h^2=0.47$. The second method, half-sib analysis of variance, allows heritability estimates both from the dam (σ_D^2) and sire (σ_S^2) components. Both components are similar, $\sigma_D^2=10.4\%$ and $\sigma_S^2=12.1\%$, so we can conclude the non-existence of a significant quantity of variance due to maternal effects or non aditive geneticvariance. Therefore, the heritability estimate has been calculated as $2(\sigma_S^2 + \sigma_D^2)/\sigma_T^2$. The value obtained, h^2= 0.45, agrees with the one from the first method, although, in this case, with a greater standard error. This estimate suggests that the observed variation in the erythrocyte GSH level is determined, in a great part, by a genetic component. Board et al. (1974), in Australian Merino, reported, also, a high heritability value, h^2=0.7, for this character.

As we have indicated, data about parentage were verified by means of transferrin polymorphism. With these data, we have analyzed the relation between trasferrin type and erythrocyte GSH level. Table 3 shows the results obtained. No significant differences were found among the four transferrin type (F=2.105; F(0.05)=8.62, d.f.=3,29), although the presence of only one and three animals in the Tf AC and TF B types, respectively, could distort, in a great part, this result. Nevertheless, we conclude, with our data, that no relation exists between transferrin types and erythrocyte GSH levels.

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Table 1. Erythrocyte GSH levels (mg/100 ml RBC) in the Malagueña breed.

		Offspring		
	Adults n=33	Total n=60	Males n=29	Females n=31
Mean value ($\bar{x}$)	98.70	83.60	82.20	84.90
Standard deviation (σ_{n-1})	16.85	14.11	11.55	12.33
Standars error (S.E)	2.93	1.82	2.14	2.21
Range	61.9-133.7	37.3-122.61	-	-

n = number of animals

Table 2. Estimates of the erythrocyte GSH levels heritability. Population composed of adult animals and offspring aged 2-2.5 months.

Form of analysis	$h^2 \pm$ S.E.	Number of animals
Offspring on dam regresion	0.46 ± 0.24	87
Half-sib analysis of variance	0.45 ± 0.36	58

Table 3. Erythrocyte GSH levels in adult animals with different transferrin types.

Transferrin types	A	AB	B	C
Number of animals	11	18	3	1
Mean value ($\bar{x}$)	91.8	102,7	108.6	75.4
Standard error (S.E.)	4.84	3.79	8.79	-
Range	75.4-119.0	75.8-122.6	-	-

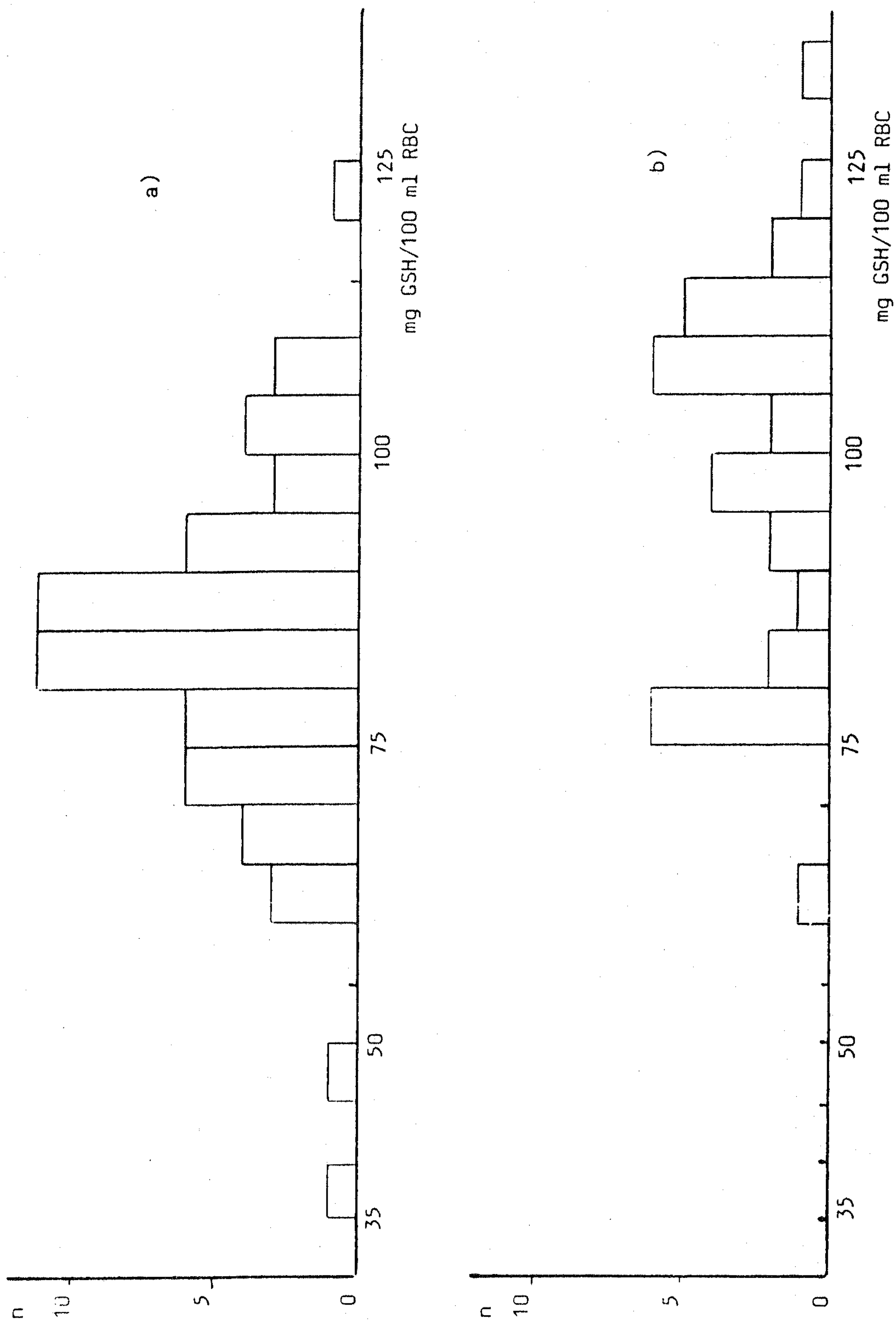

Figure 1.Distribution of the erythrocyte GSH levels in adults (a), and offspring (b). n = number of animals.