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SEGREGATION OF TRANSFERRINS IN CREOLE CATTLE IN ARGENTINA

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Electrophoretic methods with starch gel provide the opportunity to detect differences among the serum proteins of cattle. By changing the electrophoretic conditions, such as buffer, pH, time of running, etc, it is possible to vary the degree of separation for distinct proteins. The method developed by Smithies (1955) permitted the discovery of numerous genetic differences in blood serum.

In the European breeds, we find four major alleles (Tf^A, Tf^{D1}, Tf^{D2}, Tf^B) in the genetic system that controls the variation of transferrins. In the Zebu breeds, polymorphism is greater than in European cattle, with at least seven different alleles (Johansson and Rendel, 1972).

The genetic polymorphisms of blood are used in the study of evolution and of the relationships among different races (Braend *et al.* 1962). Some of the blood group systems are particularly important in cases where no pedigree is available but the genotype can be determined (Braend and Khanna 1968; Quinteros 1977).

The importance of genetic variation in serum proteins is not exclusively restricted to genetic, evolutionary and populations relationships, but also permits a better interpretation of the basic differences among species and among individuals. Additionally, this variability has an important relationship with disease resistance and physiological reactions because of the great advantage for some heterozygotes which maintains these polymorphisms (Braend and Efremov 1965; Quinteros 1977).

Research on iron-binding proteins (transferrins) done in different animal species including man, has shown that they are heterogeneous and that sialic acid is often the principal component responsible for this heterogeneity (Baker *et al.* 1968).

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Experimental research with abnormal transferrins (Spooner and Baxter, 1969) and fetal transferrins (Spooner *et al.* 1970) showed that at least three loci control their biosynthesis in cattle. These authors suggested that transferrin synthesis and expression are controlled by eight codominant alleles, some of which are characteristic for certain breeds, e.g. Tf^B and Tf^F in Zebu cattle.

As a continuation of our research on genetic markers in Argentine Creole cattle, we present here the results of our studies with transferrins in six "sire-family" groups with animals of the Sub-Estación Experimental Agropecuária of Instituto Nacional de Technologia Agropecuária, Leales, Tucumán, Republica Argentina.

Materials and Methods

Blood samples were collected from 128 Creole cattle from the SEEA Farm in Leales, Republica Argentina. These animals belong to six families distributed as shown in Table 1.

Table 1— *Distribution of the six families of Creole cattle from Leales Republica Argentina*

Family	Sire	Number of cows	Number of offspring	Total
1	Cr 145	12	12	25
2	Cr 255	16	16	33
3	Cr 271	4	4	9
4	Cr 113	15	15	31
5	Cr 237	8	8	17
6	Cr 119	6	6	13
Total	6	61	61	128

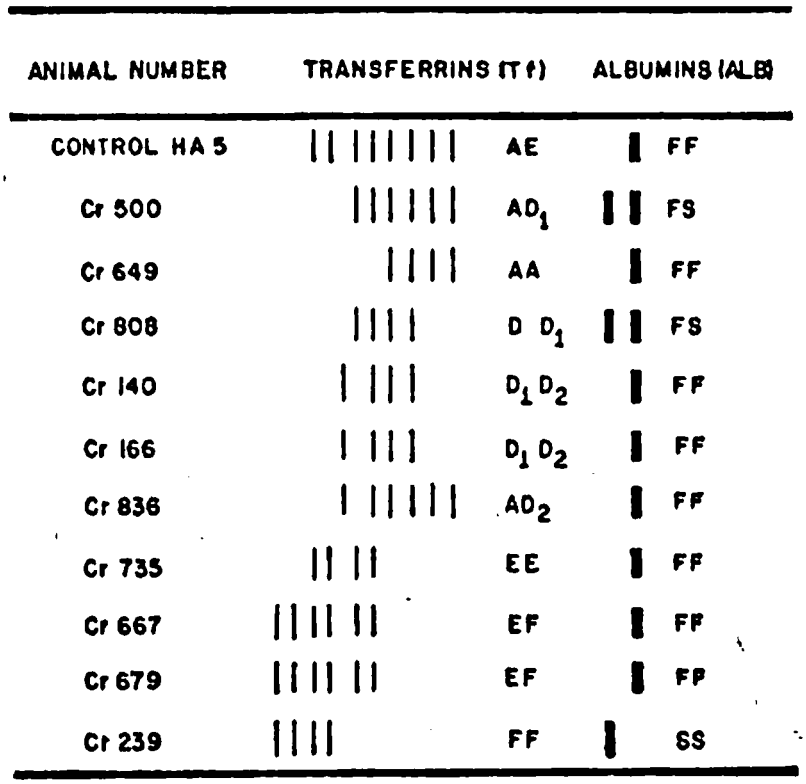
The serum protein types were determined by horizontal starch gel electrophoresis according to the method described by Kristjansson (1963), with some modifications (Quinteros and Miller, 1968). The staining techniques and the phenotypic classifications used have also been described by Quinteros and Miller (1968).

Results and Discussion

Nine transferrin phenotypes (AA, AD_1, AD_2, D_1D_1, D_1D_2, D_2D_2, EE, EF, and FF) were detected in the electrophoretograms. These differed in electrophoretic mobility as shown in the Figure.

The transferrin genotype frequencies and segregations for each family are shown in Table 2. None of the observed offspring distributions was significantly different from the

expected (X^2 = 1.913, p = .38). The gene frequencies of each allele observed are shown in Table 3. These Tables show that alleles Tf^A and Tf^{D1} occur in all families at high frequency, while the Tf^{D2} allele is much less common and alleles Tf^E and Tf^F particularly infrequent.



Schematic representation of electrophorectogram number 166, showing the Albumin (Alb) and Transferrin (Tf) phenotypes of 10 Creole cattle from Argentina.

We did not observe notable gene-frequency differences among family groups. When we compared the frequencies between sire and offspring these differences were smallest. According to Braend and Khanna (1968), gene frequencies are not easily changed. Thus genotypes A/A, A/D_1 and D_1/D_1 can be considered characteristic and useful genetic markers for the Creole Argentine breed.

When the transferrin phenotypes that occur in American breeds (Longhorn and Creole) are compared to those of other breeds, such as European or African breeds, the conclusions

are sometimes indirect. Also, even when the phenotypes look identical we cannot conclude for sure that they really are identical (Braend and Khanna, 1968).

Table 2—*Transferrin genotypes observed in the six Creole cattle families studied. In parentheses is the number of females with the same genotype.* *Means probable parentage error

Sire-family	Sire	Dam	Offspring							
			A/A	A/D_1	A/D_2	D_1/D_1	E/E	E/F	F/F	Total
Cr 145	A/D_1	A/D_1 (8)	3	4	—	1	—	—	—	17
		D_1 / D_1 (4)	—	1	—	3	—	—	—	8
Cr 119	A/D_1	A/D_1 (4)	—	2	—	2	—	—	—	9
		A/A (1)	1	—	—	—	—	—	—	2
		D_2 / D_2 (1)	—	—	1	—	—	—	—	2
Cr 255	A/A	A/D_1 (7)	2	5	—	—	—	—	—	15
		D_1 / D_1 (3)	—	3	—	—	—	—	—	6
		A/D_2 (3)	1	—	—	—	1*	—	1*	6
		D_2 / D_2 (1)	—	—	1	—	—	—	—	2
		D_1 / D_2 (1)	—	1	—	—	—	—	—	2
		A/A (1)	1	—	—	—	—	—	—	2
Cr 271	A/D_1	A/D_1 (3)	—	3	—	—	—	—	—	7
		D_1 / D_1 (1)	—	—	—	1	—	—	—	2
Cr 113	A/D_1	A/D_1 (8)	—	6	—	2	—	—	—	17
		A/A (3)	3	—	—	—	—	—	—	6
		D_2 / D_2 (2)	—	—	2	—	—	—	—	4
		D_1 / D_1 (1)	—	1	—	—	—	—	—	2
		F/F (1)*	—	—	1	—	—	—	—	2
Cr 237	A/D_1	A/D_1 (7)	—	7	—	—	—	—	—	15
		D_1 / D_1 (1)	—	—	—	—	—	1*	—	2
Total	6	61	11	33	5	9	1	1	1	128

Remarkable differences in transferrin gene frequencies exist among distinct cattle breeds, as may be seen, for example, when comparing the Muturu and N' Dama with Zebu breeds. The same occurs with the Z' factor blood which is unknown in Muturu and N' Dama breeds and is very common in Gudali and Bororo (Braend and Khanna 1968), Longhorn (Miller 1966) and Canchim (Quinteros *et al.* 1978 and Bortolozzi 1979). These considerations are important for racial studies dealing with the origin and relationship of cattle breeds.

Table 3—*Gene frequencies of transferrin alleles in Creole Argentine cattle. In parentheses are the gene frequencies of the offspring*

"Toro-Family"	Tf^A	Tf^{D_1}	Tf^{D_2}	Tf^E	Tf^F
Cr 145	.40 (.46)	.60 (.55)	-(-)	-(-)	-(-)
Cr 255	.49 (56)	.35 (.28)	.11 (03)	.03 (.03)	-03 (.06)
Cr 271	.39 (.38)	.61 (.63)	-(-)	-(-)	-(-)
Cr 113	.50 (.53)	.36 (.37)	.11 (.10)	-(-)	.03 (-)
Cr 237	.44 (.44)	.50 (.44)	-(-)	.03 (.06)	.03 (.06)
Cr 119	.42 (.33)	.46 (.33)	.12 (.33)	-(-)	-(-)
Total	.45	.45	.07	.01	.02

Serum transferrins have been studied in several cattle breeds. (For a review see Jamiesnn, 1966). The Tf^E gene has been found in low frequencies in Iceland cattle (Braend *et al.* 1962) and in Shorthorn and and Friesian cattle (Ashton 1958), while in the Swedish (Gahne 1961) and Danish breeds (Moustgard *et al* 1960) the frequency is relatively high. In small island groups obtained by natural or artificial selection, some genes can be eliminated from the populations by founder effect or genetic drift. This may have happened with the Tf^E allele in some breeds such as American Longhorn and Argentine Creole cattle.

In the population studied for transferrin loci, much polymorphic variation was noted This variation may be correlated with the environmental conditions in the south of Argentina, but our data do not permit the confirmation of this hypothesis. The occurrence in low frequency of the Tf^E allele, also very rare in Longhorn cattle, may be considered a new element to be used in future comparisons between Longhorn and Creole cattle.

Four cases of apparent parentage error were observed (Table 2), all involving alleles Tf^F and Tf^E. While there are other possible explanations for these results, we believe parentage error to be the most probable one. We have no strong evidence for the occurrence of Tf^F and Tf^E in the Creole breed, although we have observed these alleles in recent studies on other families and breeds in Argentina.

Summary

Nine transferrin phenotypes, Tf AA, AD_1, AD_2, D_1D_1, D_1D_2, D_2D_2 EE, EF and FF were detected by electrophoresis of blood serum from 128 cattle from the Instituto Nacional de

Technologia of Leales, Tucumán (Republica Argentina). These animals belong to six "sire-family" groups. The gene frequencies were : Tf^A = .45, Tf^{D1} = .45, Tf^{D2} = .07, Tf^B = .01 and Tf^F = .02. The large predominance of alleles Tf^A and Tf^{D1} induced us to conclude that they can be considerd characteristic and useful genetic markers for the Creole cattle. Another allele was observed in the Creole breeds and temporarily called Tf^F.

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REFERENCES

Ashton, G.C. (1958) ... *Nature Lond* 182 : 370
Baker, E., Shaw, D.C. and Morgan, E.H. (1968) ... *Biochemistry*, 7 : 1371
Bortolozzi J. (1979) ... Thesis. IBBMA-UNESP. 172 pp.
Braend, M and Efremov, G. (1965) ... *Nord. VetMed.* 17 : 585
————, Khanna, N.D. (1968) ... *Anim. Prod.* 10 : 129
————, Rendel, J., Gahne B. and Adalsteinsson, S. (1962) ... *Hereditas* 48 : 264
Gahne, B. (1961) ... *Anim. Prod.* 3 : 135
Jamieson, A. (1966) ... *Heredity* 21 : 191
Johansson, I. and Rendel, (1972) ... *Genetica Animal* Editorial Acribia. España, 567 pp.
Kristhansson, F.K. (1963) ... *Genetics* 48 : 1059
Miller, W J. (1966) ... *Ibid* 54 : 391
Mourigard, J., Moller, F. and Sorensen, P.H (1960) ... *Inmunog. Edinb. Org.* 122 p.
Quinteros, I.R. (1977) ... *Mendeliana* 2 : 1
———— and Miller, W J. (968) ... *Biochem. Genet.* 2 : 213
————, Bortolozzi, J , Magalhães, L.E. and Faulin, P.G. (1978) ... *Resumos SBPC* : 540
Smithies, O. (1955) ... *Biochem. J.* 61 : 622
Spooner, R.L. and Baxter, G. (1969) ... *Biochem. Genet.* 2 : 371
————, Land, R B., Oliver, R.A. and Stratil, A. (1970) ... *Anim. Blood Grps. Biochem. Genet.* 1 : 241