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Polymorphism of Blood Serum Post-Albumins in Lowland Black-and-White Cattle of North-Western Poland

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Summary. The authors showed polymorphism of the blood serum post-albumins in a population of Lowland Black-and-White cattle. Having tested 1001 samples of blood serum they found three Poa phenotypes, Poa FF, Poa SS and Poa FS, which were controlled by 2 codominant alleles, Poa^f and Poa^s. The frequencies of these alleles were: $Poa^f = 0.5245$ and $Poa^s = 0.4755$. The contribution of each Poa phenotype in the studied population was: Poa FF = 20.88%, Poa SS = 25.77% and Poa FS = 53.35%. The method used by the authors was based on Geldermann's method (1970) and allows simultaneous determination of the phenotypes of post-albumins and transferrins in cattle blood serum.

The polymorphism of blood serum post-albumins (Poa) was first determined by Gahne (1962). Having tested 426 samples of cattle serum he revealed 3 phenotypes of post-albumins: Poa AA, Poa AB, Poa BB. On the basis of twin studies using 48 pairs of monozygous twins, he ascertained that the 3 phenotypes of serum post-albumins were determined by 2 codominant alleles: Poa^A and Poa^B.

Further investigations made by Gahne (1963) led to the determination of polymorphism of the post-albumins for the following cattle breeds: Swedish Red and White (SRB), Swedish Frisian (SLB), Swedish Polled (SKB) and Jersey bred in Sweden.

Ashton (1963) proved the polymorphism of Poa in crossbreds from the following cattle breeds: British (Shorthorn and Hereford), Afrikaner Brahman and Grade Brahman.

Further investigations of Ashton and Lampkin (1965) determined polymorphism in blood serum Poa of the cattle bred in Eastern Africa. They proved that the frequency of Poa alleles in African cattle differs from that of European cattle breeds. Salerno (1964), Salerno and Principe (1972) investigated Poa polymorphism of Romagna cattle bred in Bologna, Ravenna, Ferrara and Forli as well as in the buffalos bred in the provinces of Campania and Latium.

The Poa polymorphism of German cattle breeds (in West Germany) was assessed by Geldermann (1970b).

Belayev and Fomicheva (1968) indicated polymorphism of this serum protein in Yakutian and Estonian Black-spotted cattle bred in the area of Siberia.

Simultaneously other studies were made to ascertain the eventual correlation between the phenotypes of post-albumins and the breeding traits of cattle or the animals resistance against unfavorable conditions of the environment.

Ashton (1972) studied the correlations between the Poa phenotypes of Guernsey (180 cows) and Holstein (599 cows) cows' blood serum and a series of parameters of fertility. He proved that the heterozygous cows having Poa genotype FS show less return-of-service and a shorter mean return interval. Ashton et al. (1966) did not state any correlation between the frequencies of Poa genotypes in the blood serum of 2 populations (361 cows) descended from crossing the Zebu cattle (Brahman breed) with Shorthorn and the cows' resistance to drought.

The aim of our investigations was to determinate the Poa polymorphism in blood serum of the Lowland Black-and-White cattle bred in Poland, in the area of West Pomerania. These cattle are descended mainly from West Frisian (Dutch) bulls or their descendants.

Methods and Materials

The studied material consisted of 1001 head of Lowland Black-and-White cattle from the area of West Pomerania.

The phenotypes of post-albumins were determined by horizontal electrophoresis on starch gel (first used by Smithies, 1955, 1959), with Geldermann's (1970a) modification and certain additions of our own, which were worked out during the preliminary period of using this method in our investigations. The modification lay in the composition of the gel buffer: 5.2 g Tris, 2.6 g citric acid, 0.18 g lithium hydroxide (instead of 0.1 g given in Geldermann's method), 1.5 g boric acid, 1000 ml distilled water. The starch gel was prepared from 25 g hydrolyzed starch (from the Connaught Laboratory, Canada) and 200 ml gel buffer.

The glass plates measured 20×30×0.6 cm. The buffer of the electrode containers consisted of 3.7 g sodium hydroxide, 18.5 g boric acid and 1000 ml distilled water.

A further modification consisted of using current of 170 V for an hour during the first phase. After removing scraps of blotting paper from the gel, a 500 V current was used during the second period of electrophoresis. The electrophoresis was stopped when the borate line migrated 14 - 15 cm from the start line. All remaining parameters of electrophoresis were kept strictly after Smithies (1955) and Geldermann (1970).

This method can be used like Geldermann's to determine transferrins and post-albumins simultaneously in blood serum of cattle and was exploited by the authors in further studies. The nomenclature of Poa phenotypes used here was taken from Ashton (1972).

To ascertain the genotype of the studied trait, the population of cattle was analyzed in systems of families: dam, sire, progeny.

Results and Discussion

The studies helped to determine polymorphism of blood serum post-albumins (Poa) in Lowland Black-and-White cattle. The Poa polymorphism was revealed by the existence of 3 different phenotypes controlled by two fractions (Figs.1,2) having different speeds of migration in the electric field.

The fastest migrating fraction was marked F, the slower one S.

The investigations into family systems indicated that these fractions are controlled by two codominant alleles Poa^F and Poa^S, which produce three phenotypes: Poa FF, Poa SS and Poa FS.

In the studied population of 1001 head of cattle (Table 1), 258 members had the phenotype Poa FF (20.88%), 209 members the phenotype Poa SS (25.77%) and 534 the phenotype Poa FS (53.35%).

Comparison of the observed and expected distribution of phenotypes of Poa in the studied population shows that the population was in a state of genetical equilibrium (Table 2). The frequencies of Poa alleles were Poa^F = 0.5245 and Poa^S = 0.4755.

Table 1. The frequencies of the post-albumins phenotypes in the studied population of Lowland Black-and-White Polish cattle

Total number of individuals	Parameters	Post-albumins phenotypes		
		Poa FF	Poa SS	Poa FS
1001	Head	258	209	534
	%	20.88	25.77	53.35

Poa^F = 0.5245
Poa^S = 0.4755

Table 2. The observed and expected contribution of the post-albumins phenotypes in the studied population

Breed	Distribution	Total numbers of individuals	Phenotypes		
			Poa FF	Poa SS	Poa FS
Lowland Black-and-White	observed	1001	258	209	534
	expected	1001	257.37	226.33	499.30

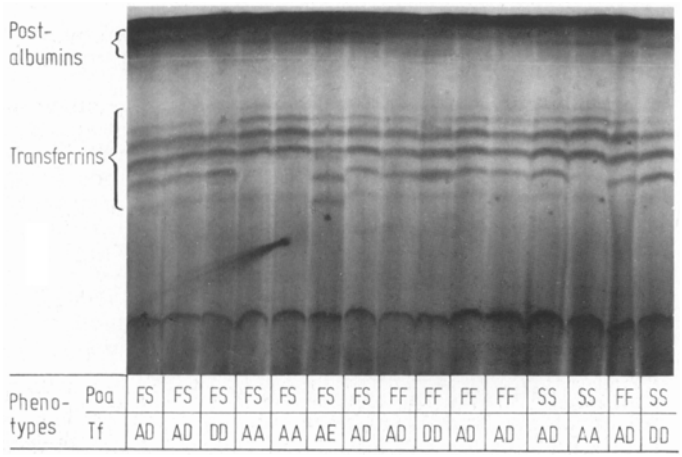

Fig.1. Post-albumin and transferrin phenotypes

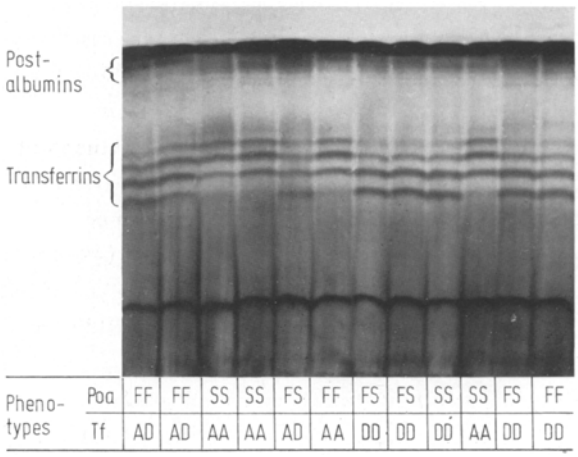

Fig.2. Post-albumin and transferrin phenotypes

Table 3. The frequencies of the alleles controlling post-albumins phenotypes in blood serum of different breeds of cattle

Breed	N	Alleles		Reference
		Poa^F	Poa^S	
Swedish Red and White (SRB)	1030	0.388	0.612	
Swedish Frisian (SLB)	273	0.789	0.216	Gahne (1963)
Swedish Polled (SKB)	48	0.792	0.208	
Jersey	19	1.000	-	
Shorthorn		0.19	0.81	Ashton (1963)
Romagna	202	0.1287	0.8713	Salerno (1964)
East African Zebus		0.68	0.32	Ashton, Lampkin (1965)
Droughtmaster	361	0.54	0.46	Ashton et al. (1966)
Brahman		0.89	0.11	
Estonian Black-Spotted	156	0.270	0.730	Belayev, Fomicheva (1968)
Yakutian	152	0.745	0.255	
German Frisian	1803	0.3912	0.6088	
German Red-and-White	907	0.2844	0.7156	Geldermann (1970b)
German Fleekvich	177	0.1671	0.8329	
Buffalo	660	0.7144	0.2856	Salerno, Principe (1972)
Lowland Black-and-White	1001	0.5245	0.4755	This publication (1975)

The obtained material shows that the frequencies of the blood serum Poa alleles of Lowland Black-and-White cattle of the studied population differ from those observed by other authors in different cattle breeds (Table 3). The nearest frequency of Poa alleles has been obtained in Droughtmaster cattle, having 50% Shorthorn blood and 50% blood of Brahman cattle.

Our investigations, as well as previous studies concerning polymorphism of serum post-albumins of certain cattle breeds in Europe, Asia, Africa and the United States of America, indicate that cattle are characterized by three phenotypes of blood serum post-albumins.

Conclusions

1. In the studied population of Lowland Black-and-White cattle from North-Western Poland (1001 head), there are three phenotypes of the blood serum post-albumins, Poa FF, Poa SS and Poa FS, controlled by two codominant alleles, Poa^F and Poa^S. The contribution of each phenotype in the studied population of cattle was 20.88%, 25.77% and 53.35%, respectively.

2. The frequencies of the alleles controlling blood serum post-albumins in the studied population were Poa^F = 0.5245 and Poa^S = 0.4755.

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