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RELATIONSHIP BETWEEN SERUM TRANSFERRIN TYPES AND FERTILITY IN THREE BREEDS OF IRANIAN SHEEP[1]

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Abstract — By means of horizontal starch gel electrophoresis, eight different transferrin alleles in 30 out of 36 possible genotypes were identified in three breeds of fat-tailed, carpet wool Iranian sheep (Karakul, Mehraban and Naeini). These alleles in order of decreasing mobility in electrophoresis were: I,A,B,C,D,M,E and P.

Data were collected on the reproductive performance of 443 ewes mated with 22 rams in nine possible mating classes (three breeds and three reciprocal crosses). There were highly significant differences among the three breeds in reproduction activity as measured by the rate of conception.

Data were also examined by classifying the ewes according to their reproductive performance and transferrin types. No significant difference was observed among the 11 transferrin types in their reproductive activity.

Age of dam was an important factor affecting fertility.

INTRODUCTION

Serum transferrins play an important role in the mechanism of iron transport in blood. Their genetic control was first reported by Ashton [4] as consisting of a series of multiple codominant autosomal alleles. The number of alleles differs among species and breeds and it is characteristic of each. More than 20 transferrin alleles (I,A,G,B′, B′Hungary, B,C,C, Hungary, M,D,U,N,N Hungary, Q,E,R,V,P,E_2,H,A^+,B^+ and E^-) have been reported in sheep [1,3,4,6,8,9–12,15,17,18,21].

Genotypic differences in transferrin types have been reported to influence or be related to some economic traits such as fertility and milk and wool production in domestic animals [2,5,7,13,14,16]. Where such associations exist, determination of different transferrin types could serve as a useful and early aid in the selection programs with farm animals.

The purpose of this investigation was to study the relationship between fertility and transferrin genotypes in three Iranian breeds of sheep.

MATERIALS AND METHODS

This study was made on three fat-tailed, carpet wool Iranian breeds of sheep namely Karakul (K), Mehraban (M) and Naeini (N). All the sheep used in the experiment were

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from the flock of the College of Agriculture, Pahlavi University. The breeding season extended from about 20 July to 10 September 1972. Ewes were assigned randomly to rams in each breeding group (8K, 8M and 6N rams were used). Allocation of the rams to the ewes was random with respect to the breed of rams and ewes.

Data from 443 ewes (aged 2–5 yr), and their 298 pure and cross-bred lambs were used in this study. The lambs were born single from December 1972 to March 1973 in the Animal Research Station of the University. Twining was very rare and therefore twin born lambs were excluded.

Serum transferrin types were determined by horizontal starch gel electrophoresis as described by Smithies [20] using Poulik's discontinuous buffer system [19]. Twenty-eight milliliters of borate buffer (11.2 g boric acid and 1.2 g lithium hydroxide/l) were added to 222 ml of gel buffer (1.4 g Tris and 0.36 g citric acid, pH adjusted to 8.0). Thirty-two grams of hydrolysed starch (Cannaught Medical Laboratories, Toronto) in 250 ml gel buffer was sufficient to fill a 22.4 X 12 X 0.6 cm tray. Ten or eleven samples were run with a single gel, three of which were reference sera. Gels were sliced and stained, using Naphthalene Black B12. The transferrin bands were identified by comparison with the reference sera.

During the breeding season all the ewes examined with a "teaser" ram each morning and ewes found to be in estrus were mated. Mating was of pen-mating type and within each breeding group mating was random. The ewes were classified into two categories:

1. Conceived: consisted of three groups: (a) those which conceived at the first mating; (b) those which conceived at the second mating; (c) those which conceived at the third or subsequent matings.

In analysing the data, all the above groups were considered as a single group because of the small number of observations in the last two groups.

2. Not-conceived: ewes which showed estrus but did not conceive.

Statistical analysis of the fertility data was done using the chi-square test.

RESULTS AND DISCUSSION

Of the 36 possible transferrin genotypes resulting from 8 observed alleles (Tf's I,A,B,C,D,M,E and P in decreasing order of electrophoretic mobility) in the K,M and N breeds, 30 were observed in this study. These 30 transferrin genotypes were as follow: Tf's IB, IC, ID, IM, AA, AB, AC, AD, AM, AE, AP, BB, BC, BD, BM, BE, BP, CC, CD, CM, CE, CP, DD, DM, DE, DP, MM, ME, MP and EE. The frequencies of different transferrin alleles and the frequencies of different transferrin genotypes are presented in Tables 1 and 2.

In Table 3, ewes of the three breeds are divided into two categories: conceived and not-conceived. Expected values were calculated for each observed value assuming that fertility was the same in the three breeds. The chi-square test indicated that there were highly significant differences among the three breeds as far as the reproductive rate was concerned ($\chi^2 = 22.8$ with 2 d.f., $p<0.01$).

The same set of data was examined by classifying the ewes into 11 sub-classes based on the ewe transferrin types (Table 4). Nineteen transferrin genotypes (IB, IC, ID, IM, AA,

Table 1. The frequency of transferrin alleles in parents and progeny of the three breeds (K, M and N)

		Transferrin alleles							
		I	A	B	C	D	M	E	P
Parents	No.	5	66	324	248	109	55	44	37
	%	0.6	7.4	36.6	28.0	12.3	6.2	4.7	4.2
Progeny	No.	3	57	259	157	61	18	27	14
	%	0.5	9.5	43.5	26.3	10.2	3.0	4.6	2.4

Table 2. The frequency of transferrin types in parents and progeny of the three breeds (K, M and N)

Transferrin types	Parents	Progeny	Total	Transferrin types	Parents	Progeny	Total
IB	0	1	1	BE	19	10	29
IC	1	2	3	BP	6	5	11
ID	1	0	1	CC	63	32	95
IM	3	0	3	CD	28	16	44
AA	2	1	3	CM	22	6	28
AB	21	33	54	CE	10	9	19
AC	19	14	33	CP	26	8	34
AD	14	6	20	DD	16	3	19
AM	2	1	3	DM	3	1	4
AE	4	1	5	DE	1	7	8
AP	2	0	2	DP	2	1	3
BB	113	69	182	MM	5	0	5
BC	16	38	54	ME	6	0	6
BD	28	24	52	MP	1	0	1
BM	8	10	18	EE	1	0	1

Table 3. Observed and expected reproductive activity of ewes as measured by the rate of conception in the three breeds (numbers in parentheses are expected values)

Reproductive activity	Breed*			Total
	K	M	N	
Conceived	125(134.4)	150(137.1)	130(133.5)	405
Not-conceived	22(12.6)	0(12.9)	16(12.5)	38

* $\chi^2 = 22.8$, d.f. = 2 ($p<0.01$).

Table 4. Observed and expected reproductive activity as measured by the rate of conception in relation to ewe transferrin type (numbers in parentheses are expected values)

Reproductive activity	Transferrin types										
	AB	AC	AD	BB	BD	BE	CC	CD	CM	CP	DD
Conceived	21 (18.9)	16 (17.1)	13 (12.6)	103 (99.9)	23 (22.5)	14 (14.4)	55 (55.8)	27 (25.2)	17 (18.9)	20 (23.4)	14 (14.4)
Not-conceived	0 (2.1)	3 (1.9)	1 (1.4)	8 (11.1)	2 (2.5)	2 (1.6)	7 (6.2)	1 (2.8)	4 (2.1)	6 (2.6)	2 (1.6)
Total	21	19	14	111	25	16	62	28	21	26	16

Table 5. Reproductive activity of the ewes of different age groups (numbers in parentheses are expected values)

Reproductive activity	Age*		
	1 to 2 years	Over 2 years	Total
Conceived	184(196.6)	221(208.4)	405
Not-conceived	31(18.4)	7(19.6)	38
Total	215	228	443

* $\chi^2 = 18.1$, d.f. = 1 ($p<0.01$).

AM, AE, AP, BC, BM, BP, CE, DM, DE, DP, MM, ME, MP and EE) were excluded because of the small number of observations, and comparisons were made only among the remaining 11 transferrin genotypes.

A chi-square test showed no significant differences in reproductive activity among the transferrin types.

Since there were differences in the average age of the ewes among the three breeds, it is possible that this was a contributing factor to the differences in fertility among the three breeds. In order to test this hypothesis, ewes of the three breeds were classified according to their age and reproductive performance (conceived and not-conceived). Ewes were divided into two age groups: one to two years and over two years (Table 5).

Chi-square test showed a highly significant difference between the two groups ($\chi^2 = 18.1$ with 1 d.f., $p<0.01$) in favour of the older ewes as far as conception rate was concerned. Therefore, it can be concluded that age was an important factor affecting the reproductive activity of these three breeds, while chi-square test showed no significant difference in reproductive rate between ewes with different transferrin types. As far as pre-natal and post-natal death of the embryo was concerned, no abortions were observed in ewes and very few lambs died after birth. Similar experiments on Hereford and Holstein Friesian cattle, however have shown that transferrin type does not affect fertility [7, 13]. From this study it can be concluded that transferrin type did not have a significant effect on fertility in the three breeds of sheep.

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