Asian Journal of Chemistry Vol. 17, No. 1 (2005), 85–90

Transferrin Types and Their Correlation with Some Important Metabolites in the Serum of Indian Sheep

ALKA ADHIKARI and S.P.S. MEHTA*
Department of Chemistry, Kumaun University, D.S.B. Campus, Nainital-263 002, India
E-mail: s_p_mehta2004@yahoo.com

Seven transferrin phenotypes, *viz.*, Tf-AA, Tf-BB, Tf-AB, Tf-AC, Tf-BC, Tf-CC and Tf-ME were observed in the serum of Indian sheep. The average concentrations of some important metabolites were correlated with the transferrin types.

Key Words: Transferrin types, Metabolites, Serum, Correlation, Sheep.

INTRODUCTION

Transferrins are proteins concerned in the transfer of iron. They are components of beta globulin zone of proteins in the serum. The transferrins in each species are controlled by a multiple autonormal allele system. The number of these alleles differs from species to species and may also vary within a particular species.

Ashton[1] reported that the beta globulin zone gives 4, 5 or 6 components depending upon the serum types. Ashton and McDougall[2] observed beta-globulin phenotypes in cattle, sheep and goats by the starch gel electrophoresis method.

Sheep exhibits the most extreme diversity in transferrins. Their transferrins have a tendency to travel unusually close to the albumin and there are a number of features which make precise typing more exciting in this species. Using sera from British breeds of sheep and a phosphate continuous buffer system, Ashton[3, 4] identified 14 distinct sheep phenotypes. These were regarded as representing all but one of the total 15 possible types from a five allele system (A, B, C, D and E) in decreasing order of electrophoretic mobility. Each allele appeared to produce two zones of different intensity, the fainter being the leading zone. The study on transferrin types was further extended by a number of workers[5–10].

EXPERIMENTAL

The Bikaneri lambs and the Bikaneri adult sheep were maintained at the Department of Physiology, U.P. College of Veterinary Science and Animal Husbandry, Mathura and the blood samples were collected as reported earlier[11–13].

Transferrin Polymorphism

Transferrin polymorphism was studied by the disc electrophoresis method of Ornstein and Davis[14].

The tris EDTA borate buffer[15] of 8.8 pH was used. The sera samples were diluted 1 : 6 with the working buffer solution saturated with sucrose. The diluted samples were charged with capillary plastic tubes mounted on a B.C.G. syringe. The capillary tube was calibrated by a standard syringe. Electrophoresis of the 0.01 mL sample was performed at 150 V for 1 h. The tubes were then taken out and the gels one by one were released by using a fine needle mounted in a glass syringe. Small quantities of water were mounted while running the gels with the needle. A little pressure was applied as and when necessary by a 10 mL rubber bulb at one end of the gel tube to force out the gel columns which were transferred to different compartments made by micro slides in the staining troughs for staining. Amido black 10B stain was used for 7–10 min and then the stain solution was pipetted out. For destaining 4 per cent acetic acid solution was used which was changed as and when required. When the background stain was completely washed out and the transferrin bands were clearly visible, the columns were transferred to suitable test tubes with 4 per cent acetic acid solution and were stored after they were properly stoppered.

The comparisons of distance travelled by the transferrin bands were made by placing the gel tubes on a white porcelain plate in a way that all the starting ends of the gel columns were in a straight line.

RESULTS AND DISCUSSION

Seven transferrin phenotypes, *viz.*, Tf-AA, Tf-BB, Tf-AB, Tf-AC, Tf-BC, Tf-CC and Tf-ME were observed (Table-1) and found to be consistent with the results reported for Desert Sheep of Sudan.[16]

The average concentrations of various constituents in blood/serum/plasma of sheep falling under different transferrin types have been given in Table-2, while Tables 3–10 represent the analysis of variance of data under the transferrin types.

For the classification of transferrin of sheep, reference sheep sera were obtained from Dr. Bouw of Copenhagen Laboratory. The references were for Tf-AB, AC, BB, BC, BM, CC, CD, CM, DP and ME types.

Only 7 phenotypes could be identified in the sera samples analyzed. The different types were distributed as Tf-AA 25, Tf-BB 12.5, Tf-AB 25, Tf-AC 12.5, Tf-BC 12.5, Tf-CC 6.25 and Tf-ME 6.25 per cent respectively.

TABLE-1
TRANSFERRIN POLYMORPHISM IN SHEEP

Transferrin types (%)						
Tf-AA	Tf-BB	Tf-AB	Tf-AC	Tf-BC	Tf-CC	Tf-ME
25	12.5	25	12.5	12.5	6.25	6.25

TABLE-2
AVERAGE CONCENTRATION OF CERTAIN CONSTITUENTS IN BLOOD/SERUM/PLASMA OF SHEEP OF DIFFERENT Tf POLYMORPHIC TYPES

Tf types	Glucose in blood (mg/100 mL)	Total protein in serum (mg/100 mL)	N.P.N. in serum (mg/100 mL)	Ca in serum (mg/100 mL)	P (Inorganic) in serum (mg/100 mL)	Cl in serum (mg/100 mL)	Bicarbonate in plasma (mg/100 mL)	Fe in serum (μg/100 mL)
1	2	3	4	5	6	7	8	9
Tf-AA	67.89 ± 5.55	7.12 ± 1.16	36.74 ± 5.20	9.55 ± 0.38	6.14 ± 0.40	586 ± 18.37	16.40 ± 1.19	35.44 ± 2.94
Tf-BB	75.82 ± 3.36	5.70 ± 1.45	50.34 ± 5.64	10.70 ± 0.99	6.17 ± 0.51	558 ± 35.38	16.90 ± 1.86	35.45 ± 1.94
Tf-AB	59.53 ± 5.13	8.04 ± 0.74	41.30 ± 4.49	10.55 ± 0.27	5.49 ± 0.18	538 ± 75.55	18.45 ± 1.20	35.91 ± 3.35
Tf-AC	65.40 ± 2.17	7.35 ± 0.86	44.63 ± 5.18	9.90 ± 0.90	5.40 ± 0.56	595 ± 0.23	19.50 ± 1.25	34.77 ± 1.19
Tf-BC	62.24 ± 2.48	6.38 ± 1.12	33.18 ± 4.14	10.70 ± 0.57	5.73 ± 0.43	548 ± 10.58	20.00 ± 0.81	34.38 ± 1.87
Tf-CC	78.84 ± 9.53	7.52 ± 0.01	29.75 ± 19.25	10.70 ± 1.30	4.55 ± 0.55	640 ± 24	21.0 ± 1	28.30 ± 4.0
Tf-ME	46.28 ± 8.12	6.09 ± 1.41	41.76 ± 7.23	10.40 ± 0.40	5.90 ± 0.80	556 ± 12.0	20.0	53.10 ± 0.94

TABLE-3
ANALYSIS OF VARIANCE OF BLOOD GLUCOSE CONCENTRATION IN DIFFERENT TRANSFERRIN TYPES

Source of variation	d.f.	S.S.	M.S.S.	'F' value	Remarks
Between types	6	1889.6120	314.9353		
				2.1555	N.S.
Error	25	3652.7932	146.1117		
Total	**31**	**5542.4052**			

N.S. = Non-significant.

TABLE-4
ANALYSIS OF VARIANCE OF SERUM TOTAL PROTEIN CONCENTRATION IN DIFFERENT TRANSFERRIN TYPES

Source of variation	d.f.	S.S.	M.S.S.	'F' value	Remarks
Between types	6	17.6687	2.9448		
				0.4860	N.S.
Error	25	151.4750	6.0590		
Total	**31**	**169.1437**			

N.S. = Non-significant.

TABLE-5
ANALYSIS OF VARIANCE OF SERUM N.P.N. CONCENTRATION IN DIFFERENT TRANSFERRIN TYPES

Source of variation	d.f.	S.S.	M.S.S.	'F' value	Remarks
Between types	6	5209.4751	868.2459		
				4.9272	H.S.
Error	25	4405.3652	176.2146		
Total	**31**	**9614.8903**			

H.S. = Highly significant.

TABLE-6
ANALYSIS OF VARIANCE OF SERUM CALCIUM CONCENTRATION IN DIFFERENT TRANSFERRIN TYPES

Source of variation	d.f.	S.S.	M.S.S.	'F' value	Remarks
Between types	6	7.20	1.2000		
				0.7208	N.S.
Error	25	41.62	1.6648		
Total	31	48.82			

N.S. = Non-significant.

TABLE-7
ANALYSIS OF VARIANCE OF SERUM PHOSPHORUS CONCENTRATION IN DIFFERENT TRANSFERRIN TYPES

Source of variation	d.f.	S.S.	M.S.S.	'F' value	Remarks
Between types	6	5.85	0.9750		
				1.0980	N.S.
Error	25	22.20	0.8880		
Total	**31**	**28.05**			

N.S. = Non-significant.

TABLE-8
ANALYSIS OF VARIANCE OF SERUM CHLORIDE CONCENTRATION IN DIFFERENT TRANSFERRIN TYPES

Source of variation	d.f.	S.S.	M.S.S.	'F' value	Remarks
Between types	6	26.496	4416		
				1.5280	N.S.
Error	25	72.252	2890		
Total	**31**				

N.S. = Non-significant.

TABLE-9
ANALYSIS OF VARIANCE OF PLASMA BICARBONATE CONCENTRATION IN DIFFERENT TRANSFERRIN TYPES

Source of variation	d.f.	S.S.	M.S.S.	'F' value	Remarks
Between types	6	74.56	12.4267		
				1.3346	N.S.
Error	25	232.78	9.3112		
Total	**31**	**307.34**			

N.S. = Non-significant.

TABLE-10
ANALYSIS OF VARIANCE OF SERUM-IRON CONCENTRATION IN DIFFERENT TRANSFERRIN TYPES

Source of variation	d.f.	S.S.	M.S.S.	'F' value	Remarks
Between types	6	718.13	119.6883		
				2.0981	N.S.
Error	25	1426.16	57.0464		
Total	**31**	**2144.29**			

N.S. = Non-significant.

The value of blood glucose in Tf-ME type animals was lowest while the value of blood glucose in Tf-CC type animals was highest. Similarly, with regard to other metabolites, *viz.*, total protein, calcium, inorganic phosphorus, serum chloride, plasma bicarbonate and serum iron, there were variations in the values under different phenotypes; the differences were not significant statistically.

The position was different with regard to the value of N.P.N. in the serum of sheep of different Tf types. The values for N.P.N. for different types were (mg/100 mL):

Tf-AA	36.74 ± 5.20,	Tf-BB	50.34 ± 5.64
Tf-AB	41.30 ± 4.47,	Tf-AC	44.63 ± 5.18
Tf-BC	33.18 ± 4.14,	Tf-CC	29.75 ± 19.4
Tf-ME	41.76 ± 7.23		

There were wide differences in the average values of N.P.N. in different transferrin types. The variations in N.P.N. concentrations were statistically highly significant.

ACKNOWLEDGEMENTS

The authors are grateful to the Head, Department of Physiology, U.P. College of Veterinary Science and Animal Husbandry, Mathura (India) for providing all the necessary facilities for the present work.

REFERENCES

1. G.C. Ashton, *Nature*, **180**, 917 (1957).
2. G.C. Ashton and E.I. McDougall, *Nature*, **181**, 945 (1958).
3. G.C. Ashton, *Nature*, **181**, 849 (1958).
4. ———, *Nature*, **181**, 1101(1958).
5. A.G.M. Khattab, J.H. Watson and R.F.E. Axford, *Animal Breed Abstr.*, **33**, 399 (1964).
6. D.W. Cooper, L.F. Bailey, G. Alexander and D. Williams, *Animal Breed Abstr.*, **35**, 2624, (1966).
7. L. Fesus, *Animal Breed Abstr.*, **36**, 2692 (1967).
8. P. King and H. Fechte, *Animal Breed Abstr.*, **36**, 449 (1967).
9. C. Stormont, Y. Suzuki, G.I. Bradford and P. King, *Genetics*, **60**, 363 (1968).
10. S. Tyankov, *Abstr. Bulgarian Sci. Lit.*, **18B**, 194 (1970).
11. Alka Adhikari and S.P.S. Mehta, *Asian J. Chem.*, **14**, 471 (2002).
12. ———, *Asian J. Chem.*, **14**, 1062 (2002).
13. ———, *Asian J. Chem.*, **15**, 311 (2003).
14. L. Ornstein and B. Davis, *J. Dairy Sci.*, **48**, 720 (1962).
15. T. Aronson and A. Gronwall, *Scand. J. Clin. Lab. Invest.*, **9**, 338 (1957).
16. H. Elsayed Osmav, *Animal Breed Abstr.*, **36**, 796 (1967).

(*Received*: 21 November 200; *Accepted*: 6 July 2004) AJC-3497