

HAEMOGLOBIN POLYMORPHISM IN SOME ZEBU MILCH BREEDS AND
THEIR CROSSBREDS WITH EXOTIC BREEDS

Haemoglobinpolymorphismus in einigen Zebu-Milch-Rassen und ihren
Artgekreuzten mit ausländischen Viehrassen

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INTRODUCTION

Haemoglobin polymorphism in cattle was one of the earliest system of genetic polymorphism to be reported (Cabanne and Serain, 1955) after the development of the starch gel electrophoresis technique by Smithies in 1955. Since then genetically determined electrophoretic heterogeneity of bovine haemoglobin has been extensively studied by many workers among diversified cattle populations. A codominant system of inheritance with two most common haemoglobin (Hb) alleles viz., Hb^A and Hb^B has been reported in many Indian breeds by various workers (Naik *et al.* 1965, 1969; Sen *et al.* 1966; Shanker, 1972; Singh *et al.* 1972; Sen Gupta, 1976; Singh and Bhat, 1980). The present study describes the status of this polymorphism among three zebu milch breeds of Indian origin and their crossbred animals with the exotic breeds.

MATERIAL AND METHODS

In the present study 1345 blood samples were collected from the herd maintained at National Dairy Research Institute, Karnal and screened for haemoglobin polymorphism. The zebu milch breeds were Sahiwal, Tharparkar and Red Sindhi and crossbreeds constituted the animals evolved from the crossing of Sahiwal with Brown Swiss exotic breed primarily. The haemoglobin typing was done using starch gel electrophoresis in a discontinuous buffer system of Gahne *et al.* (1960). The other details of electrophoresis have been described elsewhere (Shanker, 1972). The gene frequencies were determined by direct counting method.

RESULTS AND DISCUSSION

Table-1 gives the distribution of the animals of different breeds in the various haemoglobin phenotypic classes. Three haemoglobin alleles viz., Hb^A, Hb^B and Hb^C and five different phenotypes were observed among the population of animals screened, the most frequent of these were phenotypes HbAA, HbAB and HbBB. Maximum frequency was observed for the HbAA phenotype followed by HbAB and HbBB among all the breeds except in Red Sindhi where HbAB heterozygotes were found to be slightly more than HbAA. HbAC and HbBC phenotypes were found among the Sahiwal, Jersey and crossbred animals in extremely low number. The presence of two common Hb alleles (Hb^A and Hb^B) among the Indian zebu cattle breeds have been reported by many workers (Naik *et al.* 1965; Singh *et al.* 1972; Shanker, 1972; Singh and Bhat, 1980).

Hb^A allele was the predominant gene not only in the purebred Indian cattle but also among the exotic and the crossbred animals. A high

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Table-1: Haemoglobin phenotypes and gene frequencies in different breeds of cattle.

Breed	Type	No.	AA	AB	BB	AC	BC	χ^2	Hb ^A	Hb ^B	Hb ^C
Sahiwal	E	0	222	136	29	2	-	3.089	0.748	0.249	0.003
		389	217.64	144.90	24.12	0.87	-				
Tharparkar	E	0	283	97	6	-	-	0.506	0.859	0.141	-
		386	284.82	93.50	7.67	-	-				
Red Sindhi	E	0	85	94	9	-	-	7.165*	0.702	0.298	-
		188	92.64	78.66	16.69	-	-				
Holstein	E	0	24	6	-	-	-	0.070	0.900	0.100	-
		30	24.30	5.40	-	-	-				
Jersey	E	0	7	9	3	-	2	1.861	0.548	0.405	0.048
		21	6.308	9.32	3.44	-	0.816				
Crossbreeds	E	0	198	116	12	-	5	13.747	0.773	0.219	0.008
		331	197.78	112.79	15.87	-	1.16				

frequency of Hb^B allele in a small number of Jersey animals screened and also the presence of Hb^C allele as Hb^BC phenotype indicated possibility of this exotic breed to be closely related to the zebu breeds. Lehman (1959) also made similar observations based on the higher Hb^B allelic frequency in his study. The presence of Hb^C allele in extremely low frequencies in some of the Indian zebu cattle has also been reported earlier by Naik *et al.* (1965); Singh and Khanna (1973) and Shanker (1972), as observed in the present investigations. However, Hb^C allele has not been reported earlier among the established herds of major breeds (Sen *et al.* 1966; Singh *et al.* 1972).

Holstein cattle in general have absolute Hb^A gene frequencies (Rendel, 1967). However, the present screening of small number of Holstein animals revealed the presence of Hb^B allele also which suggested, therefore, the possibility of impurity of the breed. Although crossbred animals exhibited all the three Hb alleles, however, Hb^A allele was found to be more frequent than others as observed in case of other breeds too. The Hb^C allele in the crossbred animals might have been possibly contributed from their zebu parents. This allele has not been reported in the other crossbred herds (Singh and Khanna, 1971; Singh and Bhat, 1980).

SUMMARY

Haemoglobin polymorphism was investigated in about 1048 animals belonging to three zebu milch breeds, two exotic breeds and two of their crossbred breed/genetic groups. The presence of three haemoglobin alleles viz., Hb^A, Hb^B and Hb^C was observed in the population screened. Hb^A allele was found to be most frequent among all the breed/genetic groups followed by Hb^B allele and Hb^C allele occurred only rarely in Sahiwal, Jersey and the two crossbred breed/genetic groups.

ZUSAMMENFASSUNG

Haemoglobinpolymorphismus wurde in etwa 1048 Tieren geprüft, die den drei Zebumilchrassen, zwei ausländischen Viehrassen und zwei ihrer artgekreuzten Viehrassen oder genetischen Gruppen zugehörten. Das Vorhandensein von drei Haemoglobinfaktoren nämlich Hb^A, Hb^B und Hb^C wurde in den berücksichtigten Viehbestand beobachtet. Der Hb^AFactor war unter allen Rassen/genetischen Gruppen am häufigsten, danach kamen die Hb^BFactoren und die Hb^CFactoren kamen nur selten in Sahiwal, Jersey und zwei artgekreuzten Viehrassen oder genetischen Gruppen vor.

REFERENCES

- Cabannes, R. and Serain, C. 1955. Heterogeinte de s' hemoglobins des bovides. C.R. Soc. Biol.(Paris). 149:7 (cited by Ogden, A.L. 1961 Anim. Breed. Abstr. 29:137-38.
- Gahne, B., Rendel, J. and Venge, O. 1960. Inheritance of 8-globins in serum and milk from cattle. Nature, Lond. 186:907-908.
- Lehman, H. 1959. The haemoglobins of 103 Indian Gir cattle. Man, 59:66-67.
- Naik, S.N., Sanghvi, L.D. and Sukumaran, P.K. 1965. A note on blood groups and hemoglobin variants in zebu cattle. Anim. Prod., 7:275-277.
- Naik, S.N., Sukumaran, P.K. and Sanghvi, L.D. 1969. Haemoglobin polymorphism in Indian zebu cattle. Heridity, Lond. 24:239-247.
- Rendel, J. 1967. A study of blood groups and protein variants as a means of revealing similarities and differences between animal production, and population. Anim. Breed. Abstr. 35(3):370-381.
- San, A., Roy, D., Bhattacharya, S. and Deb, M.C. 1966. Haemoglobin of Indian zebu cattle and the Indian buffalo. J. Anim. Sci. 25:445-448.
- Singh, H. and Khanna, M.D. 1971. Studies on haemoglobin polymorphism in Mariana and Mariana crossbred cattle. Ind. J. Anim. Sci., 41:6-8.
- Singh, H. and Khanna, M.D. 1973. Haemoglobin-C in Kumaoni Hill cattle. Indian Vet. J., 50:241-243.
- Singh, H. and Bhat, P.N. 1980. Studies on haemoglobin polymorphism in the blood of indigenous cattle. Ind. J. Anim. Sci. 50(6):459-467.
- Singh, H., Bhatia, S.S., Batabyal, A.K. and Khanna, M.D. 1972. Haemoglobin polymorphism in six Indian cattle breeds. Ind. J. Anim. Prod., 3:106-110.
- Shankar, V. 1972. Genetic studies on blood protein polymorphism and their relationship with the productive traits in Sahiwal-Jersey crosses. M.Sc. dissertation, G.B. Pant Univ. of Ag. & Tech. Pantnagar India.
- Smithies, O. 1955. Zone electrophoresis in starch gels : group variations in the serum proteins of normal adults. Biochem. J. 61:629-641.