GAU Res. J. 1985. 10 (2) : 56-52

Haemoglobin Types in Patanwadi Sheep and their Associations with Growth, Wool Production and Wool Quality Characters

S. K. Dalal, J. V. Solanki, M. M. Patel and R. K. Shukla

Department of Animal Genetics and Breeding, GAU, Anand Campus, Anand

ABSTRACT

A flock of 343 Patanwadi lambs was screened for their Haemoglobin types by using starch gel electrophoresis. The Gene frequencies were estimated to be 0.34, 0.59 and 0.07 for A, B and D alleles respectively. The population was not found to be in Hardy-Weinberg equilibrium with the absence of AD haemoglobin type group. It was further revealed that, between type group differences were found to be significant for Weaning Weight, Yearling Weight, First year Wool Yield and Fibre density, whereas these were non-significant for Birth Weight, Fibre length, Staple length, Fibre diameter and Medullation percentage. Haemoglobin type AA group weighed higher at Weaning and Yearling age as well as had higher fibre density. However, Wool yield of first year was found to be highest in BD group followed by AB, AA, BB and DD groups.

(Received on 1st Febru. 1983)

INTRODUCTION

Haemoglobin type in sheep is one of the well studied biochemical traits which was found to have some definite association with traits of economic importance. Most of the studies in this regard were conducted on exotic breeds and some of the indigenous breeds. The present study was conducted to have some idea about various haemoglobin types and their association with growth, wool production and wool quality characters in Patanwadi sheep.

MATERIAL AND METHODS

Blood samples were collected from 343 Patanwadi lambs (at weaning age) maintained at Government Sheep Breeding Farm, Patan. The haemolysates were prepared from blood samples and then by using Starch gel electrophoresis (Smith, 1968) various haemoglobin types were identified on the basis of their relative migration. The fastest migrating band was marked as Hb^A allele, slower to that was marked as Hb^B and slowest one was marked as Hb^D allele.

Data on growth (i.e. Birth weight, Weaning weight and Yearling weight), First year wool yield and wool quality characters (Fibre length, staple length, Fibre diameter, Fibre density

* Present Address: Dept. of Animal Genetics & Breeding, Gujarat College of Veterinary Science and Animal Husbandry, Anand-388 001.

and Medullation percentage) were collected and then distributed among various haemoglobin types. For between haemoglobin type group differences, analysis of variance was conducted using following statistical model:

$$Y_{ij} = \mu, + H_i \dagger c_{ij}$$

Y_{ij} = Observation on j^{th} individual in i^{th} haemoglobin type group.

μ = Overall mean.

H_i = Effect of ith haemoglobin type group ($i = 1, 2, ——, 5$)

c_{ij} = Random error associated with j^{th} individual belonging to i^{th} haemoglobin type group NID $(0, \sigma_e^2)$

For the characters having significant between haemoglobin type group differences, Duncan's multiple range test with Kramer's modification (1956) was applied. Other statistical methods were used as per Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

The gene and genotypic frequencies of various haemoglobin alleles and type groups are presented in Table 1. Except the haemoglobin type group AD all other possible groups were available. Because of complete absence of AD group, the χ^2 value for goodness of fit was significant and it can be said that the population was not in Hardy Weinberg equilibrium. The gene frequencies were estimated to be 0.34, 0.59 and 0.07 for Hb^A, Hb^B and Hb^D alleles respectively. On the contrary, many workers found only two alleles Hb^A and Hb^B in various breeds of sheep (Harris and Warren, 1955; Evans *et al.* 1956; Agar *et al.*, 1969; Kalla *et al.* 1971; Ratnasabhapathy *et al.* 1972; More and Sahani, 1973; Bhuvanakumar *et al.*, 1974; Kothandapani *et al.*, 1974; Bhaskar *et al.*, 1976; Deshpande *et al.*, 1976; Singh *et al.*, 1976; Krishnamurthy and Ratnasabhapathy, 1980).

TABLE 1

Gene and Genotypic Frequencies of various Haemoglobin type alleles and groups in a flock of Patanwadi lambs.

Haemoglobin type groups	*Observed frequencies*	*Expected frequencies*	χ^2 *value*	*Gene frequencies*		
				A	*B*	*D*
AA	46	39.65				
AB	145	137.61	97.09**	0.34	0.59	0.07
BB	129	119.40				
AD	0	16.33				
BD	19	28.33				
DD	13	1.68				

Association with growth traits :

(a) Birth Weight (BW):

The average birth weight among all the haemoglobin type groups ranged between 2.14 and 2.31 kg with an overall average of 2.21 ± 0.02 kg. The analysis of variance (Table 3) revealed that between *Hb* type group differences were non-significant. Arora and Acharya (1972) have reported that in Nali breed Hb – BB individuals were only marginally better with regards to birth weight. Krishnamurthy and Ratnasabhapathy (1980) in Nilgiri and its

crosses showed that Hb – BB individuals at birth, weighed heavier.

(b) Weaning weight (WW) :

The average weaning weight for all the *Hb* type groups ranged between 12.75 to 14.84 kg with an overall average of 14.52 ± 0.08 kg. Analysis of variance (Table 3) indicated that between haemoglobin type group differences were significant ($P<0.01$). Hb–AA group was showing highest average weaning weight (14.84 ± 0.18kg) followed by Hb–BB (14.79 ± 0.10 kg), Hb–DD (14.54 ± 0.40 kg), Hb–AB (14.43 ± 0.12 kg) and Hb–BD (12.75 ± 0.41 kg). Meyer *et al.* (1967) reported that the Hb–AB type individuals weighed a little higher, whereas Arora and Acharya (1972) and Krishnamurthy and Ratnasabhapathy (1980) observed that Hb–BB type group had higher weight at weaning age.

(c) Yearling weight (YW):

In the present study overall yearling weight was estimated to be 24.05 ± 0.17 kg. The between haemoglobin type group differences were found to be significant ($P<0.01$) Hb–BB group was weighing highest (24.53 ± 0.28 kg) followed by type Hb–AA, Hb–DD, Hb–AB and Hb–BD groups. Kroiter and Aitmulhanow (1968) observed that sheep of Hb–AA type exceeded in yearling weight. Arora and Acharya (1972) reported that Hb–BB were only marginally better in yearling weight. Krishnamurthy and Ratnasabhapathy (1980) found that Hb–AA group had higher weight at one year of age.

Association with Wool traits:

(a) First year wool yield (FWY):

Averages for FWY were estimated to be 1145.63 ± 35.84, 1026.35 ± 16.54, 984.88 ± 23.07, 979.69 ± 21.11 and 913.46 ± 60.88 grams in *Hb* type groups Hb–BD, Hb–AB, Hb–AA, Hb-BB and Hb–DD, respectively. The analysis of variance (Table 3) revealed significant ($P < 0.01$) differences among various haemoglobin type groups. Hb–BD group had produced highest wool at one year of age. Kroiter and Aitmulhanov (1968), Kalla *et al.* (1971) reported that sheep of Hb-AA type excelled in FWY. Chopra and Chopra (1972) also reported that Hb-AA individuals on an average produced heavier fleece. Arora and Acharya (1972) estimated that BB type individuals were marginally better in FWY whereas Krishnamurthy and Ratnasabhapathy (1980) found that AB type individuals appeared superior in FWY. However, in the present study the Hb-AA, AB and BD had better performance with regards to FWY.

(b) Fibre Length (FL):

The fibre length among all *Hb* - type groups ranged between 6.11 to 6.49 cm with an overall average of 6.38 ± 0.96 cm (Table 2). The between group differences were found to be non-significant.

(c) Staple Length (SL):

Similar to FL, there were no significant differences between haemoglobin type groups. King *et al.* (1958) reported that AA type individuals have little longer staple length (non-significant). Chopra and Chopra (1972), Krishnamurthy (1975) and Krishnamurthy and Ratnasabhapathy (1980) reported that, the Hb-AA sheep had wool of longer staple length.

(d) Fibre diameter (FD):

Averages for FD were found to be 28.84 ± 0.47, 29.47 ± 0.36, 28.97 ± 0.30,

TABLE 2

Averages with standard error and coefficient of variation (%) of growth, wool production and wool quality characters of Patanwadi sheep among various Haemoglobin type groups.

Traits / *Haemoglobin type groups*		*Birth weight (kg)*	*Weaning weight (kg)*	*Yearling weight (kg)*	*First Wool Yield (g)*	*Year Fibre length (cm)*	*Staple length (cm)*	*Fibre diameter (μ)*	*Density/ No./cm²*	*Medullation %*
AA	n	46	46	41	43	42	42	42	42	42
	$\bar{X}$	2.14[a]	14.84[a]	24.52[a]	984.88[ab]	6.37[a]	5.66[a]	28.84[a]	1317.40[c]	11.43[a]
	SE	±0.04	±0.18	±0.44	±23.07	±0.15	±0.17	±0.47	±64.25	±1.18
	CV%	13.63	8.10	11.54	15.36	15.58	19.72	10.64	31.61	66.62
AB	n	145	145	128	130	130	127	127	126	127
	$\bar{X}$	2.21[a]	14.43[b]	23.91[b]	1026.35[ab]	6.32[a]	5.61[a]	29.47[a]	1171.66[b]	15.44[a]
	SE	±0.02	±0.12	±0.25	±16.54	±0.09	±0.09	±0.36	±34.22	±1.07
	CV%	13.51	10.17	11.78	18.38	14.42	18.16	13.67	32.88	78.43
BB	n	120	119	104	112	100	106	109	108	109
	$\bar{X}$	2.22[a]	14.79[b]	24.53[b]	979.69[a]	6.49[a]	5.80[a]	28.97[a]	1089.65[ab]	14.75[a]
	SE	±0.03	±0.10	±0.28	±21.11	±0.11	±0.12	±0.30	±32.99	±1.01
	CV%	13.94	7.72	11.59	22.80	17.69	21.68	10.90	31.46	71.50
BD	n	19	18	16	16	15	16	16	16	16
	$\bar{X}$	2.24[a]	12.75[a]	20.72[a]	1145.63[b]	6.11[a]	5.50[a]	28.43[a]	972.94[a]	16.31[a]
	SE	±0.08	±0.41	±0.79	±35.84	±0.19	±0.18	±0.71	±53.28	±2.52
	CV%	15.57	13.80	15.21	12.51	12.31	13.31	9.99	21.91	61.78
DD	n	13	13	12	13	12	12	12	12	12
	$\bar{X}$	2.31[a]	14.54[b]	24.29[b]	913.46[a]	6.47[a]	5.69[a]	28.77[a]	1235.83[bc]	8.92[a]
	SE	±0.07	±0.40	±0.88	±60.88	±0.12	±0.28	±0.70	±168.83	±1.59
	CV%	10.97	9.97	12.61	24.03	6.54	16.87	8.45	47.32	61.70
Overall	n	343	341	301	314	289	303	306	304	306
	$\bar{X}$	2.21	14.52	24.05	1005.43	6.38	5.68	29.12	1154.73	14.43
	SE	±0.08	±0.17	±11.30	±0.06	±0.06	±0.20	±0.20	±0.62	±0.62
	CV%	13.71	9.71	12.30	19.92	15.52	19.45	12.00	33.33	74.94

Averages bearing different superscripts differ significantly.

28.43 ± 0.71 and 28.77 ± 0.70 for Hb-AA, Hb-AB, Hb-BB, Hb-BD and Hb-DD haemoglobin type groups, respectively. However, the differences between haemoglobin types were non-significant. Kalla *et al.* (1971) reported in Chokla sheep, that AA type individuals possess wool fibres with small diameter. Chopra and Chopra (1972) reported in Nali breed that Hb-BB type individuals had fibres of smaller fibre diameter. Krishnamurthy and Ratnasabhapathy (1980) observed that AA individuals had fibres with lower diameter.

(e) Fibre density:

Averages for fibre density among all the *Hb* type groups are presented in Table 2. The analysis of variance (Table 3) revealed between haemoglobin type group differences were significant ($P<0.01$). Results of present study indicated that sheep with

TABLE 3

Table showing analysis of variance for various growth, wool yield and wool quality characters in Patanwadi sheep.

Source of variation	*d.f.*	*Mean sum of squares*								
		Birth weight	*Weaning weight*	*Yearling weight*	*First year wool yield*	*Fibre length*	*Staple lenght*	*Fibre diameter*	*Density*	*Medullation %*
Between Haemoglobin type groups	4	0.09	17.66**	53.61**	143419.02**	0.69	0.65	7.56	553179.44**	235.23
Error	Indicated in	0.09	1.80	8.51	38767.28	0.98	1.23	12.27	142745.77	115.46
	Paranthesis	(338)	(336)	(296)	(309)	(284)	(298)	(301)	(299)	(301)

** Significant at $P < 0.01$.

types Hb-AA and Hb-DD had significantly higher density per cm^2 area of skin.

(f) Medullation Percentage:

Among various haemoglobin type groups the medullation (%) ranged between 8.92 ± 1.59 and 16.31 ± 2.52 with an overall average of 14.43 ± 0.62%. The differences between haemoglobin type groups were found to be non-significant. Chopra and Chopra (1972) reported that the fleece of individuals having Hb-AB type had maximum hairiness and those having Hb-AA were comparatively free from this defect.

REFERENCES

Agar, N. S., Rawat, J. S. and Roy, A. 1969. Haemoglobin variants in Indian Sheep. *Anim. Produ.* **11**: 247-250.

Arora, C. L. and Acharya, R. M. 1972. A note on haemoglobin and pottassium types in Nali breed of Indian Sheep and their relationship with body weight and wool yield. *Anim. Prod.* **15** : 95-97.

Bhaskar, B., Krishnamurthy, U. S. and Ratnasabhapathy, V. 1976. Genetics of blood potassium and haemoglobin in Mandya sheep. *Cheiron* **5** (1): 8-13.

Bhuvanakumar, C. K., Krishnamurthy U. S. and Ratnasabhapathy V. 1974. Haemoglobin and Transferring polymorphism in Mechari sheep. *Cheiron* **3** (1): 24-26.

Chopra S. C. and Chopra S. C. 1972. Factors affecting wool characteristic in Nali and Lohi Sheep. *Indi. J. Anim. Sci.* **42**: 363-369.

Deshpande, A. D., Kshirsagar, S. G. and Tadpatrikar, N. S. 1976. Study on sheep haemoglobin. *Mahavet* **11** : 101-103.

Evans, J. V., King. J. W. B., Cohen, B. L., Harris, H. and Warren, E. L. 1956. Genetics of haemoglobin and blood potassium difference in sheep. *Nature Lond.* **178**: 849-852.

Harris, H. and Warren, F. L. 1955. Occurrence of electrophoretic distinct haemoglobin in ruminant. *Biochem. J.* **60**: 29-31.

Kalla, S. D., Dwarkanath, P. K. and Machosingh, 1971. Haemoglobin polymorphic studies in relation to wool quality in sheep of north west Rajasthan. *Ind. J. Anim. Sci.* **41**: 109-112.

Kothandapani, R., Krishnamurthy, U. S. and Ratnasabhapathy V. 1974. Haemoglobin polymorphism in Mandya sheep. *Cheiron* **3** : 58-61.

Kramer, C. Y. 1956. Extension of multiple range rest to group means with unequal number of replications. *Biometrics.* **12** : 307-310.

Krishnamurthy, U. S. 1975. Genetics of blood potassium Haemoglobin and transferring types in Nilgiri sheep, Merino and their crosses. *Cheiron* **4**: 2-6.

Krishnamurthy, U. S. and Ratnasabhapathy, V. 1980. Genetics of Haemoglobin in Nilgiri, Merino and their crossbred sheep. Haemoglobin types and their association with K-ion type, production and reproduction traits. *Ind. Vet. J.* **57** (8): 654-659.

Kroiter, M. K. and Airmulhanov, Z. 1968. Haemoglobin polymorphism of sheep blood studied by agar gel electrophoresis Izv. Akad. Nanl. Kazakh, SSR Ser. Biol. **6**: 83-86. (c.f. *Anim. Breed. Asbts.* **37**: 1565).

Meyer, H. Lohse, B. and Groning, M. 1967. A contribution to haemoglobin and blood potassium polymorphism in the sheep. Z.

Tierziicut-Ziicut Biol. **83:** 340 (c.f. *Anim. Breed Asbstr.* **15:** 15).

More, T. and Sahani K. L. 1973. Haemoglobin variants in Rambouillet and its crosses with indigenous sheep. *Ind. J. Anim. Sci.* **43:** 1003-1005.

Ratnasabhapathy, V., Krishnamurthy, U. S., Kothandapani R. and Anantakrishnan, A. 1972. Haemoglobin and transferrin polymorphism in Madras Red. Breed Sheep. *Cheiron* **1:** 71-75.

Singh, L. B., Singh Mohan, Dwarkanath, P. K. and Amritlal. 1976. Haemoglobin variants of the indigenous, exotic and crossbred sheep. *Ind. Vet. J.* **53:** 766-771.

Smith, I. 1968. Chromatographic and Electrophoretic Techniques, Vol. II Zone Electrophoresis, 22nd Ed., William Heinemann Medical Books Ltd.

Snedecor, G. W. and Cochran, W. G. 1980. Statistical Methods 7th Ed., Iowa State University Press Ames, Iowa, U.S.A.