Indian Journal of Animal Sciences 76 (11): 934–936, November 2006

Effect of genetic variants of beta–lactoglobulin on milk production traits in Red Sindhi cows

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Received: 21 January 2005; Accepted: 24 August 2006

ABSTRACT

The present study was undertaken to find the effect of genetic variants of ß-lg on fat percentage, protein percentage, total solid percentage, casein percentage and 305 days milk yield in Red Sindhi cows. Red Sindhi animals (95) typed for ß-lg variants (AA, AB and BB) by PAGE and PCR-RFLP, were screened for this study. Least-square analysis showed that all the 3 genetic variants AA, AB, and BB were having significant effect ($P < 0.05$) on fat percentage, protein percentage, casein percentage, total solids percentage and 305 days milk yield during different lactation periods and also having significant effect ($P < 0.05$) irrespective of lactation number. Genotype BB was having significantly higher fat percentage, total solids percentage and casein percentage than AA genotypes. Genotype AA was having higher protein percentage and higher 305 days milk yield than BB genotypes in the present study.

Key words: Beta-lactoglobulin, Genetic variant, Red Sindhi

Milk protein genetic polymorphisms have evoked considerable research interest in recent years because of possible association between milk protein genotypes and economically important traits in dairy cattle.

Milk proteins such as κ-casein (K-CN) and beta-lactoglobulin (ß-lg) are associated with milk production performance and have a major influence on the compostion of milk and on the processing properties of milk. (Ng-Kwai-Hang *et al.* 1990).

Beta-lactoglobulin has 9 different variants [A, B, C, D, E, F, G, H and W] (Chung *et al.* 1995). Bovenhuis (1992) reported significant effect of ß-lg genotype on protein yield, ß-lg BB cows had lower protein yield than AA or AB cows and Holstein Friesian cows carrying BB genotypes had 0.11% higher fat content than AA genotype cows. Jairam and Nair (1983) reported that ß-lg BB type animals produced more milk than AB type animals ($P < 0.01$) in Tharparkar and their crosses. Cows with ß-lg AA or AB genotypes had significantly higher milk yield than BB cows. (Sang *et al.* 1994). Piazza *et al.* (1995) also reported that milk yield was greater with genotype AA milk than AB or BB in Argentine Friesian cows.

Beta-lactoglobulin polymorphism of Holstein Friesian and Brown Swiss were studied by native polyacrylamide gel-electrophoresis by Serafettin Celik (2003) and reported that significant relationship were found between beta-lactoglobulin genetic variants and total solids, fat, calcium and phosphorous. Effect of Kappa-Casein and beta-lactoglobulin loci on milk production traits were studied by Tsiaras *et al.* (2005) and reported that the AB variant of κ-CN genotype had a positive effect on protein yield and the B variant of ß-LG was associated with higher milk yield, and fat yield content.

The present study was conducted to study the effect of genetic variants of ß-lg on milk production traits in Red Sindhi cows.

MATERIALS AND METHODS

The present study was carried out in 95 Red Sindhi animals maintained at the Livestock Research Station, Hosur. Milk and DNA samples from 95 Red Sindhi cows were typed for ß-lg by polyacrylamide gel-electrophoresis (PAGE) and by PCR-RFLP technique, (Meignanalakshmi *et al.* 2002, Meignanalakshmi *et al.* 2001) respectively.

From the typed animals mid lactation milk samples were collected and the following estimations were carried out. The fat percentage was estimated by Gerber's butyrometer method (Fucoma test), Protein percentage by Kjeldhals

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method [IS: 1479 (part II) 1961]. Casein percentage was estimated as per the Indian Standard Method [IS: 1479 (part II) 1961] and total solids were estimated by Gravimetric method [IS: 1479 (part II) 1961].

Effect of genetic variants of beta-lactoglobulin during 4 lactations and effect of genetic variants of beta-lactoglobulin irrespective of lactation number on milk fat%, milk protein%, 305 days total milk yield, total solids% and casein% in Red Sindhi cows were analyzed by (completely random design) least-square analysis (Snedecor and Cochran 1967). The fat, protein, total solid and casein percentage were less than 30% so the values were converted to Arcinev p values and milk yield values were taken as such for analysis.

RESULTS AND DISCUSSION

The genotype and gene frequencies of ß-lg variants in Red Sindhi cows were given in Table 1. The frequency of AA, AB and BB genotypes was 0.09, 0.32 and 0.59 respectively. The gene frequencies were calculated based on Mendelian inheritance and the gene frequency of A and B were found to be 0.25 and 0.75 respectively. (Meignanalakshmi *et al.* 2001).

Table 1. Genotype and gene frequencies of ß-LG variants in Red Sindhi cows

Sample size	ß-lg genotype frequencies			ß-lg gene frequencies	
	AA	AB	BB	A	B
95	0.09 (9)	0.32 (30)	0.59 (56)	0.25	0.75

Number in parenthesis indicates number of animals.

In the present study Genetic variants of ß-lg (AA, AB and BB) in Red Sindhi cows were having significant effect on milk composition and milk yield during first, second, third and fourth lactation and were having significant effect irrespective of lactation number (Table 2).

Genotype BB was having significantly higher fat%, total solids% and casein% than AA genotypes. Genotype AA was having higher protein% and higher 305 days milk yield than BB genotypes in the present study.

Douglas (1984) reported significant differences in fat content for ß-lg variants in the following order BB and AB types having more fat% than AA type. Concentration of fat was significantly higher in milk of BB genotype than AA genotypes of ß-lg (Ng-kwai-Hang *et al.* 1986, Bovenhuis *et al.* 1992, Winkelman and Wickham 1995). Bovenhuis *et al.* (1992) reported that BB cows had lower protein yield than AA or AB genotypes in Holstein Friesian cows.

Jairam and Nair (1983) reported that ß-lg BB genotype animals produced more milk than AB genotype animals in Tharparker and their crosses. They also reported that the same effect was not observed in Sahiwal and Red sindhi cows. Significant association of higher milk yield with AA genotype of ß-lg than BB genotype has been reported by Ng-Kwai-Hang *et al.* (1986), Sang *et al.* (1994), Piazza *et al.* 1995), Winkelman and Wickam (1995). Hill *et al.* (1995) reported that ß-lg BB genotype milk contained higher concentration of total solids than ß-lg AA genotype milk. Significant relationship between ß-lg genetic variant and total solids was reported by Serafettin Celik (2003).

Concentration of casein was significantly higher in milk of BB type than AA phenotype of ß-lg (Ng-Kwai-Hang *et al.* 1986, Hill 1993). Lunden *et al.* (1995) reported that ß-lg BB genotype was significantly associated with high casein content in Swedish Red and white breeds and Swedish Holstein cows. Tsiaras *et al.* 2005 reported significant association of B variant of beta- lactoglobulin with higher milk yield and fat.

Table 2. Least-square analysis of effect of ß-lg variants on milk composition and milk yield in Red Sindhi cows irrespective of lactation number

Variants of ß-lg	Milk production traits (mean ± SE)				
	Fat%	Protein%	305-d milk yield	Total solid%	Casein%
AA	11.29 ± 0.050 (3.83 ± 0.033)	10.43 ± 0.060 (3.26 ± 0.023)	20.86 ± 0.090	2092.44 ± 14.620 (12.70 ± 0.040)	9.20 ± 0.030 (2.51 ± 0.017)
AB	11.54 ± 0.040 (4.00 ± 0.290)	10.09 ± 0.070 (3.09 ± 0.029)	1860.70 ± 22.180	21.14 ± 0.080 (13.02 ± 0.080)	9.28 ± 0.050 (2.58 ± 0.026)
BB	11.69 ± 0.030 (4.10 ± 0.019)	10.05 ± 0.050 (3.08 ± 0.021)	1857.09 ± 11.680	21.19 ± 0.040 (13.08 ± 0.052)	9.36 ± 0.030 (2.63 ± 0.013)
Statistical values					
F	14.84**	6.59**	26.02**	3.64*	33.39**
SE	0.04	0.07	17.79	0.06	0.04
CD	0.11	0.19	49.29	0.18	0.11

NS, Nonsignificant (P > 0.05); *, significant (P = 0.05); **, highly significant (P = 0.01; Bold numbers indicate transformed Arcine vp values. Numbers in parenthesis indicate original values.

Analysis of effect of ß-lg variants on milk production traits presented in this study revealed a significant correlation of variants of beta-lactoglobulin on milk production traits. Genotype BB was having significantly higher fat percentage, total solids percentage and casein percentage than AA genotypes. Genotype AA was having higher protein percentage and higher 305 days milk yield than BB genotype. This study could be used as a valuable tool for genetic improvement of dairy cattle.

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