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SHORT NOTE [NOTA CORTA]

GENETIC POLYMORPHISM OF MILK PROTEINS IN BARBARI GOATS

[POLIMORFISMO GENÉTICO DE LAS PROTEÍNAS DE LA LECHE EN CABRAS BARBARI]

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SUMMARY

Milk samples of 178 Barbari goats, maintained at the Central Institute for Research on Goats, Makhdoom, Mathura, Uttar Pradesh, India, were analyzed to study the genetic polymorphisms of milk proteins in this breed. The genetic variants in milk samples were detected by sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS–PAGE) method. The electrophoretic pattern revealed that the milk samples of Barbari goats contained four major casein variants, i.e., α_{S1}-casein, α_{S2}-casein, β-Cn, and κ-Cn and two whey proteins, viz., β-lactoglobulin and α-lactalbumin. Three α_{S1}-casein alleles viz. α_{S1}-Cn^A, α_{S1}-Cn^B and α_{S1}-Cn^F were identified in this study. The predominant allele of α_{S1}- casein was α_{S1}-Cn^B, with a frequency of 0.565, whereas the frequency of α_{S1}-Cn^A allele was 0.329. Very low frequency (0.073) of the α_{S1}-Cn^F variant occurred in the milk of this breed. The frequency of null allele (i.e., absent of this particular allele in the population) for this locus (α_{S1}-Cn^o) was 0.034. The α_{S2}-cn locus showed two variants namely A and B and the frequencies of these variants were 0.531 and 0.469, respectively. Two genetic variants (A and B) were also observed in the κ-casein locus having the frequencies of 0.708 and 0.292, respectively. No polymorphism was observed at β- casein locus in our study. The electrophoretic pattern of β-lactoglobulin showed the presence of two genetic variants at β-lactoglobulin (β-LG) locus (viz., A and B) and the gene frequency of β-LG^A and β-LG^B was 0.910 and 0.090, respectively. Regarding the α-lactalbumin locus, two genetic variants of α-lactalbumin (α -LA) viz., A and B were identified in this breed. The gene frequency of predominant allele i.e, α-LA A allele was 0.966 whereas, the frequency of rare allele i.e., α-LA B was 0.034, respectively.

Key words*: Casein, Genetic polymorphism, Goat, Milk protein.*

INTRODUCTION

Genetic polymorphism of milk proteins have received considerable research interests in animal breeding because of their relationships with production traits, milk composition and milk quality (Amigo et al., 2000; Bevilacqua et al., 2002; Feligini et al., 2005). Genetic polymorphism in the milk protein is usually a consequence of mutation which result in changes in the nucleotide sequence of particular gene involved and there by different amino acid sequence will result. The milk protein loci are highly polymorphic in nature. The genetic variant of milk protein is a heritable trait and they differ from breed to breed in their occurrence and frequency. These milk protein genes might be useful as genetic markers for the additional selection criteria in animal breeding programme. Thus the research on genetic polymorphism of milk protein in goat has several aims like to discover further new variants, characterize them and to understand the role that each variant can have on milk nutritional and technological properties. The Barbari goat, a medium sized dual-purpose breed, produce significant amount of milk and is well distributed in the semi-arid region of the country. The sufficient information on milk protein variants on Indian goat breeds is not available. Therefore, the present study was conducted to characterize the milk protein variants in Barbari goats.

MATERIALS AND METHODS

Sample collection and analyses

The present investigation was conducted on milk samples of 178 lactating does of Barbari goats maintained at the Central Institute for Research on Goats, Makhdoom, Farah, Mathura, Uttar Pradesh, India. Generally, milk samples were taken in the morning as well as in the evening from each doe. The whole milk was taken out in 20 ml of sample tubes after washing the udder with potable water and moping with cloth. The milk samples were stored at -20 °C after collection for further use. The genetic variants in milk samples were detected by sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE) method. The milk protein band patterns were studied on 14% polyacrylamide gel electrophoresis (Laemmli 1970). Gels were stained with Comassie Brilliant Blue. Milk protein variants were determined by the molecular weight in gel-documentation system (Alpha-Innotech Corporation).

Statistical Analyses

The milk protein alleles are co-dominant allele; so all the genotypes are recognizable in the phenotypes. Therefore, the genotypic frequencies at six milk protein loci were determined by direct counting the patterns in the gel-documentation system. POPGENE software (Yeh *et al.* 1999) was used to estimate the allelic frequencies, expected heterozygosity, effective number of alleles and to verify Hardy-Weinberg equilibrium. Hardy-Weinberg equilibrium (HWE) was tested by χ^2 tests.

RESULTS AND DISCUSSION

Polymorphism of milk proteins

The electrophoretic pattern of milk samples of Barbari goats showed the presence of four major casein variants, i.e., α_{S1}- casein, α_{S2} - casein, β-casein, and κ-casein and two whey proteins, viz., β-lactoglobulin and α-lactalbumin. The good separation of α_{S1}-Cn, α_{S2}-Cn, β-Cn, κ-Cn, β-lactoglobulin (β-LG) and α-lactalbumin (α -LA) genetic variants on alkaline urea gel are observed. The genotypic and allelic frequencies of different milk protein locus of Barbari goats are presented in Table 1.Three α_{S1}- casein alleles viz. α_{S1}-Cn^A, α_{S1}- Cn^B and α_{S1}-Cn^F were identified in this study. The predominant allele of α_{S1}- casein was α_{S1}-Cn^B, with a frequency of 0.565, whereas the frequency of α_{S1}-Cn^A allele was 0.329. Very low frequency (0.073) of the α_{S1}-Cn^F variant occurred in the milk of this breed. The α_{S1}- casein locus in this population also showed the presence of null allele (delete the same). The frequency of null allele for this locus (α_{S1}-Cn^o) was 0.034. In the genotypic frequencies (Table 1), the AB genotype was the most frequent (43.2%), followed by BB (34.8%), AF (12.4%), AA (5.1%) and FF (1.1%). Regarding the allelic variants at α_{S1}-Cn locus, different variants at this locus were reported in various goat breeds (Grosclaude and Martin 1997; Moili et al., 1998; Kusza et al., 2007). The gene frequencies of α_{S1}-Cn^A, α_{S1}- Cn^B and α_{S1}- Cn^F alleles in Barbari goat in the present study were well comparable with the findings observed by other workers (Kumar *et al.* 2002, Kumar *et al.* 2008) in different Indian goat breeds. Very low frequency of α_{S1}–Cn^F locus was also reported by Jordana et al. (1996) in Spanish breeds (0.08, 0.04, 0.0, and 0.0 for Murciano-Granadina, Malaguena, payoya and Canaria, respectively), which was similar with the present findings. With respect to α_{S1}-casein locus, the observed and expected genotypic frequencies for different alleles showed significant difference in this study. Therefore, the population under study was in Hardy-Weinberg disequilibrium with respect to α_{S1}-casein locus as the χ^2 value was estimated as 238.11 with one degree of freedom. The α_{S2}-cn locus is characterized by the presence of two alleles namely α_{S2}-Cn^A and α_{S2}-Cn^B and the frequencies of these variants were 0.531 and 0.469, respectively. In the genotypic frequencies (Table 1) for this locus, heterozygous AB accounted for 46% of the population followed by homozygous AA (30%) and BB (24%). Kumar *et al.* (2002) and Kumar (2005) also observed the presence of A and B variants (viz. α_{S2} -Cn^A and α_{S2} –Cn^B) at α_{S2} -casein locus in Indian goat breeds and the most prevalent variant, A was expressed as homozygous form in all the Indian goat breeds in both the studies. No polymorphism was observed at β- casein locus in our study. In our study, two genetic variants (A and B) were detected in the κ-casein locus having the frequencies of 0.708 and 0.292, respectively. However, the monomorphic pattern (κ-Cn^A) of κ-casein locus in Barbari goats was reported by Kumar *et al.* (2002) and Kumar (2005) in their earlier studies. The electrophoretic pattern of β-lactoglobulin (β-LG) showed the presence of two genetic variants at β-lactoglobulin locus (viz., A and B) and the gene frequency of β-LG^A and β-LG^B was 0.910 and 0.090, respectively. The presence of β-LG^A and β-LG^B at this locus was reported in Alpine and Saanen goat (Boulanger, 1976) and in Jamunapari, Barbari, Sirohi and Jakhrana breeds (Kumar et al., 2002) and these studies also indicated that variant A was dominant over variant B, which is corroborated with the present findings. Our study showed that the population was in genetic equilibrium with regards to β-LG locus (χ^2 = 1.68). Regarding the α-lactalbumin locus, two genetic variants of α-lactalbumin (α -LA) viz., A and B were identified in this breed. The gene frequency of predominant allele i.e, α-LA^A allele was 0.966 whereas, the frequency of rare allele i.e., α-LA^B was 0.034, respectively. Chifola and Micari (1987) also reported two variants of α-lactalbumin A and the rare α-lactalbumin B in three Italian breeds of sheep and their frequencies were .004, 0.012, respectively. Kumar *et al.* (2002) also identified two variants of α-lactalbumin where A variant was dominant over variant B. On the contrary, Kumar (2005) observed that α-lactalbumin locus exhibited monomorphic pattern in all Indian goat breeds except Sirohi and Jakhrana. According to Hardy-Weinberg law, the Barbari goat population was in genetic equilibrium with respect to α-LA locus (χ^2 = 0.198).

CONCLUSION

The present investigation revealed that all the major casein locus (viz., α_{S1}- , α_{S2} – and κ-casein) except β-casein locus showed polymorphism in the milk samples of Barbari goats. The polymorphism also detected in both the whey proteins loci (i.e., β-lactoglobulin and α- lactalbumin) of the milk in this breed.

Table 1. Genotypic and allelic frequencies of milk protein variants in Barbari goats.

Locus	Genotypic frequency						Allelic frequency			
	AA	AB	BB	AF	FF	OO	A	B	F	O
α_{S1}-Cn	0.051 (9)	0.432 (77)	0.348 (62)	0.124 (22)	0.011 (2)	0.034 (6)	0.329	0.565	0.073	0.034
α_{S2}-Cn	0.303 (54)	0.455 (81)	0.242 (43)	-	-	-	0.531	0.469	-	-
β - Cn	1.00 (178)	-	-	-	-	-	1.00	-	-	-
κ - Cn	0.416 (74)	0.584 (104)	-	-	-	-	0.708	0.292	-	-
β - LG	0.820 (146)	0.180 (32)	-	-	-	-	0.910	0.090	-	-
α -LA	0.933 (166)	0.067 (12)	-	-	-	-	0.966	0.034	-	-

"O" represents the null allele
Figures in parentheses are number of animals.

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