Genetic polymorphism of Casein cluster in Sudan Nubian dairy goats

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Summary

Milk samples from eighty seven lactating Nubian does were analysed to study the genetic polymorphism of casein protein. The genetic variants in milk samples were detected using polyacrylamide gel electrophoresis focusing (PAGE-IEF) method. The electrophoretic pattern revealed that milk samples of the Nubian goat contained the four major casein variants: *as1*-casein (CSN1S1), *as2* –casein (CSN1S2), b-casein (CSN2) and k-casein (CSN3). Five CSN1S1 alleles viz. CSN1S1, CSN1S1, CSN1S1, CSN1S1, andCSN1S1 were identified .The predominant allele was CSN1S1, with a frequency of 0.662 followed by CSN1S1 (0.125), and CSN1S1 (0.112). A very low frequency, the allele CSN1S1 occurred. The null frequency - (i.e. absence of this particular allele in the sampled population).-for this locus (CSN1S1) was 0.050. The CSN1S1 locus had undergone Hardy-Weinberg Equilibrium. The CSN1S2 locus showed the variants namely, A, C and X and the variant frequencies were 0.775, 0.212, and 0.013, respectively. Two genetic variants (A and B) were also observed in the CSN3 locus having the frequencies of 0.950 and 0.050, respectively. In this study, polymorphism of CSN2 locus was observed, represented by A and X variants, with 0.988 and 0.012 frequencies.

Introduction

Genetic polymorphism of milk proteins received considerable research interest in animal breeding programmes due to their relationship with production traits, milk composition and quality (Feligini *et al.*, 2005). Genetic

polymorphism is usually a consequence of mutation which result in changes in nucleotide sequence of particular gene involved and hence, different amino acid sequence will result. The milk protein loci are highly polymorphic in nature. The genetic variant of milk protein is a heritable entity and differs from population to another, in their occurrence and frequency. These milk protein genes might be useful as genetic markers for the additional selection criteria in breeding programmes. Thus, the research in genetic polymorphism of milk in goat has several goals, like to discover further new variants, characterize them and understand the role that each variant can have on milk nutritional and technological properties (Grosclaude and Martin 1997).

Indigenous goats are naturally highly adapted to hot environment, and can understand recurrent drought better than cattle in Sudan. Goat milk exceeds cow milk in, monounsaturated, polyunsaturated fatty acids, and medium chain triglycerides in which all, are known to be beneficial for human health (Haenlein 1992). These properties providean opportunity for improvement of goat milk production by change in management practices

and adoption of genetic improvement technologies. The Sudan Nubian goat, a medium sized dual purpose breed, produces significant amount of milk and is well distributed throughout semi-arid region of the country. Sufficient information on milk protein variations of Sudanese goat is not available. Hence, the present study was conducted to characterize the milk protein variants in Sudan Nubian goat.

Materials and Methods

Sampling and genetic analysis

The present study was conducted on milk samples of eighty seven lactating Nubian does, maintained at the Animal Production Centre (APPC), Kuku, Khartoum north. Generally, milk samples were taken in the morning from each doe separately. The whole milk was taken out, in 5 ml sample tubes, after washing the udder and moping with a clean cloth. The samples were examined by polyacrylimide gel isoelectric focusing technique (PAGE-IEF), in some modified, as described by Erhardt (1991). Gels were stained with Commassie brilliant blue. Milk protein variants were determined by different comparison tests developed by the International Society for Animal Genetics (ISAG). Standard reference samples and testing kits were available in the Institute of Animal Breeding and Genetics, Giessen, Germany.

Statistical analysis

The milk protein alleles were co-dominant alleles; so all the genotypes are recognizable in the phenotypes. Thus, the genotypic frequencies, at the four milk casein fractions, were determined by direct counting the patterns in the gel. POPGENE software (Yeh *et al.*, 1999) was used to estimate the allele frequencies, and to verify Hardy-Wiemberg Equilibrium (HWE). HWE was tested by Chi-square test.

Results and Discussion

The electrophoretic pattern of milk samples of Sudanese Nubian goats revealed the presence of four major of caseins variants, i.e. *as*1-casein, as2-casein, B-casein and kappa-casein. The good separation of all casein fraction variants was demonstrated well in alkaline urea gel. The genotypic and allelic frequencies of different casein loci of Nubian goat are presented in **Table 1** and **Table 2**, respectively. Five as1-casein alleles: CSN1S1, CSN1S1, CSN1S1, CSN1S1, CSN1S1 were identified in this study. The predominant allele as1-casein was CSN1S1, with a frequency of 0.661 whereas the frequency of CSN1S1 allele was 0.112. Very low frequency of CSN1S1 occurred in the milk of this goat. The as-1 casein locus in this goat also, showed the presence of null allele. The frequency of the null allele for this locus (CSN1S1) was 0.050.

For the genotypic frequencies (**Table 1**), the B Bgenotype was the most frequent (56.3%) followed by AB (17.2%), EE (8.1%), AA (5.7%), BF (4.6%), FF (3.5%), and AF and 00, showed (2.3%). Namita *et al* (2009) that the most abundant genotype of as-1 casein in Brabari goat was AB (43.2%), which is dissimilar to the finding of this study. Regarding the allelic variants at as1-casein locus, different variants at this locus were reportedin various goat breeds (Grosclaude and Martin 1997, Moiole *et al* 1998, Kusza et al 2009).

The gene frequencies of CSN1S1, CSN1S1, CSN1S1, and CSN1S1 in this study were comparable with those of Namita et al 2009, Kumar *et al* 2008, and Kumar et al 2002. Very low frequency of CSN1S1 locus was also reported by Jordana *et al* 1996 in Spanish breeds; 0.08, 0.04, 0.0, 0.0, for Murciano-Granadina, Malageguena, Papoya and Canaria, respectively, which were more or less similar with these findings in our present study. With respect to as1-casein locus, the observed and expected genotypic frequencies

for different alleles showed significant difference ($P< 0.05$). Therefore, the population under the study was in Hardy-Weimberg equilibrium with respect to as1-casein locus as the Chi-value was estimated at 229.46 with one degree of freedom.

Table 1. Genotypic Frequency of Milk Casein Variants in Nubian Sudanese Goats

	Genotypic Frequency										
Locus	AA	AB	AC	AF	AX	BB	BF	CC	FF	EE	OO
αa1-casein	5.7	17.2	-	2.3	-	56.3	4.6	-	3.5	8.1	2.3
	(5)	(15)	-	(2)	-	(49)	(4)	-	(3)	(7)	(2)
αs2-casein	55.2	-	36.8	-	3.4	-	-	4.6	-	-	-
	(48)	-	(32)	-	(3)	-	-	(4)	-	-	-
B-casein	97.7	-	-	-	2.3	-	-	-	-	-	-
	(85)	-	-	-	(2)	-	-	-	-	-	-
K-casein	94.3	5.7	-	-	-	-	-	-	-	-	-
	(82)	(5)	-	-	-	-	-	-	-	-	-

O represents the null allele; Figures in parenthesis are number of animals

Table 2. Allelic Frequency of Milk Casein Variants in Nubian Sudanese

Goats

Locus	Allelic Frequency						
	A	B	C	E	F	O	X
αs1-casein	0.112	0.662	-	0.125	0.050	0.050	-
αs2-casein	0.775	-	0.212	-	-	-	0.013
B-casein	0.988	-	-	-	-	-	0.012
K-casein	0.950	0.50	-	-	-	-	-

For αs2-casein locus was characterized by the presence of three alleles namely, CSN1S2, CSN1S2 and CSN1S2; the frequencies of these variants (**Table 2**) were 0.775, 0.212 and 0.013, respectively. In the genotypic frequencies (**Table 1**) for this locus, the homozygous AA genotype accounted for55.2% of the population followed by heterozygous AC (36.8%), followed by AX (3.4%). lack of presence of B variants in this study did not agree with results reported by Namita *et al.,* 2009, for Barbari goats. In our study, two variants of CSN2 were reported (A and X). AA genotype was the most prevalent (97.7%).

Two genetic variants of kappa-casein (CSN3) were detected in this study (A and B). Mono-morphemic pattern of CSN3A of CSN3B locus was reported by Kumar 2005, in Indian goats. The two variants in our present study were in accord with those reported by Namita *et al.,* 2009.

The present investigation revealed that, all the casein loci (CSN1S1, CSN1S2, CSN2 and CSN3) showed polymorphism in the milk samples of Sudanese Nubian goats.

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التعرف علي التركيبة الوراثية ونوعية المورثات لموقع بروتين الكازين في الماعز النوبي السوداني

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الملخص:

أجريت هذه الدراسة بغرض التعرف علي التركيبة الوراثية ونوعية المورثات لموقع بروتين الكازين في الماعز النوبي السوداني بمركز بحوث الإنتاج الحيواني بحلة كوكو بالخرطوم بحري.

في هذه الدراسة تم استخدام عدد سبع وثمانون عينة لبن للماعز النوبي السوداني حيث تم تحديد المورثات فيها بأستخدام طريقة التفريد الكهربي. أسفرت نتائج الدراسة عن وجود عدد سبعة (7) مورثات لبروتين الكازين في لبن الماعز النوبي السوداني ممثلة في أحد عشرة (11) تراكيب وراثية علي النحو التالي:- AA, AB, AC, AF, AX, BB, BF, CC, FF, OO .

كان تكرار المورثات A, B, E, F, O علي النمو التالي: 0.122, 0.662, 0.125, 0.05, 0.05 في موقع ألفا – 1 – كازين. كان الموقع ألفا -1- كازين في وضع أتزان هاردي وينبرج. في حين أن ألفا -2- كازين كان له عدد ثلاثة (3) مورثات هي: A, C, X بتكرارات هي: 0.775, 0.212, 0.013 بينما الموقع كابا- كازين كان به عدد أثنين (2) من المورثات وهي: A بتكرار 0.950 وB بتكرار 0.050. أما الموقع بيتا – كازين كان نصيبه من المورثات A بتكرار 0.998 في حين كان تكرار المورثX في نفس الموقع هو 0.012.

خلصت الدراسة إلي وجود عدد أثنين (2) من المورثات في كل من الموقع ألفا -2- كازين ($CSNIS2^{x}$) والموقع بيتا – كازين ($CSN2^{x}$).