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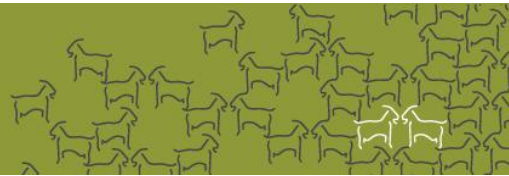
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Alpha-S1-casein protein and gene variants in goats

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Goats are essential for food security in Africa and provide a way of poverty alleviation [1]. Thereby, caseins in goat milk are an important source of nutrients [2]. Alpha-S1-casein comprises about 25% of caseins in goat milk [3]. *CSN1S1* gene is highly polymorphic [4].

The objectives of this study were (1) to provide a comprehensive overview on known α -S1-casein protein variants in goats and (2) to identify α -S1-casein protein variants in five goat breeds from Sudan (Nubian, Desert, Nilotic, Taggar, and Saanen).

We performed a literature search on reported protein variants in α -S1-casein to summarize 30 years of research (aim 1). High-density capture sequencing of a total of 28 goats of the five breeds [5] followed by single SNP genotyping of 50 unrelated individuals of each of the four Sudanese breeds was performed to distinguish α -S1-casein protein variants (aim 2). French Saanen and Alpine goats were used as outgroups for assessing the genetic diversity.

So far, 20 protein variants have been reported for α -S1-casein in goats. We clarified the names of α -S1-casein protein variants and the position of nucleotide and amino acid polymorphisms in the gene, and we provide easy translation between a DNA to a protein variant. Capture sequencing identified five non-synonymous and six synonymous SNPs in Sudanese goat breeds, of which four synonymous SNPs were novel. The variants *CSN1S1**A and *CSN1S1**B3 or *CSN1S1**B3 were most predominant among Sudanese goats and French Saanen, whereas, *CSN1S1**A is most frequent in French Alpine (**Table 1**). Interestingly, *CSN1S1**J that recently has been identified in Bezoar [5] was also found in Alpine and Desert goats. Cluster analysis based on alpha-S1-casein variants clearly differentiated Sudanese and French breeds.

The existence of high yielding α -S1-casein variants (strong variants) in Sudanese and French breeds is indicative of selection for high yield and good cheese curding properties.



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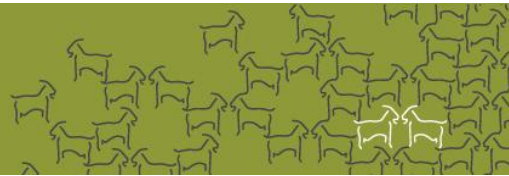


Table 1: Frequency (%) of alpha-S1-casein protein variants in four Sudanese breeds and French Saanen and Alpine goats.

Breed	No.	Frequency (%) of the alpha-S1-variants					
		CSN1S1*A	CSN1S1*B1	CSN1S1*B2	CSN1S1**B3/ CSN1S1*B4	CSN1S1*C	CSN1S1*J
Taggar	45	37	0	0	63	0	0
Nubian	49	51	0	0	49	0	0
Desert	47	41	2	0	55	0	1
Nilolotic	51	47	0	0	53	0	0
Saanen	25	42	2	14	42	0	0
Alpine	35	80	3	1	6	4	6

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