ISOLATION AND CHARACTERIZATION OF ACROSIN GENE (Acr), EXON 5 IN THE BUCKS OF GOAT BREEDS

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olecular genetic markers and determination of genetic differences between breeds are helpful in the genetic breeding programs for the improvement of productive traits such as milk and meet (Amills et al., 1995). Highest resolution of DNA variation can be obtained using sequence analysis that provides the fundamental structure of gene systems. DNA sequencing is generally not practical to identify variation between animals for the whole genome, but is a vital tool in the analysis of gene structure and expression (Drinkwater and Hazel, 1991). Advances in the understanding of the physiology, cell biology and biochemistry of reproduction have facilitated genetic analyses of fertility. Currently there are more than 200 known genes that are involved in the production of fertile sperm cells. The completion of a number of mammalian genome projects will aid in the investigation of these genes in different species. Great progress has been made in the understanding of genetic aberrations that lead to male infertility. Additionally, the first genetic mechanisms are being discovered that contribute to the quantitative variation of fertility traits in fertile male animals (Leeb et al., 2005). The reproductive gene Acr encodes

acrosin, a multifunctional protein that is abundant in the acrosomal compartment of the sperm head, which released during the early stages of the acrosome reaction, mediates secondary or consolidated binding of spermatozoa to the zona pellucida by virtue of its carbohydratebinding capacity (Jones et al., 1988). Acrosin is considered to play an essential role in fertilization, recognition, binding and penetration of the zona pellucida of the ovum (Klemm et al., 1991). Acrosin is thought to be important for secondary binding of sperm to the egg zona pellucida and subsequent proteolysis of the extracellular egg coat. Because a mouse knockout of Acr remained fertile, the functional significance of acrosin has been questioned (Baba et al., 1994). However, penetration of the zona pellucida in acrosin-deficient mice was significantly delayed, and there is ample evidence that acrosin is released during the acrosome reaction, binds the zona pellucida, and is critical for dispersion of acrosomal contents (Furlong et al., 2005; Tranter et al., 2000; Urch and Patel, 1991). A previous comparative analysis of Acr sequences from 10 mammal species revealed some evidence for adaptive change in this molecule, but P-values were

marginal in comparisons of neutral models to selection models (Swanson et al., 2003). Furthermore, large divergences between many of the sequences prevented comparison of the most rapidly evolving segment of Acr, exon 5 (Adham et al., 1996; Zahn et al., 2002). The bovine and porcine genes were cloned and characterized. Alignment of the intron/ exon structure of both genes with the previously characterized human, rat and mouse genes and with other serine protease genes reveals that the coded sequence of the mammalian proacrosin is distributed in 5 exons and the splice junction types are identical to the exons encoding the catalytic domain of other serine protease genes. A comparison of the bovine, porcine, human, guinea pig, rabbit, and rat and mouse preproprotein sequences shows that the catalytic domain is highly conserved, while the sequence of the proline rich domain is very variable among the species, ranging from 28.9% to 68.8% (Adham et al., 1996).

MATERIALS AND METHODS

1. Materials

The base goat population used in the present study was assembled at the year of 2010 from Sakha and Bourg El-Arab Experimental Stations, belonging to Animal Production Research Institute, Agriculture Research Center (ARC). It consisted of 5, 5, 10 and 10 bucks of different ages from Baladi, Barki, Zaraibi and Syrian Damascus breeds, respectively. Blood samples were collected from the jugular vein of each animal using vacutainer glass tubes which containing disodium ethylene diamine tetra acetic acid EDTA (EDTA-Na₂) as anticoagulant reagent. Centrifugation of these blood samples at 10000 rpm for 10 minutes at 4°C, were carried out then plasma protein (supernatant) was transferred to clean plastic vials and stored at -20°C for other studies. The pellet was immediately stored at -20°C for DNA extraction and PCR analysis.

2. Methods

2.1. DNA Extraction from frozen blood

Genomic DNA was extracted from all individuals in each breed by modification of the method described by Sambrook *et al.* (1989).

2.2. Detection of Acrosin gene, exon 5 by Polymerase Chain Reaction

To identify the acrosin gene Acr, exon 5, two specific primers were designed based on the known sequence of exon5 of acrosin gene (Acr) in Oreannos americanus goat breed found at NCBI database. Forward primer was 5'-GATAGGTTCTACCGCGGTGC-3' and 5'reverse primer was GGAGGCATGTCGTCCTGGAA-3'.

PCR reaction was prepared in 10 μ l contained: 2 μ l DNA, 1 μ l forward primer, 1 μ l reverse primer, 1 μ l dNTPs, 1 μ l MgCl₂, 2 μ l 5 X Green Flexi buffer, 1.9 μ l H₂O (D.W) and 0.1 μ l Taq polymerase. PCR reaction was achieved in the Techne thermocyclers which programmed as follows: Concerning the first cycle (initial denaturing), the denaturation temperature degree was 94°C for 4 min, and for the next 35 cycles, the denaturation, annealing and extension temperature degrees were 94°C for 45 sec, 58°C for 1 min and 72°C for 2 min, respectively, and for the last cycle (final extension), the temperature degree was 72°C for 5 min. Then, stored at 8°C for 10 min. *GelAnalyzer ver. 3* program was used to analyze the gels photos by comparing bands size with standard bands (DNA ladder).

2.3. DNA sequencing and analysis

One DNA sample from each breed individuals was randomly chosen and sent to Spain to be sequenced, then cleaned and concentrated using Fermentas (GeneJET PCR Purification Kit #K0702). These fragments were sequenced by sequencing service (Secugen S. L. of Madrid, Spain). The four DNA fragments sequences for *Acr* gene, exon5 which represented the four studied goat breeds were aligned using BioEdit program through multiple sequence alignment.

RESULTS AND DISSCUSION

1. Detection of acrosin gene (Acr) in the goat breeds

Profiles resulting from the use of two specific primers of *Acr* gene with the applied breeds are presented in Fig. (1). One band with a fragment size of a 378 bp was obtained in all individual samples for all breeds; this band represents exon 5 in *Acr* gene.

2. Acr gene, exon 5 DNA sequencing

One DNA sample from each goat breed with molecular size of 378 bp was randomly chosen and then sequenced through the automated DNA sequencing reaction with specific primers by sequencing service (Secugen S. L. of Madrid, Spain) as shown in Figs (2, 3, 4 and 5).

The number of each nucleotide in each sequenced fragment among these breeds was summarized in Table (1), where the numbers of Adenine and guanine bases were constantly in all breeds and were 78 and 73 bp respectively. While the number of cytosine base was 154 bp for Baladi and Zaraibi breeds and 155 bp for Barki and Damascus breeds. Also, the number of thymine base was 73 bp for Baladi and Zaraibi breeds and 72 bp for Barki and Damascus breed. Moreover, the number of G+C was 227 bp for Baladi and Zaraibi breeds and 228 bp for Barki and Damascus breeds. While the number of A+T was 151 for Baladi and Zaraibi breeds and 150 bp for Barki and Damascus breeds.

3. Acr gene, exon 5 DNA sequence alignment

The obtained sequences for *Acr* gene, exon 5 in the four studied goat breeds were compared with each other using BioEdit program as shown in Fig. (6). The sequences in Baladi and Zaraibi breeds were identity and differ from the sequences in Damascus and Barki breeds (who also identity) by only one base pair in a position number of 266 (T in Baladi

and Zaraibi breeds while it was C in Barki and Damascus breeds).

The sequences of *Acr* gene of the four studied breeds were also compared by alignment with the sequences of *Acr* gene, exon 5 of other origins (Table 2) on the data base at the national center for biotechnology information (NCBI) website <u>http://www.ncbi.nlm.nih.gov/</u>. using BioEdit program as shown in Fig. (7).

Different alignment similarity values were obtained in Table (3) which showed that the sequences of *Acr* gene, exon 5 in the four studied goat breeds were similar to the sequences of *Acr* gene, exon 5 in the other origins especially with two kinds of sheep (*Ovis canadensis* and *Ovis dalli*) and with the *Oreamnos americanus* goat. Similarity values were ranged from 0.78 to 1.

The constructed dendrogram which illustrated the genetic relationships among the four studied breeds and other 20 origins is shown in Fig. (8). The 24 different *Acr* gene, exon5 sequences including the obtained sequences in this study were divided into many groups and each group was further divided into some subgroups. The results confirmed that the sequences of *Acr* gene, exon5 in the four studied goat breeds, two kinds of sheep (*Ovis canadensis* and *Ovis dalli*) and *Oreamnos americanus* goat were included in one group.

It is concluded from this study that the *Acr* gene, exon5 found in all studied

goat breeds had a fragment with molecular size of a 378 bp and this fragment had conservation sequence in these breeds and sequence in Baladi and Zaraibi breeds was identical and differ from sequence of Damascus and Barki breeds (who also identical) by one base pair number 266 (T in Baladi and Zaraibi breeds while it was C in Barki and Damascus breeds). In addition, multiple alignment of Acr gene, exon 5 DNA sequence with the same DNA sequence in other origins give high similarity values. These results were in contrast with those of Gatesy and Swanson (2007) who reported that the Acr gene could be informative phylogenetic markers. In bovid artiodactyls (cattle, sheep, goats, andantelopes), exon 5 of Acr was highly variable, was characterized by a low level of homoplasy, and had a fairly even spread of substitutions across the 3 codon positions.

SUMMARY

Three Egyptian (Baladi, Barki and Zaraibi) and one Syrian (Damascus) goat breeds were used to isolate and characterize acrosin gene, exon 5. A sample of ten bucks individuals from Zaraibi and Damascus breeds and five bucks individuals from Baladi and Barki breeds were randomly taken and DNA was extracted from each individual and analyzed with the acrosin specific primers. One band with a fragment size of a 378 bp in all individual samples for all breeds represent exon 5 of *Acr* gene was obtained. Sequence analysis showed that Baladi and Zaraibi breeds were identical and differ from sequences of Damascus and Barki breeds (who also identical) by one base pair number 266 (T in Baladi and Zaraibi breeds while it was C in Barki and Damascus breeds). The genetic analysis for *Acr* gene, exon 5 showed that this region was conserved among the studied goat breeds.

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		Nun	nber of nuc	cleotides		
	А	С	G	Т	G+C	A+T
Baladi	78	154	73	73	227	151
Barki	78	155	73	72	228	150
Zaraibi	78	154	73	73	227	151
Damascus	78	155	73	72	228	150

Table (1): The numbers of A, C, G and T nucleotide for each chosen fragment of the four goat breeds.

	Source	The accession number	Name	Size (bp)
1	B. taurus	X68212.1	Acr gene, exon 5	539
2	Ovis canadensis Sheep	EF033138.1	Acr gene, exon 5	393
3	Ovis dalli Sheep	EF033137.1	Acr gene, exon 5	393
4	Gazella granti	EF033151.1	Acr gene, exon 5	408
5	Neotragus moschatus	EF033155.1	Acr gene, exon 5	408
6	Raphicerus campestris	EF033152.1	Acr gene, exon 5	408
7	Antidorcas marsupialis	EF033150.1	Acr gene, exon 5	408
8	Saiga tatarica	EF033152.1	Acr gene, exon 5	408
9	Tragulus napu	EF033156.1	Acr gene, exon 5	408
10	Pelea capreolus	EF033149.1	Acr gene, exon 5	408
11	Connochaetes taurinus	EF033147.1	Acr gene, exon 5	408
12	Beatragus hunteri	EF033146.1	Acr gene, exon 5	408
13	Alcelaphus buselaphus jacksoni	EF033145.1	Acr gene, exon 5	408
14	Oreotragus oreotragus	EF033154.1	Acr gene, exon 5	406
15	Damaliscus lunatus lunatus	EF033143.1	Acr gene, exon 5	406
16	Hippotragus niger	EF033142.1	Acr gene, exon 5	393
17	Oryx dammah	EF033141.1	Acr gene, exon 5	408
18	Damaliscus pygargus phillipsi	EF033144.1	Acr gene, exon 5	408
19	Connochaetes gnou	EF033148.1	Acr gene, exon 5	393
20	Oreamnos americanus Goat	EF033140.1	Acr gene, exon 5	393
21	Damascus Goat	-	Acr gene, exon 5	378
22	Barki Goat	-	Acr gene, exon 5	378
23	Zaraibi Goat	-	Acr gene, exon 5	378
24	Baladi Goat	-	Acr gene, exon 5	378

Table (2): Acr gene, exon 5 with its accession number and size in different origins at Gene Bank site.

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Origin	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	ID	0.91	0.91	0.92	0.93	0.90	0.91	0.91	0.81	0.91	0.93	0.93	0.92	0.92	0.93	0.93	0.94	0.92	0.93	0.92	0.91	0.91	0.90	0.90
2		ID	1.00	0.90	0.90	0.88	0.89	0.89	0.79	0.89	0.95	0.94	0.94	0.90	0.94	0.93	0.93	0.94	0.95	0.96	0.98	0.98	0.98	0.98
3			ID	0.90	0.90	0.87	0.89	0.89	0.79	0.90	0.95	0.94	0.94	0.90	0.94	0.92	0.93	0.94	0.94	0.96	0.98	0.98	0.98	0.98
4				ID	0.92	0.94	0.98	0.98	0.80	0.89	0.92	0.91	0.91	0.91	0.91	0.90	0.90	0.91	0.91	0.90	0.89	0.89	0.89	0.89
5					ID	0.90	0.90	0.91	0.81	0.90	0.92	0.92	0.92	0.92	0.92	0.91	0.92	0.92	0.92	0.92			0.90	0.90
6						ID	0.93	0.94	0.78	0.88	0.90	0.90	0.90	0.91	0.90	0.90	0.90	0.90	0.90	0.89	0.87	0.87	0.87	0.87
7							ID	0.97	0.79	0.90	0.91	0.90	0.90	0.90	0.90	0.90	0.90	0.91	0.91	0.90	0.89	0.89	0.89	0.89
8								ID	0.79	0.88	0.91	0.90	0.90	0.90	0.91	0.90	0.90	0.91	0.91	0.90	0.89	0.89	0.89	0.89
9									ID	0.80	0.81	0.81	0.80	0.79	0.80	0.79	0.80	0.80	0.81	0.81	0.79	0.79	0.79	0.79
10										ID	0.92	0.91	0.91	0.90	0.91	0.90	0.91	0.92	0.92	0.91	0.90	0.90	0.89	0.89
11											ID	0.99	0.99	0.92	0.99	0.97	0.98	0.99	1.00	0.96	0.95	0.95	0.94	0.94
12												ID	0.99	0.92	0.99	0.97	0.97	0.99	0.99	0.95	0.94	0.94	0.94	0.94
13													ID	0.92	0.99	0.96	0.97	0.99	0.99	0.95	0.94	0.94	0.94	0.94
14														ID	0.92	0.92	0.92	0.93	0.92	0.92	0.90	0.90	0.89	0.89
15															ID	0.97	0.98	0.99	0.99	0.96	0.94	0.94	0.94	0.94
16																ID	0.99	0.96	0.97	0.94	0.92	0.92	0.92	0.92
17																	ID	0.97	0.98	0.95	0.93	0.93	0.93	0.93
18																		ID	0.99	0.95	0.94	0.94	0.94	0.94
19																			ID	0.95	0.94	0.94	0.94	0.94
20																				ID	0.96	0.96	0.96	0.96
21																					ID	1.00	1.00	1.00
22																						ID	1.00	1.00
23																							ID	1.00
24																								ID

Table (3): Similarity matrix among the four studied breeds and other 20 origins based on Acr gene, exon 5 alignment.

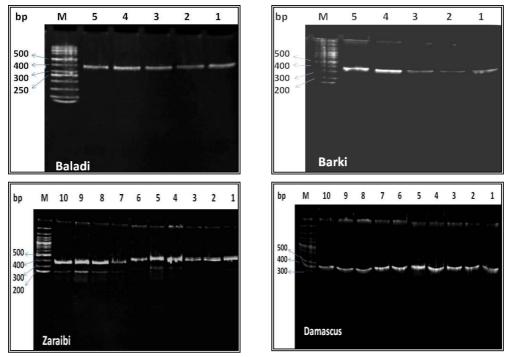


Fig. (1): PCR product for the *Acr* gene, exon 5 fragments of individual samples for (a) Baladi, (b) Barki, (c) Zaraibi and Damascus (d) breeds.

15	TAGGCTCTAC CGCCGTGCAC ATGATTCAGT TGCCCACCGC CTCCCCCGCT TCTACTCCAG
61	GGGCCCAAGC GAGCCCTGGC TCCGTCCAGC CTTCCGTTCG CCCACCTTGG TTCTTCCAAC
121	ACGTTCCTCG ACCACCTCCC TCTCAGCAAG CTATTGCCGT GGCCCAACCC CTAAATCCCT
181	CAAACCTCCG ACCCTCCATC CCATCTGCCG TCCCCTCCCG ACGACCACCC CCACCGCAGC
241	CTTCCACGAG GCCTCCCCAG GCACTTTCCT TTGCCAAGCG ACTGCAGCAG CTCATAGAGG
301	TCTTGAAGGG AAAGGCCTTT CTGAACGAAA AGAGCAATTA TGAGATGGAA ACCACAGACC
361	TTCCAGGACG ACACGCCT 3'

Fig. (2): Nucleotides sequence of Acr gene, exon 5 in Baladi breed.

15'TAGGCTCTAC CGCCGTGCAC ATGATTCAGT TGCCCACCGC CTCCCCCGCT TCTACTCCAG
61 GGGCCCAAGC GAGCCCTGGC TCCGTCCAGC CTTCCGTTCGCCCACCTTGG TTCTTCCAAC
121 ACGTTCCTCG ACCACCTCCC TCTCAGCAAG CTATTGCCGT GGCCCAACCC CTAAATCCCT
181 CAAACCTCCG ACCCTCCATC CCATCTGCCG TCCCCTCCCG ACGACCACCC CCACCGCAGC
241 CTTCCACGAG GCCTCCCCAG GCACTCTCCT TTGCCAAGCG ACTGCAGCAG CTCATAGAGG
301 TCTTGAAGGG AAAGGCCTTT CTGAACGAAA AGAGCAATTA TGAGATGGAA ACCACAGACC
361 TTCCAGGAACG ACACGCCT 3'

Fig. (3): Nucleotides sequence of Acr gene, exon 5 in Barki breed.

15' TAGGCTCTAC CGCCGTGCAC ATGATTCAGT TGCCCACCGC CTCCCCCGCT TCTACTCCAG
GGGCCCAAGC GAGCCCTGGC TCCGTCCAGC CTTCCGTTCG CCCACCTTGG TTCTTCCAAC
ACGTTCCTCG ACCACCTCCC TCTCAGCAAG CTATTGCCGT GGCCCAACCC CTAAATCCCT
CAAACCTCCG ACCCTCCATC CCATCTGCCG TCCCCTCCCG ACGACCACCC CCACCGCAGC
CTTCCACGAG GCCTCCCCAG GCACTTTCCT TTGCCAAGCG ACTGCAGCAG CTCATAGAGG
TCTTGAAGGG AAAGGCCTTT CTGAACGAAA AGAGCAATTA TGAGATGGAA ACCACAGACC
TTCCAGGACG ACACGCCT3'

Fig. (4): Nucleotides sequence of Acr gene, exon 5 in Zaraibi breed.

15' TAGGCTCTAC CGCCGTGCAC ATGATTCAGT TGCCCACCGC CTCCCCCGGT TCTACTCCAG
GGGCCCAAGC GAGCCCTGGC TCCGTCCAGC CTTCCGTTCG CCCACCTTGG TTCTTCCAAC
ACGTTCCTCG ACCACCTCCC TCTCAGCAAG CTATTGCCGT GGCCCAACCC CTAAATCCCT
CAAACCTCCG ACCCTCCATC CCATCTGCCG TCCCCTCCCG ACGACCACCC CCACCGCAGC
CTTCCACGAG GCCTCCCCAG GCACTCTCCT TTGCCAAGCG ACTGCAGCAG CTCATAGAGG
TCTTGAAGGG AAAGGCCTTT CTGAACGAAA AGAGCAATTA TGAGATGGAA ACCACAGACC
361 TTCCAGGACG ACACGCCT 3'

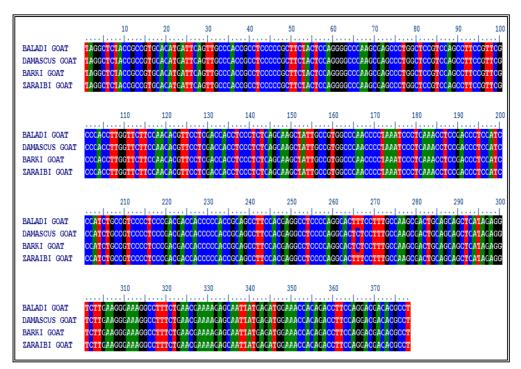


Fig. (5): Nucleotides sequence of Acr gene, exon 5 in Damascus breed.

Fig. (6): Multiple alignment of the nucleotides sequence of the 378 bp for the *Acr* gene, exon 5 in the four studied goat breeds.

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B.taurus	TAGGCTC	TANCAC	GGTGCACA			CCACCGC		GCTTC							TCAGCC	
Ovis canadensis Sheep Ovis dalli Sheep	TAGGCTC TAGGCTC		CGTGCACA CGTGCACA	TGATTO	AGTIGC	CCACCGC	CTCCCCC CTCCCCC			AGGGGC	CCAAGC CCAAGC				CCAGCC	TT <mark>CCA</mark> TT <mark>C</mark> G TTCCCTTCG
Gazella granti	TAGGCTC TAGGCTC	ACCGC	CGTGCACA	TOROTO	AGTTOC	CCACCGC	GTCCCCC		TACTCC	AGEGGC						
Neotragus moschatus	TAGGCTC	TABCCC	GGTGCACA	Teec re	AGETEC	CCACCO	TTCCCC	GCTTC	TACTCC	GGAGC	CCAAGC CCAAGC	GAGCC	CCAGC CTGGC	TCCGC	CCAGCC	TT <mark>CCATTC</mark> G TT <mark>CCATTC</mark> G
Raphicerus campestris	TAGGCTC	CTCCGC	6 G T G C A C C	TGGCTC	AGETGC	CYACCGC	TTCCCCC	GCCTC	TACTCC	AGTAGC		CAGCC	CCGGC	TCCGC	CCAGCC	TT <mark>CCATTC</mark> G
Antidorcas marsupialis	TAGGCTC	стссос	GGTGCACA	TEECTC	AGTTGC	CCACCGC	GCCCCCC	GCTTC	TACTCC	AGTAGC		GAGCC				TTCCATTCG
Saiga tatarica		CT <mark>C</mark> AGT	GGTGCACA	TGGCTC	AGCTGC	CCACCGC	ATCCCCC	ссттс	тастсс	AGTAGC	CCAAGC	GAGCC	CCGGC	тссбт	CCAGCC	TT <mark>CCA</mark> TT <mark>C</mark> G
Tragulus napu	TAGGTTC	TAGTGC	CTTGCACA	TGATTC	AGTTGC	CCACATO	ттсстсі	CCTTC	TACGCC	AGTATC	CCCAGC	GAGAC	CIGGC	CCCAT	GCAGCC	TT <mark>CC</mark> CAT <mark>C</mark> A
Pelea capreolus	TAGGCTC	T A G C G C	G G T G <mark>C A C</mark> A		AGTTGC	CCACTGC	TACCCC	GCTTC	CACTCC	AGCAGC		CAGCC				TT <mark>CCGC</mark> TCG
Connochaetes taurinus	T AGGC T C	T <mark>accgc</mark>	AG <mark>t</mark> gcaca		AGTTGC		TTCCCCC			AGTAGC		GAGCC	CTGGC			TT <mark>CCATT</mark> CG
Beatragus hunteri	TAGGCTC	T ACCGC T ACCGC	AG <mark>T</mark> GCACA	TGATTC		CCACTGO	TTCCCCC	GCTTC	TACTCC	AGTAGC		GAGCC	CIGGC	T CCGT	CCAGCC	TT <mark>CCATT</mark> CG
Alcelaphus buselaphus jackso	TAGGCTC	TACCGC	AGTGCACA				TTCGCCC			AGTAGC	CCAGGC		CIGGC			TT <mark>CCATTC</mark> G
Oreotragus oreotragus	TAGGCTC		GGTGCACA	I G GC I C	AGGTGC					AGTAGC	CCAAGY		CIGGC			TT <mark>CC</mark> GTTCG
Damaliscus lunatus lunatus		T <mark>acc</mark> gc Taccgc	AGTGCACA GGTGCAC	IGALLC				GCTIC		AGTAGC	CCAGGC	GAGCC	CIGGC			TT <mark>CCATTC</mark> G
Hippotragus niger	TAGGCTC TAGGCTC		GGTGCACE GGTGCACA	TOATTO	AGCTGC AGCTGC					AGTAGC		GAG <mark>CC</mark> GAGCC		TCCCT		TT <mark>CCATT</mark> CG TT <mark>CCATTC</mark> G
Oryx dammah	TACCOTC	TACCCC	AGTGCACA				TTCCCCC					GAGCC				
Damaliscus pygargus phillipsi Connochaetes gnou	TAGGCTC TAGGCTC TAGG <mark>I</mark> TC	TACCCC	AGTGCACA	TGATTO		CCACTGO		GCTTC	TACTCC	AGTAGC	CCAGGC		CTGGC	TCCGT	CCAGCC	TT <mark>CCATTC</mark> G TT <mark>CCATTC</mark> G
Oreamnos americanus Goat	TAGGITC	TACCGC	GGTGCACA		AGCTGC		CTCCCC			AGTEGC	CCAAGC		CTGGC	TCCGT	CCAGCC	TT <mark>CC</mark> GTTCG
Damascus Goat	TAGGCTC	TACCOC	CGTGCACA	TGATTO			CTCCCCC	GCTTC		AGGGGC		GAGCC		TCCGT	CCAGCC	TTCCETTCG
Barki Goat	TAGGCTC	TACCOC	CGTGCACA	TGATTC	AGTTGC	CCACCGO	CTCCCCC	GCTTC	ТАСТСС	AGGGGC	CCAAGC					TT <mark>CC</mark> GTT <mark>C</mark> G
Zaraibi Goat	TAGGCTC	TACCOC	CGTGCACA CGTGCACA	TGATTC	AGTTGC	CCACCGO	CTCCCCC	GCTTC	ТАСТСС	AGGGGC	CCAAGC	GAGCC	стесс	тссст	CCAGCC	TTCCCTTCG
Baladi Goat	TAGGCTC	TACCOC	CGTGCACA	TGATTC	AGTTGC	CCACCGC	CTCCCCC	ссттс	тастсс	AGGGGC	CCAAGC				CCAGCC	TT <mark>CC</mark> GTT <mark>C</mark> G
		110	120		130	14	0	150		160	17	0	18	0	190	20
B.taurus	CCCACCT	GGTTC	TTCCAACA	CGTTCC	TCAACC	ACCTCCC	TCTCAGO	AAGC	ATTGCC	GTGGCC	CAACCC	i ciril Racel		CAAGC	CCCCG	CCCTCAGTC
Ovis canadensis Sheep	CCCACCT	TGGTTC	TTCCAACA	CGTTCC	TCGACC	ACCTCCC	TCTCAGO	AAGCT	ATTOCC	GIGGCC	CAACCO	CTAAA	тссст	CAAAC	CICCGA	
Ovis dalli Sheep	CCCACCT	TGGTTC	TTCCAACA	CGTTCC	TCGACC	ACCTCCC	TCTCAGO	AAGCT	ATTGCC	GTGGCC	CAACCO	CTAAA	тссст	CAAAC	CTCCGA	
Gazella granti	CCC ACCT	TGGTTC	TT <mark>CCAAC</mark> A TT <mark>CCAAC</mark> A	CGTTCC	TCGACC	ACCTCCC	TCTCAGO	AAGCT	ATTGCC	GCGGCC	CAACCC	CCACA	тссст	CAAAG	CCCGA	сссесебтс
Neotragus moschatus	CCCACCT	TGGTTC	TTCCAACA TTCCACCA	CGTTCC	TCGACC	ACCTCCC	TCTCAGO	AAGCT	ATTGCC	GTGGCC	CAACCC	CCACA	T CCCG	CAAAG	CCCCGA	
Raphicerus campestris	CCCACCT	TGGTTC	TTCCASCA	CGTTCC	TCGACC	ACCTCCC	CCTCAGO		ATTGEC	AGGCC	CAACCC	CCACA		CAAAC	CCCCCG	
Antidorcas marsupialis	CCCACCT	TGGTTC	TTCCAACA	CCTTCC	TCGACC	ACCTCCC	TCTCAGO	AAGCT	ACTGCC	GCGGCC	CAACCC	CCACA	тссст			
Saiga tatarica	CCCACCT	TGGTTC	TTCCAACA TTCCAACA	CGTTCC	TCGACC	ACCTCCC	TCTCAGO	AAGCT	ATTGCI		CAACIC	CCACA		CAAAC		
Tragulus napu		GGTTC	CCAACA	CGGICC	CGACC	ACCICCO	COCAGO	BACCIO	GIC	GTGACC	CEACCO	CUACC		CACAC		CCTCCAGTT
Pelea capreolus		TGGTTC	TTCCAACA TTCCAACA	COLLOC	CGACC	ACCICCO	TOTOTO	AAGC	agi gcc	GGGCC	CAGCCC	CCACC		CBAAC		
Connochaetes taurinus Beatragus hunteri	CCCACCT		TTCCAACA		TCGACC		TCTCAGE	AAGC	ATTOCO	GTGGCC	CAACCC CAACCC	CCAAA		CAAAC	CTCCGA	CCCTCAGTC CCCTCAGTC
Beatragus nunteri Alcelaphus buselaphus jackso		TGGTTC	TT <mark>CCAAC</mark> A TT <mark>CCAAC</mark> A	CGTOCO	TCGACC	ACCTCCC	TCTCACE	AAGCT	ATTOCC	GIGGCC		CCAAA		CAAAC	CTCCGA	CCCTCAGTC CCCTCAGTC
Oreotragus oreotragus	CCCACCT	TGGTTC	TTCCAACA	CETTCO	TCGGCC	ACCTCCC	MCTCAGO	AAGCT	ATTOCC	GTGGCC	CAACCC				CCCCGG	
Damaliscus lunatus lunatus	CCCACCT	TGGTTC	TTCCAACA	CGTTCC	TCGACC	ACCTCCC	TCTCAGE	AAGCT	ATTOCC	GTGGCC	CAAACC				CICCGA	
Hippotragus niger	CCCACCT	TGGTTC	TTCCAACA	CGTTCC	TCGACC	ACCTCCC	TCTCAGO	AAGCT	ATTGCC	GTGGCC	CAACCC	TCAAA	CCCCT	CAAGC	CTCCGA	CCCTCAGTC
Oryx dammah	CCCACCT	TGGTTC	TTCCAACA	CGTTCC	TCAACC	ACCTCCC	TCTCAGO	AAGCT	ATTGCC	GTGGCC	CAACCC	тсала	тссст	CAAGC	CTCCGA	CCCTCAGTC
Damaliscus pygargus phillipsi	CCCACCT	TGGTTC	TTCCAACA	CGTTCC	TCGACC	ACCTCCC	TCTCAGO	AAGCT	A T T G C C	GTGGCC	саадсс	CCAAA				CCCTCAGTC
Connochaetes gnou	CCCACCT	TGGTTC	TTCCAACA	CGTTCC	TCGACC	ACCTCCC	TCTCAGO	AAGCT	A T T G C C	GTGGCC	CAACCC	CCAAA	T <mark>CCC</mark> T	CAAAC	CTCCGA	CCCTCAGTC
Oreamnos americanus Goat	CCCACCT	TGGTTC	TT <mark>CCAAC</mark> A TT <mark>CCAAC</mark> A	CGTTCC	TCGACC	ACCTCCC	TCTCAGO	CAAGC T	6 T T G C C	GTGGCC	C <mark>AACCC</mark>	CTAAA	T <mark>CCC</mark> T	CAAAC	CTCCGA	CCCTCCGTC
Damascus Goat		TGGTTC	TTCCAACA	CGTTCC	TCGACC	ACCTCCC	TCTCAGO	AAGCT	ATTGCC	GTGGCC	CAACCC	CTAAA		CAAAC	CTCCGA	CCCTCCATC
Barki Goat	CCCACCT	GGTTC	TTCCAACA	CGTTCC	CGACC	ACCICCC	TCTCAGO	AAGCT	ALLGCC	GIGGCC	CAACCC	CHAAA	TCCC T	CAAAC	CTCCGA	CCCTCCATC
Zaraibi Goat																
Daladi Ceat	CCCACCI			CGTTCC	TCGACC	ACCTCCC	TCTCAGO	AAGCT	ATTGCC	GTGGCC	CAACCC	CTAAA	TCCCT	CAAAC	CTCCGA	
Baladi Goat	CCCACCT				TCGACC	ACCTCCC	TCTCAGO	AAGCT	ATTGCC	GTGGCC GTGGCC	CAACCC	CTAAA	TCCCT	CAAAC	CTCCGA CTCCGA	CCCTCCATC CCCTCCATC
Baladi Goat	CCCACCT	TGGTTC	TTCCAACA	CGTTCC	TCGACC TCGACC	ACCTCCC ACCTCCC	TCTCAGO TCTCAGO	AAGCT	ATTGCC	G <mark>T</mark> GG <mark>CC</mark>	CAACCC	CTAAA CTAAA	TCCCT	CAAAC	CTCCGA CTCCGA	CCCTCCATC CCCTCCATC
Baladi Goat	CCCACCT	210	220	CGTTCC	TCGACC TCGACC			AAGCT	ATTGCC ATTGCC	260	CAACCO CAACCO 27		TCCCT TCCCT		CTCCGA CTCCGA 290	CCCTCCATC
B.taurus	CCACCT		TTCCAACA 220 GACCCCCA	CGTTCC		ACCTCCC ACCTCCC 24	TCTCAGO	AAGCT	ATTGCC ATTGCC	260	CAACCO CAACCO 27		TCCCT TCCCT		CTCCGA CTCCGA 290	CCCTCCATC
B.taurus Ovis canadensis Sheep	CCCACCT					ACCTCCC ACCTCCC 24 CCGCAGC CCGCAGC							28 AAGCG		CTCCGA CTCCGA 290 AGCAGC	CCCTCCATC 30 TCATAGAGG
B.taurus Ovis canadensis Sheep Ovis dalli Sheep	CCACCT CCASCTG CCATCTG CCATCTG		220 220 220 2 2 2 2 2 2 2 2 2 2 2 2 2 2			ACCTCCC ACCTCCC 24 CCGCAGC CCGCAGC							28 AAGCG		CTCCGA CTCCGA 290 AGCAGC	CCCTCCATC 30 TCATAGAGG
B.taurus Ovis canadensis Sheep Ovis dalli Sheep Gazella granti	CCACCT CCASCTG CCATCTG CCATCTG CCATCTG TCASCTS	210 210 CCCCCCC CCACCC CCACCC CCCCCCCCC	220 SACCCCCA CCTCCCA CCTCCCA SACCCCCA	CGTTCC CGACCA CGACCA CGACCA CGACCA	230 CCCCCCA CCCCCCA CCCCCCA CCCCCCA	ACCTCCC ACCTCCC CCGCAGC CCGCAGC CCGCAGC CCGCAGC		250 TAGGCC TAGGCC TAGGCC TAGGCC	ATTGCC ATTGCC CTCCCC CTCCCC CTCCCC CTCCCC	260 AGGCAC AGGCGC AGGCGC	CAACCC CAACCC 27 TCTCCT TCTCCT TCTCCT TCTCCT		28 AAGCG AAGCG AAGCG AAGCG	CAAAC CAAAC ACTGC ACTGC ACTGC ACTGC	CTCCGA CTCCGA 290 AGCAGC AGCAGC AGCAGC AGCAGC	CCCTCCA 30 TCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG
B.taurus Ovis canadensis Sheep Ovis dalii Sheep Gazella granti Neotragus moschatus	CCACCT CCACCTG CCATCTG CCATCTG TCAECTE CCTTCTG	210 CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC	220 SACCCCCA CCTCCCSA CCTCCCSA SACCCCCA CACCCCCA	CGTTCC CGACCA CGACCA CGACCA CGACCA CGACCA				250 TAGGCC TAGGCC TAGGCC TAGGCC TAGGCC	ATTGCC ATTGCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC	260 260 AGGC AC AGGC GC AGGC GC AGGC AC AGGC AC			28 28 AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG	CAAAC CAAAC ACTGC ACTGC ACTGC ACTGC ACTGC	CTCCGA CTCCGA 290 AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC	CCCTCCATC 300 TCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG
B.taurus Ovis canadensis Sheep Ovis dalli Sheep Gazella granti Neotragus moschatus Raphicerus campestris	CCACCT CCACCTG CCATCTG CCATCTG TCAECTE CCTTCTG	210 210 CCCCCCC CCACCC CCACCC CCCCCCCCCCCCCCC	TTCCAACA 220 SACCCCCCA CTCCCCA CTCCCCA SACCCCCCA SACCCCCCA SACCCCCCA	CGTTCC CGACCA CGACCA CGACCA CGCCA CGCCA CGCCA	230 CCCCCCA CCCCCCA CCCCCCA CCCCCCA CCCCCCA CCCCCC			250 TAGGC TAGGC TAGGC TAGGC TAGGC		260 260 AGGC AC AGGC GC AGGC GC AGGC AC AGGC AC			28 AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG	CAAAC CAAAC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC	290 290 AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC	CCCTCCA 300 TCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG
B.taurus Ovis canadensis Sheep Ovis dalii Sheep Gazella granti Neotragus moschatus Raphicerus campestris Antidorcas marsupialis	CCACCT CCACCTG CCATCTG CCATCTG TCAECTE CCTTCTG	210 210 CCCCCCC CCACCC CCACCC CCCCCCCC CCCCCCCC	220 220 24 25 25 25 26 25 26 25 26 26 26 26 26 26 26 26 26 26 26 26 26	CGTTCC CGACCA CGACCA CGACCA CGBCC3 CGACCA CGBCC3	TCGACC TCGACC 230 CCCCCCA CCCCCA CCCCCA CCCCCA CCCCCA CCCCCA CCCCCA			250 TAGGC TAGGC TAGGC TAGGC TAGGC TAGGC		260 260 AGGCAC AGGCGC AGGCGC AGGCAC AGGCAC AGGCAC			28 28 28 AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG	CAAAC CAAAC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC	290 290 AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC	CCCTCCA 30 CCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG
B. taurus Ovis canadensis Sheep Ovis dalil Sheep Gazella granti Neotragus moschatus Raphicerus campestris Antidorces marsupialis Saiga tatarica	CCACCT CCACCTG CCATCTG CCATCTG TCASCTS CCTTCTG TCASCTS TCASCTS	210 210 CC C C C C C C C A C C C C C A C C C C C C C		CGTTCC CGACCA CGACCA CGACCA CGACCA CGCCCA CGCCCA CGCCCA CGCCCA	TCGACC TCGACC 230 CCCCCCA CCCCCA CCCCCA CCCCCA CCCCCA CCCCCA CCCCCA CCCCCA CCCCCA	ACCTCCC ACCTCCC CCGCAGC CCGCAGC CCGCAGC CCGCAGC CCGCAGC CCGCAGC CCGCAGC CCGCAGC				260 260 AGGC AC AGGC C AGGC AC AGGC AC AGGC AC AGGC AC AGGC AC		CTAAA CTAAA TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC	28 28 AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG	CAAAC CAAAC CAAAC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC	CTCCGA CTCCGA 290 AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC	CCCTCCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG
B.taurus Ovis canadensis Sheep Ovis dalii Sheep Gazella granti Neotragus moschatus Raphicerus campestris Antidorcas marsupialis	CCACCT CCACCTG CCATCTG CCATCTG TCAECTE CCTTCTG TCAECTE TCAECTE TCAECTE TCAECTE	210 210 200 C C C C C C C C C C C C C C C C C C		CGTTCC CGACCA CGACCA CGACCA CGCCCA CGCCCA CGCCCA CGCCCA CGCCCA CGCCCA CGCCCA CGCCCA CGCCCA	TCGACC TCGACC 230 CCCCCCA CCCCCCA CCCCCCA CCCCCCA CCCCCCA CCCCCC			250 250 250 250 250 250 250 250 250 250	ATTOCC ATTOCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC	260 260 AGGC AC AGGC GC AGGC AC AGGC AC AGGC AC AGGC AC AGGC AC AGGC AC		CTAAA CTAAA TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC	28 AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG	CAAAC CAAAC CAAAC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC	CTCCGA CTCCGA 290 AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC	CCCTC BATC 30 1 1 1 1 1 1 1 1 1 1 1 1 1
E taurus Ovis canadensis Sheep Ovis dali Sheep Gazelia granti Reotragus moschatus Raphicerus campestris Antidorcas marsupialis Saiga tatarica Tragutus napu Pelea capreolus	CCACCT CCACCTG CCATCTG CCATCTG TCACCTS TCACCTS TCACCTS TCACCTS TCACCTS TCACCTS CCACCTS	210 210 200 C C C C C C C C C C C C C C C C C C		CGTTCC CGACCA CGACCA CGACCA CGCCCA CGCCCA CGCCCA CGCCCA CGCCCA CGCCCA CGCCCA CGCCCA CGCCCA	TCGACC TCGACC 230 CCCCCCA CCCCCCA CCCCCCA CCCCCCA CCCCCCA CCCCCC			250 250 250 250 250 250 250 250 250 250	ATTOCC ATTOCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC	260 260 AGGC AC AGGC GC AGGC AC AGGC AC AGGC AC AGGC AC AGGC AC AGGC AC		CTAAA CTAAA TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC	28 AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG	CAAAC CAAAC CAAAC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC	CTCCGA CTCCGA 290 AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC	CCCTC BATC 30 1 1 1 1 1 1 1 1 1 1 1 1 1
B. taurus Ovis canadensis Sheep Ovis dall Sheep Gazelia grant Neotragus moschatus Raphicerus campestris Antidorcas marsupalis Saiga tatarica Tragutus napu	CCACCT CCACCTG CCATCTG CCATCTG TCACCTS TCACCTS TCACCTS TCACCTS TCACCTS TCACCTS CCACCTS	210 210 200 200 200 200 200 200 200 200	220 24 25 26 27 27 27 27 27 27 27 27 27 27 27 27 27	CGACCA CGACCA CGACCA CGACCA CGACCA CGCCCG CGACCA CGCCCG CGCCCG CGCCCG CGCCCG CGCCCG CGCCCG CGCCCG CGCCCG CGCCCG CGCCCG CGCCCG CGCCCG CGCCCA CGCCCA	100 ACC 230 230 000000000000000000000000000000000000		TCTCAG TCTCAG CTTCCAG CTTCCAG CCTCCAG CCTCCAG CCTCCAG CCTCCAG CCTCCAG CCTCCAG CCTCCAG CCTCCAG	250 TAGCC TAGCC TAGCC TAGCC TAGCC TAGCC TAGCC TAGCC TAGCC TAGCC TAGCC TAGCC TAGCC	ATTOCC ATTOCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC CTCCCC	260 260 AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC		CTAAA CTAAA TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC	28 AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG	CAAAC CAAAC CAAAC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC	CTCCGA CTCCGA 290 AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC	CCCTC CATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG TCATAGAGG
B taurus Ovis candi Sheep Ovis dali Sheep Gazello granti Neotragus moschatus Raphicerus campestris Antidorca marsupalis Saiga tatarica Tragutus napu Pelea capreolus Beatragus hunteri Alcelaphus buselaphus jackso	CCACCT CCACCT CCATCTG CCATCTG CCATCTG CCATCTG TCACCTC TCACCTC TCACCTC TCACCTC CCACCTC CCACCTG CCATCTG CCATCTG CCATCTG	210 210 200 200 200 200 200 200 200 200		CGACCA CGACCA CGACCA CGACCA CGACCA CGCCC CGCCC CGCCC CGCCC CGCCC CGCCC CGCCC CGCCC CGCCC CGCCC CGCCC CGCCC CGCCC CGCCC CGCCC CGCCCA CGCCA CGCCA CGCCA CGCCA CGCCA CGCCA CGACCA	TCGACC TCGACC 230 CCCCCA		TCTCAG TCTCAG CTTCCAG CCTCCAG CCTCCAG CCTCCAG CCTCCAG CCTCCAG CCTCCAG CCTCCAG CCTCCAG CCTCCAG			250 AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC		CTAAA CTAAA TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC	Z Z Z Z Z Z Z Z Z Z Z Z Z Z	CAAAC CAAAC CAAAC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC	290 290 AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC	CCCTC C A TC 300 TCAT AGAGG TCAT AGAGG
E taurus Ovis canadensis Sheep Ovis dali Sheep Gazelia granti Neotragus moschatus Raphicerus campestris Antidorcas marsupialis Saiga tatarica Tragutus napu Pelea capreolus Connochaetes taurinus Beatragus hunteri Alcelaphus buselaphus jackso Oreotragus oreotragus	CCACCT CCACCT CCATCCO CCATCCO CCATCCO CCATCCO CCATCCO CCATCCO CCATCCO CCATCCO CCATCCO CCATCCO	210 210 200 200 200 200 200 200 200 200			Z30 Z30 CCCCCA CCCCCA CCCCCA CCCCCA CCCCCA CCCCCA CCCCCA CCCCCA CCCCCA		ICTCAG TCTAG TCTAG CTTCAG CTTCAG CTTCCAG CTTCCAG CTTCCAG CTTCCAG CTTCCAG CTTCCAG CTTCCAG CTTCCAG CTTCCAG CTTCCAG	250 250 250 250 250 250 250 250 250 250		260 AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC		CTAAA CTAAA TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC	Z Z Z Z Z Z Z Z Z Z Z Z Z Z	CAAAC CAAAC CAAAC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC	290 290 AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC	CCCTQ ATC 30 CATAGAGG TCATAGAGG
B taurus Ovis canil Sheep Ovis dali Sheep Gazello granti Neotragus moschatus Raphicerus campestris Antidorca marsupalis Saiga tatarica Tragutus napu Pelea capreolus Beatragus hunteri Alcelaphus buselaphus jackso Oreotragus oreotragus Damaliscus luntatus luntus	CCACCT CCATCTC CCATCTC CCATCTC CCATCTC CCATCTC CCATCTC TCASCTS TCASCTS TCASCTS TCASCTS CCASCTC CCATCTC CCATCTC CCATCTG CCATCTG CCATCTG	210 210 200 200 200 200 200 200 200 200	TTCCAAGA 220 SACCCCA CCTCCCB SACCCCA CCTCCCB SACCCCCA GACCCCCA GACCCCCA CACCCCCA CACCCCCA CACCCCCA CACCCCCA CACCCCCA CACCCCCA CACCCCCA CACCCCCA CACCCCCA CACCCCCA		ZO ZO ZO ZO ZO ZO ZO ZO ZO ZO		TCTCAG TCTCAG TCTCAG CTTCCAG CCTCCAG CCTCCAG CCTCCAG CCTCCAG CCTCCAG CCTCCAG CCTCCAG CCTCCAG CCTCCAG	250 TAGGCT TAGGCC TAGGCC TAGGCC TAGGCC TAGGCC TAGGCC TAGGCC TAGGCC TAGGCC TAGGCC TAGGCC TAGGCC TAGGCC TAGGCC		260 260 AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC AGGCAC		CTAAA CTAAA TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC TTGCC	AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG AAGCG	CAAAC CAAAC CAAAC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC ACTGC	CTCCGA CTCCGA 290 AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC AGCAGC	CCCTQ A TC 30 1 CAT AG AGG TCAT AG AGG
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Fig. (7): Multiple alignment of the nucleotides sequence of the obtained 378 bp for the *Acr* gene, exon 5 with the other 20 origins.

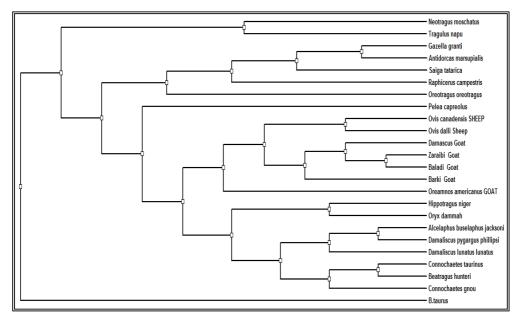


Fig. (8): Genetic relationship among the four studied breeds and other 20 origins based on *Acr* gene, exon 5 alignment.