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STUDY OF BIODIVERSITY IN GOATS IN ALBANIA

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Abstract

Goats are well adapted to Albanian climatic conditions. Goat breeding is primarily found in the mountains, natural - pastures and hilly regions of the country. Goat variability is high in Albania. They are farmed under traditional extensive production systems. The objective of this study was the identification and phenotypic characterisation of various goat breeds/ecotypes or populations in Albania. Qualitative and quantitative traits of horns (form and length), coat cover, ears, hair, teeth, the cutting, etc., are used to distinguish among phenotypes representing sub-populations of goats. There are identified ten local goat populations and two exotic breeds. The animals of "Has", "Dragobia", "Skuqja of Mati", "Velipoja" and "Lara of Kallmeti" ecotypes have high - medium body size, developed skeleton, thin and strong feet. The body size of "Capore of Mokra" and "Liqenasi" ecotypes is medium-small and the animals of "Dukati" and "Muzhake" ecotypes are of smaller body size. The native populations which are not classified can be considered as part of Balkan goat population. The differences between local and exotic goat breeds are significant ($P<0.05$) for all morphological and production traits. Morphological differences among various local ecotypes/populations and high level of polymorphism of the visible phenotypic profile indicate a high diversity of goats in Albania. Analyses of principal component of the Albanian local goat population show that 3-4 subpopulations can be identified..
Key words: *goat, polymorphism, local population, principal component*

Introduction

The goat population in Albania counted 775 thousand goats (576 thousand milked goats). After 1996, the size of goat population was decreased, with an average decrease rate of about 2.9% /year (Statistical yearbook, 2011. MoAFCP). Goats in Albania represent a high diversity and heterogeneity. Therefore, it is not difficult to distinguish among well-defined genetic entities. Based on different indicators of body conformation and level of production several subpopulation/ecotypes of Albanian goat population could be noted (Dema, 1985; Bleta, et al., 2002). In general they are isolated populations. Their evolution has been product of human being and natural selection interaction for adaptation to the agro-ecological conditions. The name of their geographical region is used frequently to name these ecotypes..

The study of the features and the productive behaviour of a population are of considerable utility, especially, when animal resources display some authentic details, biologic, technical or environmental. The characterization of local goats, raised in different regions of Albania, presents scientific and technical interests, especially to the genetic improvement and also to the conservation of animal genetic resources.

Lauvergne (1982) introduced the concept of standardized breeds, derived from traditional populations determined by a group of alleles in a homozygosis state. This state was due to

selectivity over succeeding generations in a population deemed traditional and that may originally have been very variable in its extension and purposes owing to the practice of many types of reproduction.
The aim of this study was to characterize the local Albanian goats on their morphological appearances and to link morphological characteristics to genetic determinism.

Materials and methods

A total of 26 herds were surveyed and sampled. Animals were 491 females and 73 males. Regions of populations/ecotypes of local goat that are observed and measured for morphological features, and their size are presented Table 1.

Table 1. Regions, population/ecotypes and number of animals

Local population/ecotype		Number of animal	
Acron	Name	Female	Male
HA	Hasi	41	7
DR	Dragobia	36	6
SMA	Skuqe e Matit	44	7
VE	Velipoja	51	6
LAK	Lara of Kallmeti	34	8
CA	Caporre of Mokrra	61	7
LI	Liqenas	46	6
DU	Black of Dukati	55	9
MU	Muzhake	62	8
NUC	Non classifiable	61	9
	Total	491	73

To estimate different morphometric traits the measurements were done ion adult animals. The traits measured were: body length, wither height, heart girth, udder circumference, teats length, tibia circumference.
The genetic profiling was done following the standards proposed by Lauvergne (1986), Cogovica (1987) and Lauvergne et al (1987). Those standards recommend various scales such as length of horns, colour pattern, length of the ear, etc. Phenotypes that are qualitative in nature were marked in terms of presence or absence while quantitative variables were measured.
Elementary statistics (mean, standard deviation) of morphometric traits that were observed and measured were determined. The methods of studying whole characters rest on the principles of multi-dimensional analysis. Analyse of variances was performed following the GML model with fixed factors:

$$Y_{ijkl} = \mu + + a_i + b_j + (a\ b)_{ij} + \varepsilon_{ijk}$$

Where

y_{ijkl} = a quantitative variable (body length, wither height, heart girth, tibia circumference),
μ = general mean of population,
a_i = effect of the i^{th} ecotype/local population,
b_j = effect of the j^{th} sex,
$(a \times b)_{jk}$ = effect of sex within ecotype
ε_{ijl} = residual error.

In above statistical model the sex factor and the interaction effect of breed x sex or effect of bread and sex were removed for udder circumference and teat length traits.

Qualitative measures were analysed according to norms defined by Lauvergne (1986) and Cogovica (1987).Absolute frequencies of phenotypes were determined in each ecotype/population. These frequencies were complemented by relative gene frequencies coding for the observed phenotypes with presumably established genetic determinism. A principal component analysis was performed on the quantitative variables: body length, wither height, heart girth, udder circumference and data of polymorphism of locus: ear length, horns, wattles, beard and hair length, that were used for study of genetic profile of Albanian local goat population.

Results and discussion

Descriptive statistics for quantitative characters

The estimations of main statistical indicators of measured quantitative traits of Albanian local goat population are presented in Table 2. The variance values and variance coefficient highlight the significant level of the variability of these traits in goat population. Udder conformation indicators have the highest variation. The variance coefficient of udder circumference is estimated to be about 35.7% and that of teat length 33.3%. The variation of hearth girth indicator is also high. The wither height has minimal and maximal values respectively 51 cm and 75cm. The differences of body length of smaller animals up to those with greater body size are estimated to be about 39.6%. Referring average values of these indicators and their respective variances we can say that distinguished goat subpopulations are present in Albania. To verify this hypotheses the variance analyses according to above linear model was carried out (Table 2) accepting in advance the classification in local ecotypes/populations (Dema, 1985).

Table 2. Descriptive statistics of quantitative variables

Parameter	Body length	Wither height	Heart girth	Tibia circumference	Udder circumference	Teat length
N	564	564	564	564	491	491
Mean	68.02	64.16	80.08	7.58	34.75	3.75
STD	0.762	0.612	0.957	0.09	0.159	0.08
Variance	18.1	14.5	22.7	2.12	12.4	1.25
Minimum	58	51	67	6.3	18	3.01
Maximum	81	75	93	10.4	45	4.24
CV%	26.61	22.66	28.39	27.96	35.7	33.3

Analyzes of variance

The genetic factor (ecotype) effects on phenotypic variance of all analysed traits. The effect is particularity larger on body length ($P<0.001$), wither height ($P<0.001$) and udder circumference ($P<0.01$). The effect of sex appears to be a tendency on tibia circumference. The effect of "sex x

ecotype" is significant only for body length trait (P<0.05). These results show that the classification in ecotypes to distinguish different subpopulations in Albanian goat population using body conformation traits reflects properly its variability. This classification could be used successfully for preservation and development of genetic fund of Albanian local goats.

Table 3. Analyses of variance

Variable	df	Body length	Wither height	Heart girth	Tibia circumference	df	Udder circumference	Teat length
Ecopype	9	***	***	*	*	9	**	*
Sex	1	**	**	**	NS			
Sex x ecotype	9	*	NS	NS	NS			
Residual	546	Variance 46723	Variance 32165	Variance 51294	Variance 2126	483	Variance 18452	Variance 1328
R^2 (%)		45.4	41.2	46.7	32.1		23.7	32.6

*df: degrees of freedom, NS: non significant; *** : P < 0.001; **: P< 0.01 ; *:P <0.05*

The least squares means and their standard errors of analysed traits of different ecotypes are presented in Table 4.

Table 4. The least squares means and their standard errors

Ecotype/ population	N	Body length	Wither height	Heart girth	Tibia circumference	N	Udder circumference	Teat length
Hasi	48	69.8±1.1	67.4±0.7	80.3±1.0	8.5±0.09	41	33.5±0.12	3.9±0.09
Dragobia	42	72.4±2.2	68.9±1.1	84.7±0.7	8.9±0.07	36	37.3±0.13	4.2±0.14
Skuqe of Matit	51	74.1±2.6	69.1±2.0	86.8±0.9	7.8±0.09	44	37.8±0.18	3.8±0.09
Velipoja	57	77.4±1.3	68.6±0.8	87.2±1.2	9.2±0.13	51	39.6±0.12	4.1±0.01
Lara of Kallmeti	42	76.9±2.4	70.1±0.6	86.8±1.6	7.7±0.11	34	37.1±0.19	4.3±0.07
Caporre of Mokrres	68	65.4±2.3	61.8±1.0	81.2±0.7	6.9±0.04	61	36.8±0.14	3.6±0.11
Liqenas	52	65. 1±2.2	66.2±1.1	78.3±0.9	7.2±0.06	46	33.6±0.16	3.7±0.08
Black ofe Dukati	64	62.5±2.7	56.8±0.8	72.6±1.0	6.4±0.09	55	30.6±0.16	3.3±0.08
Muzhake	70	64.8±2.1	61.1±0.7	75.8±0.8	7.2±0.04	62	31.2±0.15	3.6±0.06
Non classifiable	70	63.8±2.2	58.9±0.9	73.8±1.2	7.0±0.06	61	32.7±0.17	3.5±0.04

Referring to the last squares means of body length, wither height and heart girth two main groups of studied ecotypes could be distinguished: first group, animals with great/average body size - Hasi, Dragobia, Velipoja, Skuqe of Matit and Lara of Kallmeti and the second group include animals with small/average body size: Capore of Mokrra, Liqenas, Black of Dukati, Muzhake dhe non classifiable. Based on udder indicators ecotypes of Dragobia, Velipoja and Lara of Kallmeti could be distinguished. The second group could be classified as the best one for milk production. These results are in accordance with those reported by Dema (1985); Kume et al., (1994, 1995); Bleta et al. (2002).

The visible phenotypic profile

Frequencies of observable phenotypes tended towards one (Table 4). The obedient characters to this tendency were the presence of the horns, the presence of beard, the absence of the wattles and the pigment alteration.

From the phenotypic frequencies the genetic profile was deduced for the Albanian local goat population (Table 5) and for each ecotype (Table 6). These frequencies show the dominance of the wild character which supposes that the studied goat populations belong to the traditional type according to Lauvergne (1986).

Table 5. Genetic profile of Albanian local goat population.

Name of locus	Alleles		Allelic frequencies
	Name	Symbol	
Ear length	Wild	EL^+	0.69
	Reduced	EL	0.31
Horns	Wild	Ho^+	0.97
	Polled	Ho^p	0.03
Wattles	Wild	Wa^+	0.74
	Wattled	Wa^w	0.26
Beard	Wild	Br^+	0.99
	Bearded	Br^b	0.01
Hair Length	Wild	HL^+	0.17
	Long	HL^L	0.83
Pigment alteration	Black	Rn^+	0.88
	Ruane White	Rn^R	0.12
Type of eumelanine	Back	B^+	0.58
	Brown	B^b	0.42

Table 6. Genetic profile of Albanian local goat ecotype/populations

Ecotype/population	Alleles						
	EL^+	Ho^+	Wa^+	Br^+	HL^+	Rn^+	B^+
Hasi	0.95±0.02	0.98±0.01	0.85±0.04	1.00±0.0	0.48±0.12	0.97±0.02	0.15±0.03
Dragobia	0.73±0.05	0.99±0.01	0.89±0.03	1.00±0.0	0.55±0.23	0.99±0.01	0.79±0.04
Skuqe e Matit	0.78±0.04	0.98±0.01	0.82±0.04	1.00±0.0	0.12±0.07	0.98±0.01	0.39±0.06
Velipoja	0.74±0.04	0.96±0.02	0.72±0.01	1.00±0.0	0.04±0.05	0.91±0.02	0.11±0.02
Lara e Kallmetit	0.72±0.03	0.96±0.01	0.89±0.02	1.00±0.0	0.11±0.06	0.89±0.02	0.12±0.02
Caporre e Mokrres	0.81±0.03	0.96±0.01	0.81±0.03	0.98±0.01	0.03±0.05	0.87±0.03	0.21±0.03
Liqenas	0.81±0.04	0.96±0.03	0.79±0.04	1.00±0.0	0.12±0.07	0.89±0.02	0.81±0.07
E zeza e Dukati	0.39±0.06	0.99±0.00	0.88±0.03	1.00±0.0	0.15±0.02	0.98±0.01	0.88±0.07
Muzhake	0.41±0.05	0.98±0.01	0.72±0.04	1.00±0.0	0.01±0.05	0.66±0.04	0.85±0.06
Non classifiable	0.52±0.03	0.98±0.00	0.68±0.09	0.99±0.01	0.02±0.04	0.72±0.05	0.81±0.07

According to Cogovica 1987 a gene controls the length of the ears with intermediate dominance. Short ears result from the EL^r/El^r heterozygote. Ear size appears to be conditioned by a gene series where small ears are dominant or additive to large ears (Pattie et Restall 1989). In the Albanian goat population, the most frequent is the EL^+ allele with a frequency equals to 0.69. In ecotype Hasi, Capore e Mokrres and Liqenas the frequency of this allele tend to be equal to 1. Ecotype e Zeza e Dukati and Muzhake were characterised by the dominance of small ears.

The polled character (Ho^p) is an autosomal gene bound to the sex. In the homozygous state, HO^p exercises a pleitropic action leading to partial or total sterility (French, 1971; Dolling, 1999; Pattie and Restall, 1989; Vivicorsi 1998). This is not the case of Albanian local goat population. The allelic frequency of Ho^+ in all ecotypes is equal to 1.

The presence of the wattles is controlled by a dominant autosomal gene (Wa^w) (Lauvergne, 1987). The presence of wattles on the neck is dominant and is common in some strains of feral and milking goat (Pattie and Restall, 1989). But in this study, the absence of wattles dominates with the wild allele Wa+ and an allelic frequency nearing 0.74.

The beard is controlled by the autosomal allele Br bound to the sex, dominating in males and recessive in females (Lauvergne, 1987). The Albanian local goat population characterize by the presence of the beard. The allelic frequency of Br^+ is equal to 1.

A pair of autosomal alleles controls the length of the hairs with intermediate dominance of the short hair HL^+ in relation to the HL^L gene with long hairs (Lauvergne et al., 1987, Pattie and Restall, 1989). In our study we observed a greater proportion of the long-haired animals HL, with 83% of HL^L. Only in ecotype of Dragobia and Has the allelic frequency of long hair is respectively 0.52 and 0.45. The similar results were reported by Lanari et al. (2003) with proportion 53% and 47% for long and short hairs, respectively, in Criollo goat population and Naft, M. et al (2009) 0.57 and 0.43 for HL^+ and HL^L in goats in the Tunisian oasis.

For Coat colour the locus Rn for pigment alterations with the ruane allele Rn^R and the recessive wi1d allele Rn^+ was verified. The B locus that induces eumelanine with two phenotypes, one black and one brown along with two alleles: the B^+, black and the B^b, brown was verified, also. The little frequency of Rn^+ was identified in ecotype Muzhake and non classifiable population, meanwhile in these ecotype the alellic frequency of B^+, has the high value.

Analyse of principal component

Analyse of principal component was performed on the quantitative variables: body length, wither height, heart girth, udder circumference and data of polymorphism of locus: ear length, horns, wattles, beard and hair length. The presentation of ten ecotypes in the plan of first two principal components that explains about 92% of the general variance is given in Figure 1.

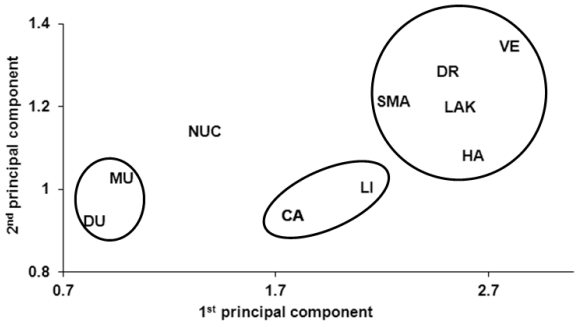

Figure 1. Scatter of ten Albanian goat populations in the plan of first two principal components

Local population: HA –Hasi, DR-Dragobia, SMA-Skuqe e Matit, VE-Velipoja, LAK-Lara e Kallmetit, CA-Capore e Mokrres, DU-Dukati, MU-Muzhake, LI- Liqenasi, NUC- Native breed not classifiable

Three groups can be distinguished in this figure: (1) Velipoja, Dragobia, Skuqe of Mati, Lara of Kallmet and Has; (2) Capore of Mokrra, Liqenasi; (3) Black of Dukatit, Muzhake. Goats

subpopulation considered as non classifiable that constitutes about 82% of the whole Albanian goat population cannot be included in none of above groups. In fact this population is constituted by herds that hardly could be identified as distinguished groups of animals. Referring to morphometric indicators and traits of phenotypic profile different animals could be noticed in the same herd. Comparing the above groups of ecotypes/subpopulations of Albanian local goats with their geographical region location certain hypothesis can rise up:

- the evolution process of Albanian local goat population is developed in accordance with the principle of isolation in distance
- the phenomena of local differentiation of Albanian local goat population is present which is characterised by distinct genetic niches. Based on them is carried out the classification of subpopulations as ecotypes.

Conclusions

Albania local goat population is characterised by high level of variability of morphometric and polymorphism of phenotypic profile traits. Evolution process of these populations and human being actions have created several distinguished subpopulations/ecotypes. The phenomena of local differentiation resulted by isolation in distance is evidenced as well as the creation of distinguished genetic niches. This work may constitute the basis for microsatellite studies to help implementing breeding strategies for the genetic improvement and conservation of Albanian goat populations.

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