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ANALYSIS OF ENVIRONMENTAL AND GENETIC FACTORS IN GROWTH CHARACTERISTICS OF BALKAN GOAT

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Abstract: Research was conducted on animals of Balkan goat breed. The impact of environmental factors on the weight of kids was analyzed, and also the value of genetic parameters of growth traits of kids to weaning had been examined. The body weight of kids varied depending on the year from 2.27±0.09 kg to 2.43±0.08 kg at birth and 10.81±0.58 kg to 11.13±0.51 kg at weaning. Variations depending on the season, ranged from 2.24±0.09 kg to 2.51±0.05 kg. Sex also had an impact because the male kids had higher weight of 0.12 kg at birth and 0.20 kg at weaning. All differences caused by environmental factors were statistically significant ($P<0.01$). Single born kids in comparison with twin born kids had higher birth weight by 0.22 kg at birth and 0.37 kg in weaning. The differences were statistically significant ($P<0.01$). It is a known fact that the increase in litter size influences decrease in body weight of kids. We also found that the weight at birth is associated with body weight at weaning. Heritability for growth traits observed moving in the range of low values from 0.102 ± 0.039 to 0.153 ± 0.041. Repeatability of the observed traits varied from low to medium values in the interval from 0.118 ± 0.030 to 0.528 ± 0025.

Key words: Balkan goat, growth characteristics, environment, genetic factors

Introduction

Goats are one of the most abundant species of domestic animals in the world and are grown in different geographical and climatic conditions. Due to different environmental factors, there are different breeds of goats with regard to milk yield, growth characteristics and prolificacy (*Safari et al., 2005, Bosso et al., 2007, Kumar et al., 2007, Žujović et al., 2006, 2007, Concepta et al, 2008*). In the Balkan Peninsula, goats are raised in various systems of production, ranging from the extensive to the intensive systems. In addition to known Saanen and Alpine

goats, farmers in Serbia are raising local goats such as the Balkan breed, which is the most frequent in the mountainous regions of the country.

Despite the tradition, goat breeding in Serbia after the Second World War was completely ignored and the production of meat and milk was reduced to a minimum. In recent years, the government and science are increasingly devoting their attention ~~to~~ improving the goat production because they found out that the farmers through meat and milk production can use natural resources and generate high profits. Population of Balkan goats has good genetic potential, but to make it realized it is necessary the systematic and programmed breeding. In this regard selection as a continuous process is the most reliable way to achieve genetic progress of the population. Breeding programs of goats are based on a number of genetic and environmental factors (*Manfredi, et al., 2001, Rupp et al., 2004, Petrović et al, 2005, Bharathidhasan et al., 2009*). Namely, it is known that the efficient work on the genetic improvement in goat breeding depends on the hereditary factors and environment, but also from optimal models for assessing the quality of animal (*Lanari et al., 2003, Barillet et al, 2004*). Any effective selection is largely dependent on heritability of the trait and its genetic relationship with other traits of economic importance (*Portolana et al, 2002, Al-Shorepy et al., 2002, Kosum et al., 2004, Alade et al., 2010*). Objective of this study is to examine the influence of some phenotypic and genetic parameters of growth traits in the Balkan goat.

Material and methods

The research was performed in the region of Stara Planina Mountain on the population of the Balkan goat. All tested animals had the same conditions of housing care and nutrition. Goats during the summer were on pasture and during the winter months in the building of a farm where they were fed hay and concentrate. Statistical analysis was performed by GLM procedure of SAS statistical package program (SAS, 2005) using the next model:

$$Yijklmn = \mu + Ji + Sj + Ak + Tl + Dm + \varepsilon ijklmn,$$

where:

Yijklmn = body weight of nth kid of *m* age of dam, *l* birth type, *k* sex and born during *j* season in *i* year
μ = overall population mean
Ji = effect of *i* year
Sj = effect of *j* season
Ak = effect of *k* sex of kid
Tl = effect of *l* type of birth

Dm= effect of age of doe
εijklmn = residual error

The fixed effects included in the model were year and season of birth, sex of kid, type of birth and age of dam. Heritability and repeatability estimates were computed by the method of paternal half-sib analysis using VARCOMP procedures of SAS (2005).

Results and Discussion

Estimates of Least squares means of birth and weaning weight of kids are shown in table 1.In Table 1 we can see that phenotypic parameters expressed through the body weight of kids varied depending on the year from 2.27±0.09 kg to 2.43±0.08 kg at birth and 10.81±0.58 kg to 11.13±0.51 kg at weaning. The variation in birth weight of kids born in different years reflected variation in level of management. Our findings indicate that variations depending on the season, ranged from 2.24±0.09 kg to 2.51±0.05 kg. Sex also had an impact because the male kids had a higher weight of 0.12 kg at birth and 0.20 kg at weaning. Any differences caused by environmental factors were statistically significant (P<0.01).

Effect of type of birth and age of dam on birth and weaning weight of kids is shown in Table 2. Single kids are heavier by 0.22 kg than twins at birth and 0.37 kg in weaning. The differences were statistically significant (P<0.01). We also found that the weight at birth is associated with body weight at weaning. Age of doe significantly affected birth weight. Difference between ages 2 and 3 was significant (P<0.05) but between ages 2 and other ages (4, 5, 6) it was very significant (P<0.01). Results of the heritability and repeatability are shown in Table 3.

Table 1. Effect of year, season and sex on birth and weaning weight of kids

Year of birth	Birth weight (kg)			Weaning weight (kg)		
	N	Mean	S.E.	N	Mean	S.E.
Year						
1	125	2.27	±0.09	119	10.81	±0.58
2	120	2.38	±0.06	116	10.85	±0.39
3	118	2.43	±0.08	112	11.13	±0.51
Season						
Summer	128	2.51	±0.05	123	11.18	±0.50
Autumn	125	2.33	±0.08	119	10.90	±0.39
Winter	123	2.24	±0.09	117	10.71	±0.32
Sex						
Male	124	2.42	±0.05	117	11.03	±0.31
Female	121	2.30	±0.07	116	10.83	±0.41

Heritability for growth traits observed moving in the range of low values from 0.102 ± 0.039 to 0.153 ± 0.041. Repeatability of the observed traits varied from low to medium values in the interval from 0.118 ± 0.030 to 0.528 ± 0025.

Table 2. Effect of type of birth and age of doe on birth and weaning weight of kids

Effect	Birth weight (kg)			Weaning weight (kg)		
	N	Mean	S.E.	N	Mean	S.E.
Type of birth						
Single	125	2.47	±0.05	119	11.12	±0.57
Twins	120	2.25	±0.08	116	10.75	±0.36
Age of doe						
2	128	2.20	±0.06	123	10.70	±0.48
3	125	2.29	±0.09	119	10.87	±0.38
4	123	2.36	±0.08	117	10.93	±0.34
5	124	2.58	±0.04	117	11.06	±0.30
6	121	2.37	±0.06	116	11.09	±0.43

Variations in phenotypic parameters similar to our results are stated by other authors *(Bagnicka and Lukasyewicz, 1999, Žujović et al., 2007, Memiši et al., 2009*). Some authors, such as *Horst et al.* (1993), *Das et al. (*1996) and *Hermiz* (2001) informed that the season has a significant effect on body weight of kids, which is consistent with our research. Influence of season in our study can be interpreted as a factor in nutrition. Specifically, during the summer the food more accessible, so kids have a higher body weight. During autumn and winter, the level of nutrition decreased as well as kids' body weight. *Said et al.* (1990) and *Das et al.* (1996) stated that some environmental effects and availability of feed quantity may affect the weight of kids.

The influence of sex of kids can be attributed to different hormonal status between male and female kids. According to *Hossein et al. (*2011) single born kids in comparison with twin born kids had higher birth weight and weaning weight. It is a known fact that the increase in litter size, reduced body weight of kids. In our research, birth is associated with body weight at weaning. With this statement agreed many other authors, including *Horst et al. (*1993), *Gebrelul et al. (*1994) and *Das et al.* (1996). Age of doe significantly affect birth weight and our results is partially agrees with other results that were reported earlier (*Das et al., 1996 and Hermiz, 2001 and 2005*). *Van der Westhuizen et al*. (2004) stated that kids born to young does (2-year-old does) had lower body weights up to 16 months of age than kids born to 4- to 8-year-old does. Birth, weaning and 8-month body weights of kids born to older does were also lower. Authors concluded that age of dam is one of the internal factors that have a marked influence on overall efficiency of the flock.

Table 3. Heritability and repeatability estimates of live weight and growth traits of kids

Trait	Heritability	Repeatability
Body weight at birth	0.153±0.041	0.196±0.022
Body weight at 3 month	0.110±0.044	0.211±0.041
Weight at 6 month	0.121±0.057	0.528±0.025
Weight at 12 month	0.138±0.045	0.118±0.030
Weight at 18 month	0.121±0.037	0. 171±0.052
DG[1] up to 3 month	0.102±0.039	0.188±0.011
DG up to 6 month	0.123±0.050	0.231±0.039
DG up to 12 month	0.118±0.047	0.123±0.041
DG up to 18 month	0.121±0.051	0. 163±0.055

[1] DG = average daily gain.

Heritability for body weight at birth in our research (0.153) is lower than what we found in the literature (*Al-Shorepy, et al., 2002; Portolana et al., 2002 and Kosum,et al., 2004*). Higher values of heritability were found *Boso et al.* (2007) who reported that heritability for BW, W120, W360, GR0–4 and GR4–12 were 0.5, 0.43, 0.30, 0.32 and 0.11 for goats and 0.39, 0.54, 0.21, 0.54 and 0.23 for sheep, respectively. *Hermiz et al.* (2008) report that heritabilities for BWT, WWT, WT6M, WT9M and WT12M were 0.30, 0.38, 0.17, 0.19 and 0.28, respectively. Repeatabilities of growth traits are in agreement with *Alade et al*. (2010), but most of the estimates are higher than values in the literature (*Odubote and Akinokun, 1992 and Das et al., 1996*).

Conclusion

These results showed that there is a strong influence of environmental factors on the body weight of kids at birth and weaning. Also can be noted that heritability for body weight and average daily gain of kids is low and variable. Repeatability of the observed traits varied from low to medium values. We can say that despite the Balkan goat adapted to the conditions in region of Stara Planina Mountain there is a high variability of the observed parameters. This means that in the previous period, adequate selection is not carried out. For the consolidation of production traits is necessary to develop a serious breeding program in the future, especially since the Balkan goat is an important genetic resource.

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Analiza spoljnih i genetskih faktora u osobinama porasta balkanske koze

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Rezime

Istraživanje je sprovedeno kod balkanske rase koza. Izvršena je analiza uticaja spoljnih faktora na težinu jaradi , a takođe je ispitivana vrednost genetskih parametara osobina porasta do odbijanja.Telesna masa jaradi u zavisnosti od zavisi od godine varira od 2,27 ± 0,09 kg do 2.43 ± 0.08 kg na rođenju i 10.81 ± 0.58 kg do 11.13 ± 0.51 kg pri odlucivanju. Varijacije u zavisnosti od sezone, kreću se u rasponu od 2.24 ± 0.09 kg do 2,51 ± 0.05 kg. Pol je takođe imao uticaj, jer su muška jarad imala veću težinu za 0,12 kg na rođenju i 0.20 kg pri odlucivanju. Sve razlike izazvane faktorima okoline bile su statistički značajne (P <0,01). Jarad rođena kao jedinci u poređenju sa blizancima imaju više porođajne težine za 0,22 kg na rođenju. Takođe su u prednosti i za 0.37 kg pri odbijanju. Razlike je statistički značajna (P <0,01). To je poznata činjenica da povećanje veličine legla, smanjuje telesnu masu jaradi. Takođe smo ustanovili da masa na rođenju je povezana sa telesnom masom pri odlučivanju. Heritabilnost za osobine porasta se kreće u rasponu od 0,102 ± 0,039 do 0,153 ± 0,041. Ponovljivost posmatranih osobina varira od niskih do srednjih vrednosti u intervalu od 0.118 do 0.528 ± 0.030 0025 ±.

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