

Biotechnology in Animal Husbandry 31 (2), p 245-253 , 2015  
Publisher: Institute for Animal Husbandry, Belgrade-Zemun

ISSN 1450-9156  
UDC 636.082'636.32  
DOI: 10.2298/BAH1502245M

## PRODUCTIVE CHARACTERISTICS AND BODY MEASUREMENTS OF ALPINE GOATS RAISED UNDER SMALLHOLDER PRODUCTION SYSTEMS IN CENTRAL SERBIA

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Original scientific paper

**Abstract:** The purpose of this study was to evaluate present level of productivity and determine linear body traits of Alpine goats raised in Serbia on smallholder farms. Data were collected from 22 smallholder farms located in Belgrade district, with total of 330 purebred Alpine does 2-9 years of age, 145 yearling does and 476 kids. Traits measured were: body weight of does, body weight of kids at birth, 30 days of age and at weaning (90-120 days), prolificacy of mature and yearling (primiparous) does, six linear body traits of does (withers height, body length, hearth girth, chest depth, chest width, pelvic width) and milk production (milk yield, milk fat and milk protein content). The analysis showed the average body weight of does to be 54.96 kg, while the average body weight of kids at birth, 30 days of age and weaning was 2.73 kg, 8.7 kg and 18.3 kg., respectively. Prolificacy was 144% in mature and 125% in yearling does. Measurements of linear body traits were: withers height 67.87 cm, body length 71.92 cm, hearth girth 81.79 cm, chest depth 32.93, chest width 21.49 cm and pelvic width 17.63 cm. Among dairy production traits, following results were obtained: lactation length 220.73 days, total milk yield 531.66 kg, milk fat content 3.33% and milk protein content 3.16%. It was concluded that the overall productivity of Alpine goats raised under smallholder production systems in Serbia is satisfying. Giving the fact that these animals are usually kept under poor conditions, many of these productive traits are very good.

**Key words:** goats, body weight, body traits, prolificacy, milk

## Introduction

Within the sector of farm animals in Serbia, the goat industry is the least developed. Despite the fact that Serbia has very favourable natural conditions for goat breeding, this production is not attractive to farmers, primarily due to the bad economy situation in the country. The main reason for this negative situation, in which the goat breeding has been for a long period, is the lack of organized and guaranteed purchase of goat milk, which would provide some security for farmers. Production of our goats is directed towards milk-meat, but priority is milk. This relates especially on households where the production of goat milk is more acceptable than rearing of cows (Žujović *et al.*, 2011). Dairy goat is considered the cow of the poor. The goat eats little, occupies a small area and produces enough milk for the average unitary family, whereas maintaining a cow at home cannot be afforded by the homeowner, hence the growing popularity of goat as the poor person's cow (Aziz, 2010).

In Central Serbia goats are mainly raised extensively in very small herds on individual family farms. Produced milk is mainly used for making of cheese, which is sold at local green markets.

A very small number of goats are under the control of productive and reproductive traits, approximately 1800 of them, which is about 1% of the total number of goats that are bred on this territory. From total number of goats registered in central heard book, Alpine breed is the most dominant with 87%, followed by local breeds, Balkan goat and Serbian white goat. Alpine goats can be found all over Central Serbia, in different regions, from lowlands to hilly-mountainous areas.

The Alpine is the most common breed of goats in France with 60% of the females being registered at the Official Milk Control organization. It is an animal of average size and the females are the good milk yielders. It is a goat with close-cropped hair, often towed colour. Rustic, the Alpine breed is well adapted to both off-grazing production system and pasture.

In developing countries, the performance of high-yielding breeds imported from countries with highly advanced production systems is often negatively affected due to genotype-environment interactions (Smith *et al.*, 1988; Bondoc *et al.*, 1989).

In goat breeding the easiest and fastest way to describe the breed is the description of external markings, measurement of body characteristics and production traits (Nemeth, 2010). Thanks to the good adapting abilities Alpine goat breed is quite spread around the world, and in Serbia it is raised very successfully in various regions of the country. However, there is little information available regarding body measurements and productivity of Alpine goats raised in Serbia.

Accurate data are required to determine the future outlook of the goat populations and their productivity. Therefore, the purpose of this study was to

determine present level of productivity of Alpine goats raised in Serbia on smallholder farms.

## Materials and methods

Data were collected from 22 smallholder farms located in Belgrade district, with total of 330 purebred Alpine does 2-9 years of age, 145 yearling does and 476 kids. The average flock size was 15 goats, with a range of 2 to 76. Animals were kept extensively, mostly at pasture, except for the winter, when they were kept indoors. Nutrition was based primarily on pasture (during warm part of the year) and quality alfalfa hay (during cold part of the year). Supplementary diet was consisted of grain and mineral-vitamin mix. Goats were bred through natural service.

Body weight at mating and prolificacy was measured in 330 mature does. Prolificacy was also measured in 145 yearling does. Body weight of kids was measured at birth, at the age of 30 days and at weaning (the age of 90 – 120 days). Prolificacy was calculated as the percentage of number of kids born on total number of does delivered according to the following equation.

$$\text{Prolificacy (\%)} = (\text{No. of kids born} / \text{No. of does kidding}) \times 100$$

Six linear body traits were measured in 330 mature does as follows: body weight (BW), wither height (WH), body length (BL), hearth girth (HG), chest depth (CD), chest width (CW) and pelvic width (PW). The length, width and depth data were measured by stick and hearth girth was measured by tape. Body length was measured as the distance between the shoulder and pin bone (tuber ischii). Wither height was measured as the distance from the surface of a platform to the withers. Heart girth represented the circumference of the chest. Chest depth was measured as vertical distance from sternum to withers. Chest width was measured as width of the rib cage between the fore legs. Pelvic width was taken as the distance between the two pelvic bones (Tubercxae), across the dorsum.

Among dairy production traits, following traits have been analyzed: the milk yield in full lactation, milk fat content, milk protein content and lactation duration (in days).

The milk recording was conducted by AT method, which was done in the time interval of 28-34 days, once in the morning and next time at evening, by official recorder (International agreement, 2009). First recording was done 40 days after kidding. Milk components (fat and protein) were analyzed using the ultrasonic milk analyzer Ekomilk.

The collected data were analyzed by the statistical package Statistica for Windows 7 (stat. Soft. Inc.). Obtained results were presented using descriptive statistics.

## Results and Discussion

Descriptive statistics for live weight of does, birth weight of kids, body weight of kids at the age of 30 days, body weight of kids at weaning and prolificacy of mature and yearling does are set out in Table 1.

**Table 1. Descriptive statistics for productive and fecundity traits in does and kids**

Traits	N	Mean	SD	CV%
BW of does (kg)	330	54.96	2.11	3.84
BW of kids at birth (kg)	476	2.73	0.46	16.85
BW of kids at 30 days of age (kg)	476	8.7	1.05	12.07
BW of kids at weaning (kg)	476	18.3	1.13	6.17
Prolificacy (mature does), %	330	144		
Prolificacy (yearling does), %	145	125		

BW – body weight

Body weight is an important economic trait in the selection of animals and the main purpose of animal breeding practices is to improve traits of economic value.

Live weight of adult goats, as presented in Table 1, was 54.96 kg and prolificacy rate was 144%. *Nemeth et al. (2005)* reported average live weight of 54.08 in Alpine does raised in Hungary, which is in accordance with present study. In the study of *Memiši and Stanišić (2014)* it was reported that Alpine does raised in Serbia had live weights of 46.47 to 52.77 kg, which was lower than in present study. According to *Kume et al. (2012)* Alpine does in the country of origin have live weight of 80 kg, which is far more than observed in the present study.

Average body weights of kids were 2.73 kg at birth, 8.7 kg at the age of 30 days and 18.3 kg at weaning (90 -120 days of age). *De Menezes et al. (2007)* found body weights of Alpine kids to be: 3.61 kg at birth, 7.35 kg at 30 days of age and 19.11 kg at 90 days of age. *Kume and Hajno (2010)* also reported higher birth weights (3.11-3.15 kg), but lower weights at 30 days of age (6.71 kg), compared to the present study.

The prolificacy obtained in the present study (144%) is somewhat lower than in research of *Drobnic et al. (1998)* who determined litter size of 1.64 in controlled Slovenian herds of Alpine goats. *Crepaldy et al. (1999)* also reported bigger litter size of 1.6 kids/doe of Alpine breed raised in Italy. However, *Kasap et al. (2012)* obtained almost exact value for litter size of 1.46 kids/doe when investigating reproductive parameters of Alpine goats in Croatia. In primiparous does, prolificacy of 125% was lower than in mature does which is consistent with numerous statements that litter size is influenced by parity (*Amoah and Gelaye, 1990; Awemu et al., 1999; Kasap et al., 2012*).

The prolificacy has influence on the economy and milk production. It is expected for twin kidding mothers to have more of the milk yield compared to

those having one kid. More kids also mean more meat and more incomes from selling them as quality breeding animals.

The mean values along with standard deviation and coefficient of variation for wither height, body length, chest width, chest depth, heart girth and pelvic width in Alpine goats are presented in Table 2.

**Table 2. Descriptive statistics of analyzed body measurements in Alpine does**

Traits	N	Mean	SD	CV%
WH (cm)	330	67.87	1.72	2.53
BL (cm)	330	71.92	1.97	2.73
HG (cm)	330	81.79	8.55	10.45
CD (cm)	330	32.93	3.77	11.45
CW (cm)	330	21.49	1.57	7.30
PW (cm)	330	17.63	3.38	19.17

WH – wither height, BL – body length, HG – heart girth, CD – chest depth, CW – chest width, PW – pelvic width

Morphological measurements have been traditionally used for characterisation of different breeds of animals by many researchers. Furthermore, external body measurements have been studied to predict body weight, as well as to predict carcass characteristics (*Khan et al., 2006; Pesmen and Yardimci, 2008; Abd-Alla 2014*). Body size and shape measured objectively could improve selection for growth by enabling the breeder to recognize early maturing and late maturing animals of different sizes (*Akpa et al., 2013*). Where genetic evaluation has still limited use, identification of some descriptive linear traits may be useful and farmers' friendly tools for selecting goats with desirable characters (*Haldar et al., 2014*).

The body measurements obtained in this study were as follows: wither height 67.87 cm, body length 71.92 cm, hearth girth 81.79 cm, chest depth 32.93, chest width 21.49 cm and pelvic width 17.63. *Nemeth et al. (2005)* reported very similar values for almost all studied body traits of Alpine goats raised in Hungary: 67.9 cm for wither height, 74.3 cm for body length, 32.5 cm for chest depth an 17.2 cm for pelvic width, except for chest width which was somewhat lower (19.8 cm) than in the present study. There is a lack of information on body traits of Alpine goats in the literature and therefore these results are hard to compare.

**Table 3. Mean  $\pm$  se milk traits depending on the order of lactation**

Order of lactation	N	Lactation length, days	Total milk yield, kg	Milk fat, %	Milk protein, %
I	136	219.75 $\pm$ 13.48	486.63 $\pm$ 6.11	3.4 $\pm$ 0.00	3.16 $\pm$ 0.00
II	36	222 $\pm$ 3.59	595.16 $\pm$ 12.69	3.3 $\pm$ 0.01	3.15 $\pm$ 0.01
III	39	208.08 $\pm$ 3.31	537.28 $\pm$ 10.52	3.31 $\pm$ 0.01	3.19 $\pm$ 0.01
IV	34	215.29 $\pm$ 3.73	568.44 $\pm$ 12.09	3.32 $\pm$ 0.02	3.16 $\pm$ 0.02
V	22	205.95 $\pm$ 4.17	556.05 $\pm$ 18.11	3.31 $\pm$ 0.02	3.15 $\pm$ 0.01
VI+	57	240.47 $\pm$ 31.79	564.68 $\pm$ 11.03	3.32 $\pm$ 0.01	3.14 $\pm$ 0.01
Overall	325	220.73 $\pm$ 7.95	531.66 $\pm$ 4.67	3.33 $\pm$ 0.00	3.16 $\pm$ 0.00

Milk traits of Alpine goats, such as milk yield, lactation length, milk fat and milk protein content are set out in Table 3.

Overall milk production in studied population was 531.66 kg for the lactation of 221 days, with 3.33% of milk fat and 3.16% of milk protein content, on average. These results are in accordance with findings of *Crepaldy et al. (1999)* who found milk yield in Alpine goats to be 567 kg in the lactation of 231 days. *Mioč et al. (2008)* also obtained similar results for milk yield (557 kg) and somewhat higher milk fat content (3.47%) in Alpine goats in Croatia. However, values from the present study are higher than those of *Memiši et al. (2011)* who found that the milk yield of Alpine does in Serbia was 362.83 kg for the lactation of 252 days. These authors also determined somewhat lower content of milk protein (2.93%), but milk fat content was at the same level as in present study (3.32%). *Pavliček et al. (2006)* also established lower milk yield of Alpine goats in Croatia, being from 288.26 kg at first lactation to 382.96 kg at third lactation, with lactation lasting for 201-203 days. According to *Kume et al. (2012)* milk yield of Alpine goat breed in the country of origin is 950 kg for the lactation of 256 days.

When observed by order of lactation, milk yield was lowest in first lactation (486.63 kg) which is in agreement with findings of other authors (*Mourad et al., 2001; Pavliček et al., 2006; Memiši et al., 2011*) who also reported lower milk yield in primiparous does. Highest milk yield was observed in second lactation (595.16 kg) and then varied in subsequent lactations. It is expected to have linear increase in milk yield from first to third lactation (*Bogdanović et al., 2010*), however, milk production is highly sensitive production, affected by many different factors and therefore some deviations can be expected. Milk performance is polygenic property caused by numerous genes which directly or indirectly have impact on its expression. Production of milk is closely associated with environment factors, such as: nutrition of mothers/dams before and after partus, number of kids, climatic and soil conditions, housing and care, and many other factors (*Memiši et al., 2011*).

Lactation length also differed, being shortest in V lactation (206 days) and longest in VI+ lactation (240 days), which also influenced variations in milk yield. Milk fat content was highest in first lactation, while proteins remained almost constant.

## Conclusion

Based on the results obtained in the present study and compared to results of other authors it can be concluded that the overall productivity of Alpine goats raised under smallholder production systems in Serbia is satisfying. Giving the fact that these animals are usually kept under poor conditions, many of these productive traits are very good.

There is always room for improvement, but it must be kept in mind that high outputs need high inputs. Better housing, better diet, better health care and stricter selection could lead to productivity improvement, but with higher production cost. With the current trend in goat production in Serbia, with a lack of organized purchase of goat milk and unstable market for goat products, all major investments in the production would not be justified.

## Acknowledgment

Research was financed by the Ministry of Education and Science of Republic of Serbia, project TR 3105.

## Proizvodne karakteristike i telesne mere koza alpske rase gajenih na malim porodičnim gazdinstvima u Centalnoj Sbjiji

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## Summary

Cilj ovog istraživanja bio je da se proceni postojeći nivo produktivnosti i da se utvrde vrednosti linearnih telesnih mera koza alpske rase koje se gaje u Srbiji kod individualnih poljoprivrednih proizvođača. U ispitivanje su uključena 22 poljoprivredna gazdinstva locirana u beogradskom okrugu, sa ukupno 330 koza alpske rase uzrasta 2-9 godina, 145 prvojenica i 476 jaradi. Analizirane su sledeće osobine: telesna masa koza, telesna masa jaradi na rođenju, sa 30 dana uzrasta i pri odlučanju (90-120 dana), plodnost odraslih koza i prvojenica, linearne telesne mere (visina grebena, dužina trupa, obim grudi, dubina grudi, širina grudi, širina karlice) i osobine mlečnosti (dužina laktacije, količina mleka za laktaciju, sadržaj mlečne masti i proteina). Prosečne vrednosti telesne mase i plodnosti ispitivanih kategorija bile su: telesna masa koza 54,96 kg, telesna masa jaradi na rođenju 2,73 kg, telena masa jaradi sa 30 dana 8,7 kg i telesna masa jaradi pri odlučanju 18,3 kg, plodnost odraslih koza 144%, plodnost prvojenica 125%. Utvrđene su sledeće vrednosti telesnih mera: visina grebena 67,87 cm, dužina trupa 71,92 cm, obim grudi 81,79, dubina grudi 32,93 cm, širina grudi 21,49 cm i širina karlice 17,63 cm. Prosečna laktacijska mlečnost je iznosila 531,66 kg mleka u laktaciji od 221 dan, sa 3,33% mlečne masti i 3,16% proteina. Na osnovu utvrđenih rezultata i poređenjem sa rezultatima drugih autora zaključeno je da je produktivnost koza alpske rase gajenih na malim poljoprivrednim gazdinstvima zadovoljavajući. Plodnost koza je na nešto nižem nivou, kao i porođajne mase jaradi. Međutim, ako se ima u vidu da su uslovi gajenja ovih životinja često veoma

skromni, mnoge od ovih proizvodnih osobina su veoma dobre. Prostora za poboljšanje ima, ali uz veća ulaganja koja uslovljavaju i veću cenu proizvodnje. Ipak, uz nepostojanje organizovanog i zagarantovanog otkupa mleka koza, kao ni zaštitnih cena mleka, što bi proizvođačima pružilo neku sigurnost u proizvodnji, sva veća ulaganja u ovom trenutku ne bi bila isplativa.

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