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DYNAMICS OF GROWTH AND DEVELOPMENT OF ANGLO-NUBIAN GOAT KIDS UNTIL THE WEANING PERIOD

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Abstract

The present work focuses on investigating the growth of Anglo-Nubian goat kids from birth to weaning at 90 days of age. The study includes a total of 40 goats kids of the Anglo-Nubian breed and was carried out in the farm of the RIMSA - Troyan, Bulgaria. Key performance indicators such as birth weight, weaning weight and average daily gain were determined and exterior measurements were taken. The average daily growth for the first, second and third months for males is (0.129; 0.192; 0.155 kg) and for females (0.112; 0.184; 0.176 kg) respectively. At the age of 3 months, singles are reliably superior in both weight and size to twins and triplets, and their average daily growth for the period is 0.160 kg. In terms of weight and exterior data, males outperform females in all measurements. For the needs of the selection, it is important to follow the key factors that influence the productivity. Growth rates, body mass and weight dynamics are very good indicators that reflect the genetic potential of animals and directly affect the quality of the obtained produce.

Key words*: body measurement, goat kids, meat, productivity, weight.*

INTRODUCTION

Goat farming is an important sector of livestock production that is gaining social and economic importance both in Bulgaria and worldwide (Yordanov, 2023).

In Bulgaria, in addition to the traditionally bred indigenous breeds and the Bulgarian white dairy goat, the Anglo-Nubian breed is attracting increasing interest.

This interest dates back to 1985, when a number of Anglo-Nubian goats and rams were imported for scientific purposes from the German Democratic Republic to the Research Institute of Mountain Stockbreeding and Agriculture - Troyan (Zunev, 1991).

These animals were then subjected to pure breeding and controlled crossbreeding with local breeds to improve production traits.

The results showed that the resulting crosses had good productive traits, which increased farmers' interest in the breed (Todorova et al., 2021). According to data, in 2023, 17 herds with a total of 984 goat dams were under breeding control in the country (Yordanov, 2023).

Systematic monitoring of the performance of the breed is essential to improve its genetic resources and economic efficiency. In this sense, tracking the growth and dynamics of external measurements in juveniles plays a major role (Morris et al., 2011; Kari et al., 2019; Georgieva et al., 2023).

The Anglo-Nubian breed is characterised by a dual production orientation for milk and meat, which requires a balanced approach to selection (Skapetas & Bampidis, 2016; Mazhangara et al., 2019).

While milk performance remains a top priority, the increasing demand for high quality goat meat requires a deeper investigation of factors affecting meat production (Mazhangara et al., 2019). According to Vuchkov (2020), the dynamics of body mass during the period from birth to weaning is a key indicator of an animal's "meatiness" potential.

The aim of the present study was to analyze the growth and weight dynamics of Anglo-Nubian breed goat kids from birth to weaning at 90 days of age.

The results obtained will be used to assess the productive potential of the breed under Bulgarian conditions, which will support future selection strategies.

MATERIALS AND METHODS

The study was carried out at the farm of the Experimental Base of the Research Institute of Mountain Stockbreeding and Agriculture in Troyan, Bulgaria. The location is situated at an altitude of 380 meters above sea level (42° 53' 39" N / 24° 42' 57" E). The region has a temperate-continental climate with a distinct mountain influence, characterized by four seasons, and the absence of fog and strong winds. Over the past ten years, the average temperature in February and March has ranged from 3.5 to 6.01°C, while the average precipitation has been between 49.7 and 59.5 mm.

A total of 40 Anglo-Nubian goat kids, 20 males and 20 females, were included in the study. Of these, 15 were singletons, 16 were twins and 9 were triplets.

The animals were born between February and March 2021 in a herd under the control of the Association for Breeding of Dairy Goat Breeds in Bulgaria. Immediately after birth, each goat kid is routinely examined and given an individual identification tag. For the first three days after birth, the goat kids stay with their mothers in individual crates, after which they are moved to group pens where they are kept until weaning.

Until 45 days of age, feeding is done in a controlled manner with milk (Table 1) using a teat bucket. After this period, alfalfa hay and concentrate forage containing corn, wheat, barley, oats, sunflower meal, soybean meal, and other ingredients are gradually added to their diets.

The live weight of the goat kids was measured with an electronic scale to the nearest 0.001 kg one hour after birth, and at 30, 60 and 90 days of age (the time of weaning). On this basis, the average daily gain was calculated for the following periods: from birth to 30 days of age, from 30 to 60 days and from 60 to 90 days.

The exterior parameters were evaluated using a Lidtin stalk (designed for small ruminants), a Wilkens peregrine and a measuring tape. Measurements were performed on fixed animals placed on a flat surface.

Table 1. Physicochemical composition of goat milk from 10th to 90th day after birth

Indicators	Days								
	10	20	30	40	50	60	70	80	90
Fat content (%)	4.68	4.02	3.51	4.01	3.5	3.27	3.71	3.12	3.01
Protein	3.31	3.05	3.01	3.2	3.11	3.1	3.21	3.09	3.07
Lactose	4.99	4.6	4.53	4.81	4.68	4.66	4.83	4.65	4.32
DFR	9.07	8.35	8.22	8.75	8.5	8.47	8.77	8.45	8.21
Dry matter (%)	13.75	12.37	11.73	12.76	12	11.74	12.48	11.57	11.26
Salts	0.74	0.68	0.67	0.71	0.69	0.69	0.71	0.69	0.52
Acidity (T°)	15	14	10	13	12	13	13	13	13
Density (g/cm^3)	1.0300	1.0281	1.0280	1.0300	1.0290	1.0290	1.0210	1.0290	1.0290
Ca (mg/%)	0.170	0.170	0.151	0.17	0.146	0.156	0.162	0.165	0.165

Statistical analysis

Data were statistically evaluated by one-way ANOVA. The Fit model procedure of JMP v.7 software package was used to perform the statistical analysis (JMP Version 7, SAS Institute Inc. Cary, NC). The effects were considered to be significant at $P<0.05$; $P<0.01$ and $P<0.001$. Significant differences among the means were determined using Tukey test ($P<0.05$). All data were expressed as mean values with pooled standard errors.

RESULTS AND DISCUSSIONS

In Table 2, we look at the changes in weight over the study period according to the sex of the goat kids. At birth, male goat kids outweighed females by about 0.370 kg ($P>0.05$), which is consistent with observations in most goat breeds where males are born with higher weights (Hristova et al., 2013; Kari et al., 2019; Sahal et al., 2022). Hormonal differences between the sexes (the anabolic

effect of male sex hormones) partly explain this superiority (summarised by Sahal et al., 2022). At 30 days of age, there was a significant difference in growth rate of 0.875 kg in males (P<0.001). The mean daily growth rate at this time was also significantly higher in males than in females (P<0.001). This is an expected result as it is well known that males tend to grow faster at a younger age.

Table 2. Weight development of goat kids according to sex

Indicators	♂+♀		♂		♀		Sig. ♂×♀
	Mean	SD	Mean	SD	Mean	SD	
kg. Birth	3.335	0.57	3.520	0.49	3.150	0.59	NS
kg. 30d	6.957$^{a.b}$	0.81	7.395^{a}	0.88	6.520^{b}	0.41	***
Growth rate	0.121$^{a.b}$	0.02	0.129^{a}	0.01	0.112^{b}	0.01	***
kg. 60d	12.597$^{a.b}$	0.95	13.160^{a}	0.85	12.040^{b}	0.68	***
Growth rate	0.188	0.01	0.192	0.01	0.184	0.00	NS
kg. 90d	17.563	1.80	17.815	2.46	17.310	0.68	NS
Growth rate	0.166	0.02	0.155	0.06	0.176	0.00	NS
Growth for the whole period	0.158	0.02	0.159	0.03	0.157	0.01	NS

Note: *- P < 0.05; **- P < 0.01; ***- P < 0.001
^{a,b}- different letters on one line indicate values with significant reliability

Weight at 60 days again showed a statistically significant difference of 1.120 kg (P < 0.001) in favour of male over female goat kids. Interestingly, the mean daily growth rate for the 30-60 days period showed no significant difference between the sexes, suggesting that the growth rate of females had accelerated compared to the first month.

At 90 days of age, the weights of fawns of both sexes were similar, with a negligible difference between them.

Mean daily growth rates from 60 to 90 days varied within a narrow range, indicating a relatively uniform growth rate in the animals studied.

Mean daily gain over the entire 90-day period showed no significant differences between males and females, indicating that weaning weights were similar despite differences at different stages of development.

Table 3. Weight development of goat kids according to type of birth

Indicators	Singletones		Twins		Triplets		Sig.
	n=15		n=16		n=9		
	Mean	SD	Mean	SD	Mean	SD	
kg. Birth	3.873	0.36	3.240	0.17	2.610	0.36	NS
kg. 30d	7.433^{a}	0.95	6.920$^{a.b}$	0.52	6.230^{b}	0.31	***
Growth rate	0.119	0.36	0.122	0.01	0.121	0.36	NS
kg. 60d	13.200^{a}	0.89	12.550^{a}	0.73	11.680^{b}	0.61	***
Growth rate	0.192	0.01	0.188	0.01	0.182	0.01	NS
kg. 90d	18.260^{a}	0.43	17.625$^{a.b}$	1.65	16.288^{b}	0.56	*
Growth rate	0.169	0.01	0.169	0.01	0.154	0.01	NS
Growth for the whole period	0.160	0.24	0.160	0.15	0.152	0.580	NS

Note: *- P < 0.05; **- P < 0.01; ***- P < 0.001.
^{a,b}- different letters on one line indicate values with significant reliability.

With regard to the type of birth (Table 3), singletons had the highest birth weight, followed by twins and triplets. Despite the apparent trend of decreasing birth weight with increasing number of births, the difference was not statistically significant. From a physiological point of view, in addition to the lack of competition (Mellado et al., 2011), the presence of more space in the maternal womb (Zhang et al., 2006) facilitates the growth of

singletons and ensures their superiority during the postnatal period, both in terms of weight and body size. At 30 days of age, singletons in our study were significantly heavier than triplets, while twins were intermediate ($P<0.001$).

The average daily growth rate for the period 0-30 days did not show a statistically significant difference, suggesting that all infants grew at approximately the same rate despite their different birth weights. The difference between groups persisted at 60 days of age ($P<0.001$). Although the daily growth rate between 30 and 60 days was not statistically significantly different between the groups, there was a trend towards lower growth in the triplets. At 90 days of age, significant differences were observed ($P<0.05$). The identical twins still have an advantage over the triplets, while the fraternal twins are in an intermediate position.

Although the monozygotic twins maintained a higher body weight throughout the period, the difference in total daily weight gain between the groups was not statistically significant. Regardless of the type of birth, the children gained in a similar way, but the lower birth weight of the triplets could not be compensated until weaning (90 days) and the difference persisted.

The rate at which individual body part sizes change over the period from birth to weaning of the goat kids varies (Tables 4 and 5). From birth, male kids (Table 4) were superior to females in all external characteristics. They were significantly taller and more erect ($P < 0.05$). This superiority persisted throughout the study period at 30, 60 and 90 days of age (at weaning).

Birth type had a pronounced effect on the values of the external measurements, with goat kids born as singletons (Table 5) significantly outperforming twins and triplets in all parameters: this is an expected result, as singletons receive more nutrients in utero during pregnancy, leading to better intrauterine development (Mellado et al., 2011).

The type of birth has the greatest effect on height and length, as well as chest development, and these differences are still significant at three months.

The statistical differences between the groups are most pronounced at birth and in the first two months, with twins and triplets partially compensating for the initial delay with age. Such a growth pattern has been demonstrated in other breeds as a consequence of intrauterine competition for food resources in multiple pregnancies (Gaddour et al., 2020). The obtained results contribute to a more comprehensive understanding of the factors influencing the growth and development of Anglo-Nubian goat kids in Bulgarian conditions. The relationships found between the sex, birth type and body development in this study highlight the need for a personalised approach in the rearing and feeding of the goat kids until weaning.

One of the strengths of the study is the detailed analysis of weight development and external measurements, which allows conclusions to be drawn that are highly applicable in practice. The methods used ensure the reliability of the results and statistically significant differences confirm trends reported in previous studies.

A limitation of the study is the relatively small number of animals, which cannot be a clear criterion for the generalizability of the results. Factors such as diet and rearing conditions, which may have influenced growth performance, were not investigated in detail. Tracking these factors and increasing the sample size in future studies will provide even clearer insights to achieve better results on performance in multiple pregnancies.

CONCLUSIONS

The average daily growth rate for male calves up to 30, 60 days and at weaning was (0.129; 0.192; 0.155 kg) and for females (0.112; 0.184; 0.176 kg).

External measurements showed significant differences according to sex and type of birth. Male goat kids were larger in all parameters, and singletons outperformed twins and triplets in body size, especially in height and length.

The growth dynamics observed in male Anglo-Nubian goat kids at 60 and 90 days of age can be used as a guide for assessing their carcass performance and determining the appropriate time for slaughter.

Table 4. Exterior measurements of goat kids according to sex

Indicators	At birth				1 Month				2 Month				3 Month				Sig.
	♂		♀		♂		♀		♂		♀		♂		♀		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Withers height	32.73^{e}	1.46	31.63^{e}	1.79	38.89^{c}	2.49	36.32^{d}	1.34	47.96^{b}	1.37	46.47^{b}	1.23	57.58^{a}	2.68	56.01^{a}	1.44	***
Rump height	32.30^{e}	1.53	31.40^{e}	1.67	38.70^{c}	2.39	35.85^{d}	1.27	47.75^{b}	1.45	46.20^{b}	1.32	57.40^{a}	2.74	55.75^{a}	1.59	***
Body length	28.60^{f}	1.11	27.50^{f}	1.85	36.85^{d}	2.00	34.15^{e}	1.59	46.62^{b}	1.59	44.25^{c}	1.23	55.65^{a}	2.62	53.97^{a}	1.37	***
Chest width	7.12^{e}	0.05	6.97^{e}	0.24	11.45^{d}	0.66	10.89^{d}	0.45	14.63^{b}	0.89	13.76^{c}	0.64	16.66^{a}	1.16	16.05^{a}	0.54	***
Chest depth	11.32^{f}	0.4	10.90^{f}	0.62	15.59^{d}	1.36	13.53^{e}	1.06	18.96^{b}	1.31	16.93^{c}	0.83	23.86^{a}	1.11	23.51^{a}	0.7	***
Chest girth	29.55^{a}	2.72	27.65^{a}	1.79	42.8^{b}	2.78	40.20^{c}	2.33	51.40^{d}	2.76	47.99^{e}	1.96	64.35^{a}	2.34	63.36^{a}	1.12	***
Shin-bone girht	6.11^{c}	0.26	5.98^{c}	0.32	6.36^{b}	0.22	6.05^{c}	0.09	6.97^{a}	0.18	6.99^{a}	0.08	7.07^{a}	0.81	6.97^{a}	0.11	***

Note: *- P < 0.05; **- P < 0.01; ***- P < 0.001

^{a,b,c,d,e,f} - different letters on one line indicate values with significant reliability

Table 5. Exterior measurements of goat kids according to birth type

At birth								1 st Month							2 nd Month							3rd Month						
Type of birth	Singletones		Twins		Triplets		Sig.	Singletones		Twins		Triplets		Sig.	Singletones		Twins		Triplets		Sig.	Singletones		Twins		Triplets		Sig.
Indicators	Mean	SD	Mean	SD	Mean	SD		Mean	SD	Mean	SD	Mean	SD		Mean	SD	Mean	SD	Mean	SD		Mean	SD	Mean	SD	Mean	SD	
Withers height	33.86^{a}	1.24	31.69^{b}	0.72	30.24^{c}	0.77	***	33.86^{a}	1.24	31.69^{b}	0.72	30.24^{c}	0.77	***	48.17^{a}	1.44	47.11^{a}	0.73	45.79^{b}	1.12	***	57.90^{a}	2.42	56.66^{a,b}	2.22	55.18^{b}	0.50	*
Rump height	33.40^{a}	1.30	31.44^{b}	0.73	30.00^{c}	0.71	***	33.40^{a}	1.30	31.44^{b}	0.73	30.00^{c}	0.71	***	48.07^{a}	1.49	46.75^{b}	1.00	45.56^{b}	1.33	***	57.73^{a}	2.49	56.38^{a,b}	2.36	55.00^{b}	0.71	*
Body length	29.45^{a}	0.97	27.88^{b}	0.80	26.00^{c}	1.11	***	29.45^{a}	0.97	27.88^{b}	0.80	26.00^{c}	1.11	***	46.52^{a}	1.81	45.34^{a,b}	1.50	43.78^{b}	1.16	***	55.89^{a}	2.40	54.61^{a,b}	2.19	53.37^{b}	0.77	*
Chest width	7.24^{a}	0.20	7.02^{b}	0.05	6.77^{c}	0.19	***	7.24^{a}	0.20	7.02^{b}	0.05	6.77^{c}	0.19	***	14.77^{a}	1.04	14.06^{b}	0.45	13.47^{b}	0.54	***	16.67	1.05	16.35	0.96	15.81	0.39	NS
Chest depth	11.59^{a}	0.41	11.03^{b}	0.10	10.44^{c}	0.53	***	11.59^{a}	0.41	11.03^{b}	0.10	10.44^{c}	0.53	***	18.78^{a}	1.38	17.92^{a}	1.36	16.59^{b}	0.84	***	24.13^{a}	0.98	23.64^{a,b}	0.92	23.02^{b}	0.36	*
Chest girth	30.87^{a}	2.26	28.00^{b}	0.63	25.89^{c}	1.17	***	30.87^{a}	2.26	28.00^{b}	0.63	25.89^{c}	1.17	***	51.59^{a}	2.91	49.21^{b}	2.18	47.39^{b}	1.6	***	64.80^{a}	2.08	63.74^{a,b}	1.70	62.02^{b}	0.69	**
Shin-bone girht	6.31^{a}	0.17	6.03^{b}	0.06	5.64^{c}	0.20	***	6.31^{a}	0.17	6.03^{b}	0.06	5.64^{c}	0.20	***	7.03^{a}	0.12	6.89^{a,b}	0.09	6.87^{b}	0.19	*	7.09	0.21	7.00	0.07	6.93	0.12	NS

Note: *- P < 0.05; **- P < 0.01; ***- P < 0.001

^{a,b}- different letters on one line indicate values with significant reliability

REFERENCES

Gaddour, A., Najari, S., Ouni, M., & Ben Hamouda, M. (2020). The effect of birth type on growth performance and survival rate of local goat kids in arid regions. *Small Ruminant Research*, 192, 106191.

Georgieva, G., Stoycheva, S., & Bancheva, T. (2023). Dynamics of live weight in Romanov lambs up to 90 days of age. *Journal of Mountain Agriculture on the Balkans*, *26*(3), 52-64.

Hristova, T., Stoycheva, S., Zunev, P., & Maslev, T. (2013). Non-genetic factors affecting birth weight of goat kids. IV. *International Symposium "Agrosym 2013", Book of proceedings "Agrosym 20*13*"*, 1066-1069.

Kari, A, Ghazali, F.A., Amran, N.A.S., Asmawi, H., Kamarudin, N.F.S., & Lananan, F. The study of male and female Saanen goat's growth performance at UniSZA dairy goat farm (UDGF). *Bioscience Research*, 16, 296-305.

Khalid, E., Ali S.M.A., Mekki, D.M., & Bakhit, S.A. (2022). Pre and post-weaning performance of Crossed kids F1 (Desert and Damascus) under the traditional management system, North Kordofan-Sudan. International *Journal of Education and Research*, 10, 35-46.

Mazhangara, I.R., Chivandi, E., Mupangwa, J.F., & Muchenje, V. (2019). The potential of goat meat in the red meat industry. *Sustainability*, *11*(13), 3671.

Mellado, M., Meza-Herrera, C., Veliz-Deras, F.G., & De Santiago-Miramontes, M.A. (2011). Effect of litter size and birth weight on neonatal mortality in small-ruminant flocks. *Journal of Animal Science*, *89*(6), 1674-1681.

Morris, C., Wheeler M., & Foote, B. (2011). Relationships between live weight and herd-test traits in a Saanen goat herd in New Zealand. New Zealand *Journal of Agricultural Research*, *54* (4), 315-320.

Skapetas, B., & Bampidis, V. (2016). Goat production in the world: Present situation and trends. Livestock. *Resesrch for Rural Development*, 28, 1-6.

Todorova, V., Todorov, D., Borislavov, R., & Borislavov, N. (2021). *Breeding Program for the Anglo-Nubian goat breed in Bulgaria*. Association for the Breeding of Dairy Goat Breeds, Ruse, 1-89.

Vuchkov, A. (2020). Weight development during suckling period of kids from two indigenous Bulgarian goats breeds. Knowledge. *International Journal*, 41(4), 837-842.

Yordanov, G. (2023). *Farm animal breeds in the Republic of Bulgaria.* Catalogue Sixth revised and updates edition. Sofia, Bulgaria, 1-288.

Zhang, C.Y., Shen, Z., Zhou, Z.Q., & Yang, L.G. (2006). Studies on the growth and developmental rules of young Boer goat. *Journal Huazhong Agriculture University*, 12, 640-644

Zunev, P. (1991). *Phenotypic and Genotypic Characterization of the Breeding Core of the Bulgarian White Dairy Goat Breed*, PhD Thesis, SAA - Sofia, 1-123.