Scientific Papers. Series D. Animal Science. Vol. LXIX, No. 1, 2026
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

ASSESSMENT OF THE GROWTH ABILITIES OF LAMBS FOR MARKET REALIZATION FROM BULGARIAN SHEEP BREED FOR WOOL AND MEAT

Genoveva STAYKOVA[1], Pavel TODOROV[2], Todor TSONEV[3], Margarit ILIEV[4], Tsonka ODZHAKOVA[2]

[1]Agricultural Academy, Sofia, Agricultural Institute - Shumen, 3 Simeon Veliki Blvd, 9700, Shumen, Bulgaria
[2]Agricultural Academy, Sofia, Research Centre of Stockbreeding and Agriculture - Smolyan, 35 Nevyastata Street, 4700, Smolyan, Bulgaria
[3]Agricultural Academy, Sofia, Research Center for Agriculture - Targovishte, 91 Kyustendzha Street, 7700, Targovishte, Bulgaria
[4]Agricultural Academy, Sofia, Institute of Agriculture - Karnobat, 1 Industrialna Street, 8400, Karnobat, Bulgaria

Corresponding author email: staikova666@abv.bg

Abstract

The aim of the study is to assess the growth abilities of lambs until weaning of the Northeastern Bulgarian Fine-fleece breed. The animals are the property of the Scientific Center for Agriculture - Targovishte. Four groups were formed, which included 15 lambs - singles and 5 twins of both sexes. The live weight trait was recorded at birth, at 10 days, 30, 70 and 90 days. It was found that the lambs of this breed show good growth abilities until weaning. Female lambs reached an average of 24.471 kg, and males - 23.091 kg at 90 days. The average daily gain of lambs ranged from 0.148 kg to 0.306 kg for females by periods and from 0.156 kg to 0.342 kg for male lambs. The highest gain was achieved by lambs of both sexes in the period 70-90 days. The results show a good potential for compensation in the growth of lambs born as twins. The total gain achieved by twin lambs in 90 days was only 10.04% lower than singles in females, but 2.38% higher in male lambs.

Key words*: average daily gain, lambs, live weight, Northeastern Bulgarian Fine-fleece sheep breed, sex, type of birth.*

INTRODUCTION

The history of fine-fleece sheep breeding in Bulgaria reflects the general trends in the development of the agricultural sector. During the socialist period (1944-1989), sheep breeding developed rapidly and successfully. Bulgarian fine-fleece sheep breeds occupy a significant share of the total gene pool in the sector, which exceeded 10 million sheep at the end of the period. Wool production is of strategic importance for the textile industry and the foreign trade balance, together with meat production from fine-fleece farms. Trends in recent decades show a serious reduction of the fine-fleece population to a risk status. Under the new market conditions, wool production now generates more costs than income, and milk productivity cannot be relied on in fine-fleece sheep. Slavova & Staykova (2021) found that the largest relative share of income in the various productive areas of sheep breeding comes from the sale of animals for meat. Practice shows that the sale of lambs is the main source of income for farmers in the fine-fleece field. The sale of lambs immediately after weaning is a traditional practice and determines the economic results of breeding. At this age, they are ideal for the production of "light carcasses" – up to 13.0 kg, which are obtained from lambs with a live weight of up to 25,000-27,000 kg on the S-EUROP scale (Raycheva, 2005). The growth capabilities of the offspring and the potential for generating growth of fine-fleece lambs provide a chance for the preservation and sustainable development of the fine-fleece population against the background of competition from highly specialized imported breeds of sheep. European policies in the sector for the

preservation of biodiversity are in line with our strategy for the preservation and rational use of this valuable gene pool. The flock in the Scientific Center of Agriculture in Targovishte is a nucleus of the Northeastern Bulgarian Fine-fleece Sheep Breed (NEBFFB) - Shumen type. With a greatly reduced volume of the fine-fleece population, the Northeastern Bulgarian Fine-fleece breed occupies over 50% of the total volume in the direction. Studies of productivity and factors that influence the phenotypic expression of the genetic potential in fine-fleece breeds in our country were conducted by Iliev (1999, 2010); Iliev et al. (2017), Boykovski et al. (2012; 2018); Slavova (2000; 2019); Slavov (2007); Stefanova et al. (2002); Slavova et al. (2015; 2018); Stancheva et al. (2015; 2017; 2020); Staykova et al. (2013; 2022); Tzonev, T. (2014); Todorov et al. (2023). Mallick et al. (2017) investigated the influence of various factors on the weight development of Bharat Merino (BM) lambs, with the aim of improving the breeding program for the breed and increasing the economic effect of breeding. Mahala et al. (2019) established the results of changing some non-genetic factors on the growth and productivity of Avikalin sheep breed in India. Jawasreh et al. (2018) investigated the dynamics of live weight and weaning growth of Awassi lambs in Jordan. Studies on lamb meat production and ways to increase meat productivity provide the necessary recommendations for breeding work to preserve the Bulgarian fine-fleece sheep breeding. This scientific goal motivates the present study.

The aim of the study is to assess the growth abilities until weaning and the meat productivity of lambs from the Northeastern Bulgarian fine-fleece sheep breed.

MATERIALS AND METHODS

Study of the weight development of lambs from birth to weaning in the Northeastern Bulgarian fine-fleece sheep breed was the aim of the experiment. The study was conducted in the flock owned by the Scientific Center for Agriculture - Targovishte at the Agricultural Academy - Sofia during the lambing campaign 2024-2025. The experimental animals were matched by the method of analogues by sex /male, female/, type of birth/singles, twins/, age and live weight. Four groups were formed, which included 15 lambs each, born as singles and 5 twins of both sexes. Live weight was measured in the morning with an accuracy of 0.100 kg. The live weight trait was recorded at birth, at 10 days, at 30 days, at 70 days and at 90 days. The exact age at weaning in days is recorded, then equated to 90 days, for the purpose of data comparability. The animals have free access to a concentrated starter mixture with 18% crude protein, alfalfa hay and straw. Feeding and adaptation to different types of feed in the period until weaning is without quantitative restrictions. The lambs have constant access to drinking water and salt for licking. A total of 200 measurements of the live weight of the lambs from all groups were made, on the basis of which the average daily gain by periods was calculated for both sexes and for different types of birth. The data were processed using the Basic Descriptive Statistics method with the Minitab-16 software product. The reliabilities of the differences between the levels of the trait in the respective groups were established based on the distribution degree measured by Student.

RESULTS AND DISCUSSIONS

It was found that female lambs of the Northeastern Bulgarian fine-fleece breed are born with an average live weight of 4.327 kg, at 10 days they weigh an average of 5.880 kg, at 30 days - 9.242 kg, at 70 days - 18.342 kg and at 90 days an average of 24.471 kg (Table 1). The data in the table show that single female lambs achieve an 8.96% to 13.97% higher average live weight by age than lambs born as twins during the study period. The weight of twins at birth and at 10 days is significantly lower ($P<0.05$). The dynamics of the variance shows a variation in the live weight of female lambs within the range of 16.53% to 27.26% by the studied trait. In lambs born as singles, the highest variation is observed in live weight at birth (22.38%), while in twins the variation increases significantly at the last two ages (24.29% and 25.07%). This trend is probably due to the difference in the compensatory capabilities of

the individual individuals and the dynamics of the maternal effect. Female single lambs show a 10.26% higher absolute growth rate for the study period, without statistical certainty of the differences between the groups. Iliev et al., (2024) published values close to our average data on live weight at weaning for market realization of Karnobat fine-fleece lambs of both sexes (25.240 kg). Slavova et al. (2018) found a lower live weight at birth (3.541 kg) of female lambs of the Thracian fine-fleece breed, compared to our study, but at subsequent ages up to 70 days, the Thracian lambs showed higher average values for the trait and higher growth intensity. Karnobat fine-fleece female lambs were born with a lower average live weight (Staykova et al., 2023) and at one month they were equal in weight to their peers from our study. Until weaning, however, the Karnobat breed showed better growth abilities of the female offspring and outperformed the Northeastern Bulgarian lambs by 16.29%. Tzonev, T. (2014) reported a higher average weight at weaning of female lambs of the Northeastern Bulgarian fine-fleece breed by 8.07%. The author points out that single female lambs have a slightly lower birth weight (Tzonev, 2014), but at 30 and 70 days they slightly exceed the results of our study. Female twins are born with a 17.80% lower average weight than our results, but by 70 days of age they surpass the twins in our study by 6.80% (Tzonev, 2014). Staykova et al. (2025) found similar values of average live weight up to 70 days of female lambs from the Copper Red Shumen breed of sheep, which inhabits the same area - Northeastern Bulgaria. Live weight at weaning, however, is higher by 12.48% in female lambs from the Northeastern Bulgarian Fine-fleece breed.

Table 1. Live weight of female lambs up to weaning from the Northeastern Bulgarian Fine-fleece breed

Trait	Female lambs - total n = 20			Female lambs - singles n = 15			Female lambs - twins n = 5		
	x	Sx	C%	x	Sx	C%	x	Sx	C%
Live weight - birth, kg	4.327	0.212	21.58	4.497 l	0.260	22.38	3.901 l	0.342	18.67
Live weight - 10 days, kg	5.880	0.234	17.83	6.083 m	0.264	16.83	5.270 m	0.431	18.29
Live weight - 30 days, kg	9.242	0.348	16.85	9.457	0.404	16.53	8.606	0.676	17.58
Live weight - 70 days, kg	18.342	0.753	18.37	18.763	0.805	16.62	17.081	1.860	24.29
Live weight - 90 days, kg	24.471	1.020	18.61	25.101	1.071	16.57	22.590	2.522	25.07
Total gain for the whole period, kg	20.072	0.959	21.37	20.604	1.050	19.72	18.491	2.251	27.26

Significance of differences by rows – when the symbols are identical: from A to Z – P< 0.001; from a to k – P< 0.01; from l to z – P< 0.05.

The average growth rates of female lambs of the Northeastern Bulgarian fine-fleece sheep breed for the study period were respectively: 0.148 kg, 0.169 kg, 0.228 kg and 0.306 kg by periods and the total average until weaning was 0.223 kg (Table 2). The results show that single female lambs achieve from 1.77% to 26.42% higher growth at different ages, compared to twins. The highest growth is shown by singles in the period from 70 to 90 days (0.317 kg) (P<0.05). The twins give significantly lower growth from birth to 10 days (P<0.01). It was found that in terms of the total average daily gain for the entire studied period, female lambs born as twins at the end of the study were characterized by only 10.04% lower total gain. The coefficients of variation for average daily gain were high and ranged from 19.16% to 42.88%. In twin lambs, the dynamics increased after 30 days of age. The greatest variation in both types of birth of female lambs was found in the period from 70 days to weaning. This is the period in which the offspring begin to demonstrate their own growth abilities, after the gradual elimination of the effect of the different milk yield of the mothers. Slavova et al. (2018) found a higher average daily gain of Thracian female lambs in periods up to 70 days of age. The average growth of Karnobat female lambs is higher up to 70 days (Staykova et al.,

2023), in the latter period it decreases compared to our results, but the total average growth per day for the entire period is almost the same for both fine-fleece breeds. Tzonev (2014) published a slightly higher growth of single female lambs from the North-East Bulgarian fine-fleece breed up to 30 days, but then the results are similar to ours until weaning. The same author found a stronger compensatory growth in twins, which almost reached singles at weaning with a difference of only 3.6% in favor of singles (Tzonev, 2014). Copper-red Shumen female lambs are characterized by higher growth intensity up to 30 days and then show 16.14% lower average daily gain until weaning compared to our results for the Northeastern Bulgarian fine-fleece breed (Staykova et al., 2025).

Table 2. Average daily gain of female lambs up to weaning from the Northeastern Bulgarian Fine-fleece breed

Trait	Female lambs - total n = 20			Female lambs - singles n = 15			Female lambs - twins n = 5		
	x	Sx	C%	x	Sx	C%	x	Sx	C%
Gain - birth. - 10 days, kg	0.148	0.013	40.02	0.159 a	0.016	39.64	0.117 a	0.016	30.16
Gain - 10 days - 30 days, kg	0.169	0.011	29.59	0.170	0.014	32.84	0.167	0.014	19.16
Gain - 10 days - 30 days, kg	0.228	0.016	31.67	0.233	0.019	31.56	0.212	0.033	34.62
Gain - 70 days - 90 days, kg	0.306	0.028	41.18	0.317 l	0.034	41.37	0.276 l	0.053	42.88
Total average daily gain for the period, kg	0.223	0.011	21.37	0.229	0.012	19.72	0.206	0.025	27.27

Significance of differences by rows – when the symbols are identical: from A to Z – P< 0.001; from a to k – P< 0.01; from l to z – P< 0.05.

At the same ages, the average live weight values of male lambs were respectively: 4.531 kg, 6.091 kg, 9.295 kg, 16.256 kg and 23.091 kg (Table 3), with a total absolute average gain for the period of 18.561 kg. Male singles achieved a 4.11% to 28.66% higher average live weight than their twin peers at the same ages. The average weight of twins was significantly lower by the end of the first month (P< 0.05, P< 0.01, P< 0.001). Male lambs of the Karnobat Fine-fleece breed are born with a lower average live weight, but by the end of the first month they equalize in weight with their peers from our study and are weaned at an average weight 25.11% higher compared to our results (Staykova et al., 2023). Similar results were published by Slavova (2019) for the weight development of lambs of the Thracian Fine-fleece breed, which are weaned at a slightly higher live weight. Tzonev (2014) found a slightly lower live weight at birth of single male lambs of the Northeastern Bulgarian Fine-fleece breed – Shumen type, which show better growth intensity thereafter and are weaned at a higher average weight by 21.51%. In male lambs born as twins, the same trend was observed, probably as a result of environmental effects during the study period (Tzonev, 2014). In male lambs in our study, the trend for a stronger weight variance in singles up to 28.67% was maintained. It was found that male twins realized a 2.10% higher absolute growth compared to single lambs, but without statistical certainty of the differences between the groups. This shows the tendency to compensate for the lambs from multiple lambs with more intensive growth in order to realize their genetic potential, provided that the mother's milk yield allows it. Staykova et al. (2025) established a lower average live weight at birth of male lambs from the Copper Red Shumen breed of sheep, which inhabits the same area - Northeastern Bulgaria. At weaning, the local breed showed 8.08% higher live weight of male lambs (Staykova et al., 2025). Luma & Shabani (2025) studied the growth performance of the Sharri sheep breed and the Kosova sheep breed and found similar results for the former breed and significantly lower results for male lambs from the latter breed.

Table 3. Live weight of male lambs up to weaning from the Northeastern Bulgarian Fine-fleece breed

Trait	Male lambs - total n = 20			Male lambs - singles n = 15			Male lambs - twins n = 5		
	x	Sx	C%	x	Sx	C%	x	Sx	C%
Live weight - birth, kg	4.531 a	0.202	19.91	4.867 A	0.192	15.31	3.521 Aa	0.208	13.23
Live weight - 10 days, kg	6.091 l	0.323	23.69	6.561 b	0.332	19.63	4.681 lb	0.392	18.71
Live weight - 30 days, kg	9.295	0.447	21.51	9.753 m	0.523	20.77	7.920 m	0.541	15.27
Live weight - 70 days, kg	16.256	0.734	20.20	16.633	0.941	21.90	15.122	0.723	10.71
Live weight - 90 days, kg	23.091	1.120	21.75	23.340	1.441	24.15	22.381	1.160	12.58
Total gain for the whole period, kg	18.561	1.061	25.65	18.473	1.370	28.67	18.861	1.381	16.33

Significance of differences by rows – when the symbols are identical: from A to Z – P< 0.001; from a to k – P< 0.01; from l to z – P< 0.05.

The results in Table 1 and Table 3 show that female lambs by the end of the first month are characterized by a lower average live weight than males by 4.50% and 3.46%. After this age, however, female lambs in total and separately from both types of birth outperform males in total and by groups. Similar average data are also observed in terms of total absolute growth (7.53% higher for females) for the entire period, with the exception of the total growth for the period of male twins. In single male lambs, the coefficient of variation is highest at weaning (24.15%). Similar observations show the results in female twins in the last period until weaning (25.07%). Female singles show a greater diversity in live weights at birth. Călin et al. (2024) studied the potential of two sheep breeds in Romania for growth and lamb meat production - the Tsurcană breed and the Tsigaie breed. The first breed is definitely presented with lower values for average live weight by periods in lambs of both sexes, and the results for average daily growth of the animals are similar. The Tsigaie breed shows similar results to ours for average weight by periods and for average daily growth achieved by male and female lambs for the entire period of the study (Călin et al., 2024).

The results for average daily growth of male lambs of the Northeast Bulgarian Fine-fleece breed are respectively: 0.156 kg, 0.161 kg, 0.175 kg and 0.342 kg, an average of 0.207 kg for the entire period until weaning (Table 4). The highest growth is shown by male offspring in the period from 70 to 90 days (0.342 kg), but without statistical certainty of the differences. Male lambs of the Karnobat fine-fleece breed are characterized by a higher average daily growth up to 70 days, but after this age they show lower growth values than our results (Staykova et al., 2023). The twins give a significantly lower growth from birth to 10 days (P< 0.01) in our study. After the tenth day, however, we observe the opposite trend and the twin lambs realize a higher average growth until weaning, including as an absolute total average daily growth by 2.38% more than the singles for the period of the study. The coefficients of variation are high, especially for the first two periods and reach 48.65% for the birth weight of the twins. A gradual decrease follows and the variability increases again for the growth from 70 to 90 days in singles. In the latter period, lambs already rely mainly on their own potential for creating growth and mother's milk reduces its influence as a factor. At this age, the phenotypic realization of the trait depends largely on the feeding and rearing conditions on the farm. Tzonev (2014) established a higher growth of single lambs of the Northeastern Bulgarian fine-fleece breed - Shumen type up to 70 days, but until weaning the results are close to ours. Lambs born as twins also gradually increase the average growth values by periods, but cannot reach the growth of singles (Tzonev, 2014). In our study, male twins show good opportunities for compensatory growth and give a higher total average daily gain for the entire period. Staykova et al. (2025) published similar growth results for male twin lambs of the Copper Red Shumen breed, raised in the same area, but for singles and for males in general, the
local breed is distinguished by slightly higher results.

Table 4. Average daily gain of male lambs up to weaning from the Northeastern Bulgarian Fine-fleece breed

Trait	Male lambs - total n = 20			Male lambs - singles n = 15			Male lambs - twins n = 5		
	x	Sx	C%	x	Sx	C%	x	Sx	C%
Gain - birth. - 10 days, kg	0.156	0.017	47.14	0.169 a	0.019	43.88	0.116 a	0.027	48.65
Gain - 10 days - 30 days, kg	0.161	0.013	36.56	0.160	0.017	40.84	0.162	0.016	23.26
Gain - 10 days - 30 days, kg	0.175	0.011	29.21	0.172	0.014	30.97	0.180	0.021	26.52
Gain - 70 days - 90 days, kg	0.342	0.029	37.90	0.335	0.037	43.12	0.363	0.035	21.40
Total average daily gain for the period, kg	0.207	0.012	25.65	0.205	0.015	28.67	0.210	0.015	16.33

Significance of differences by rows – when the symbols are identical: from A to Z – P< 0.001; from a to k – P< 0.01; from l to z – P< 0.05.

The results in Table 2 and Table 4 show that female lambs achieve a lower average daily gain up to 10 days of age by 5.13%, then outperform males up to 70 days and again give lower results in the last period until weaning, where males dominate with 10.53%. Against the background of these dynamics in the different gender groups, the total average gain for the period of female offspring is slightly higher, but in lambs born as twins the male lambs shows a better potential for compensation in the realization of growth.

This study outlines the trends in the dynamics of live weight and growth of lambs from the Northeastern Bulgarian fine-fleece breed until weaning and market realization. The full manifestation of the genetic potential for lamb meat production can be realized only under optimal conditions of feeding and rearing of the lambs and their mothers even before conception.

CONCLUSIONS

The Northeastern Bulgarian fine-fleece sheep breed is characterized by a good growth rate of lambs until weaning. Female lambs reach an average of 24.471 kg, and males, respectively, 23.091 kg per 90 days.

The average daily gain of lambs from the Northeastern Bulgarian fine-fleece breed ranges from 0.148 kg to 0.306 kg for females by periods and from 0.156 kg to 0.342 kg for male lambs. The highest growth is achieved by lambs of both sexes in the period 70-90 days.

The results of the study show a good potential for compensation in the weight development of lambs born as twins. The total growth achieved by twin lambs in 90 days is only 10.04% lower than singles in females, but 2.38% higher in male lambs from the Northeastern Bulgarian fine-fleece breed of sheep.

ACKNOWLEDGEMENTS

This research work was carried out with the support of Agricultural Institute – Shumen and Institute of Agriculture – Karnobat and was financed from Project Zh №189 "Conservation and rational use of endangered Local and Fine-fleece sheep breeds in eastern Bulgaria" of Agricultural Academy – Sofia, Bulgaria.

REFERENCES

Boykovski, S., Georgiev, D., & Tzonev, T. (2018). *Influence of the breeds Australian Merino and Booroola Merino Breed on productivity and fertility of Fine Fleece sheep.* Shumen, BG: Uni Express Ltd. Publishing House, 162 pp. (Bg).

Boykovski, S., Stefanova, G., Tzonev, T., & Anev, G. (2012). *Productivity of Merino sheep, bred in Bulgaria*. Shumen, BG: Uni Express Ltd. Publishing House, 163 pp. (Bg).

Calin, I., Raducuta, I., Puie, A., Poliopol, A., & Caprita, I. (2024). Research on quantitative aptitudes in the direction of meat production in lambs from Țurcană and Țigaie breeds. *Scientific Papers. Series D. Animal Science,* LXVII(2), 301-306.

Iliev, M., Slavova, P., Laleva, S., & Krastanov, Z. (2017). Fattening and slaughter qualities of the lambs by Karnobat Local breed and croses with Karnobat Fine Wool breed, *Bulgarian Journal of Animal Husbandry*, 54(1), 3-9 (Bg).

Iliev, M. (1999). *Study on the effect of genetic and non-genetic factors on productivity and selection system in sheep of the Karnobat Fine Fleece breed with a*

view to its preservation and improvement. Doctoral dissertation, Sofia. 178. (Bg)

Iliev, M. (2010). Characteristics of the productivity of sheep from the Karnobat Fine Fleece breed. *Bulgarian Journal of Animal Husbandry,* 2, 22-27 (Bg).

Iliev, M., Staykova, G. & Tsonev, T. (2024). Assessment of the live weight and wool productivity of the Karnobat Fine Fleece sheep breed. *Bulgarian Journal of Animal Husbandry,* 61(1), 3-10 (Bg).

Jawasreh, K., Ismail, Z., Iya, F., Castañeda-Bustos, V., & Valencia-Posadas, M. (2018). Genetic parameter estimation for pre-weaning growth traits in Jordan Awassi sheep, *Veterinary World*, 11(2), 254-258.

Luma, X. & Shabani, M. (2025). Comparative analysis and environmental impact in dynamics of body weight growth, the fattening and slaughtering characteristics of lambs from the Sharri sheep breed and the Kosova breed sheep. *Bulgarian Journal of Agricultural Science,* 31(2), pp. 379-385.

Mahala, S., Saini, S., Kumar, A., Prince, L. & Gowane, G. (2019). Effect of non-genetic factors on growth traits of Avikalin sheep. *Small Ruminant Research*, 174, 47-52.

Mallick, P. K., Pourouchottamane, R., Rajapandi, S., Thirumaran, S. M. K., Venkataraman, R., Nagarajan, G. & Rajendiran, A. S. (2017). Influence of genetic and nongenetic factors on growth traits of Bharat Merino sheep in sub-temperate climate of Kodai hills of Tamil Nadu, India. *Indian Journal of Animal Research,* 51(2), 365-370.

Raycheva, E., (2005). New market requirements for the quality of lamb carcasses. *Animal Science*, 1, 23-27, (Bg).

Slavov, R. (2007). *Opportunities for Improvement of Sheep from the North-Eastern Bulgarian Fine-Fleece Breed - Dobrudjan Type*. Doctoral dissertation, Stara Zagora, 179 (Bg).

Slavova, P., Dimitrov, I., & Laleva, S. (2015). Study of the dynamics of changes in live weight and fertility in sheep of the Thracian fine-fleece breed. *Science & Technologies,* V(5), *Animal studies & Veterinary medicine,* 21-27.

Slavova, P., Dimova, N., Mihaylova, M., Popova, Y., Laleva, S., Pacinovski, N., & Slavova, S. (2018). Intensity of growth, productivity and body condition score of young breeding animals of the Thracian Merino breed. *Macedonian Journal of Animal Science*, 8(1), 19-23.

Slavova, P. (2000). *Study on the variability of the selection traits in sheep from the Thracian Fine Fleece breed and possibilities of improvement by crossing with Australian Merino rams*, Doctoral dissertation, Sofia, 189 pp. (Bg).

Slavova, P. (2019). *The Thracian Fine Fleece breed in Agricultural institute – Stara Zagora.* Stara Zagora, „Contrast“ Publishing House, pp.144, (Bg).

Slavova, S. & Staykova, G., (2021). Economic aspect of breeding Karakachan sheep in the lowlands. *Bulgarian Journal of Animal Husbandry,* 58 (5), 24-31 (Bg).

Stancheva, N., Krastanov, J., & Kalajdzhiev, G. (2020). Weight development of sheep from the North-East Bulgarian Merino breed. *Bulgarian Journal of Animal Husbandry,* 57 (6), 3-10 (Bg).

Stancheva, N., Slavova, P., Kalaydhziev, G., Angelova, T., Yordanova, D., Staykova, G., & Krastanov, J., (2017). Genetic structure of the sheep from the Shumen inbreeding type of north-east Bulgarian merino sheep. *Bulgarian Journal of Animal Husbandry*, 54(3), 44-53 (Bg).

Stancheva, N., Slavova, P., Laleva, S., Krustanov, J., Iliev, M., Staykova, G., Kalaydzhiev, G., & Tzonev, T. (2015). Present status, development and productivity of Bulgarian Fine Fleece of sheep breeds in some herds of Agricultural Academy. *Bulgarian Journal of Animal Husbandry,* LII(5), 62-71 (Bg).

Staykova, G., & Stancheva, N. (2013). Effect of different sources of specific variants on signs live weight and fertility in Caucasian breed. *Agricultural Science,* Agricultural University Plovdiv, V(13), 43–50 (Bg).

Staykova, G., Iliev, M., Tsonev, T., & Anev, G. (2022). Effect of Different Sources of Specific Variance on the Wool Productivity of Sheep from the North East Bulgarian Merino Breed. *Scientific Papers. Series D. Animal Science,* LXV(1), 100-105.

Staykova, G., Iliev, M. & Tsonev, T. (2023). Weight development and growth intensity of lambs from the Karnobat Fine Fleece breed depending on sex and type of birth. *Bulgarian Journal of Animal Husbandry*, 60(5), 3-11 (Bg).

Staykova, G., Iliev, M. & Tsonev, T. (2025). Effect of different sources of specific variance on the weight development of sheep from the North East Bulgarian merino breed. *Bulgarian Journal of Agricultural Science,* 31(5), 1032–1038.

Stefanova, S., P. Marinova & M., Iliev, (2002). Study of the dynamics in fattening abilities and ratio of meat structure in lambs from the Karnobat Fine Fleece and Karnobat local breeds. *Book of the Union of Scientists in Bulgaria – Stara Zagora, Scientific conference with international participation "Stara Zagora, 2002"* 6-7 section 2, *Animal science*, 328-331. (Bg)

Todorov, P., Odzhakova, Ts. & Staykova, G. (2023). Weight development and growth intensity of lambs from the Middle Rhodopean and Karakachan breeds. *Bulgarian Journal of Agricultural Science*, 29 (3), 514–518.

Tzonev, T., (2014). *Productive characteristics of Merino sheep breed in Bulgaria*, Doctoral dissertation. Sofia, pp 124 (Bg).