

Impact of non-genetic factors on reproductive traits of ewes and lamb weight until weaning in the Sjenica Pramenka sheep

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Abstract

The aim of this study was to determine the significance of the farm (as a factor) on the fertility traits and body weight of ewes (ewe lambs and mature ewes), as well as on the body weight of lambs until weaning, and also the significance of the mother's age (as a factor) on the body weight of lambs at birth, the impact of type and sex (as factors) on birth weight and the weight trajectory of lambs from birth to weaning, depending on the mentioned factors. Examination of reproductive and productive traits, as well as the impact of factors on these traits in the population of Sjenica Pramenka sheep, was conducted on four family farms in the municipality of Valjevo. Analyzing the influence of multiple factors involved a sample of a total of 124 female breeding animals (ewe lambs and mature ewes), 149 lambs, and 4 rams of Sjenica Pramenka breed. The results of the study showed that the farm had a very highly statistically significant influence on the body weight of ewes and the body weight of lambs at birth, at 30 and 90 days of age ($P < 0.001$). The age of ewes significantly affected fertility ($P < 0.05$). The highest fertility was observed in ewes aged between 12 and 14 months at first mating, reaching 1.44, while the lowest fertility was observed in ewes mated at the age of 8 to 10 months, with a fertility rate of 1.09. The influence of birth type had a very highly statistically significant impact in all three monitoring periods ($P < 0.001$), while sex did not significantly affect the weight of lambs in all 3 monitoring periods.

Key words: farm, fertility, age, body weight of lambs

INTRODUCTION

Sheep farming is an important livestock and economic sector in mountainous and hilly areas, which constitute 60% of our country's territory. The fundamental characteristic of sheep is their ability to thrive and produce under harsh climatic conditions on poor natural pastures, in hilly terrain, and on saline soil. Sheep are typically most abundant in areas where the most extensive agriculture is practiced. They are found in these regions due to their adaptability and high resilience.

In our domestic sheep farming, Pramenka sheep comprise 80% of the share. This primitive but exceptionally resilient breed of sheep is divided into various strains adapted to different climatic and nutritional conditions. These strains differ in size, wool yield and quality, as well as in the color of wool and fur. There are significant variations in these traits both among different strains and within the same strain. This provides the opportunity for selecting the most productive strains and individuals within them. All Pramenka strains are fully adapted to local farming conditions, making them extremely resistant to adverse conditions of nutrition and care. Although Pramenka sheep provide less benefit compared to other breeds, they stand out for their exceptional ability to survive in extreme conditions (Mekić et al., 2007).

Sheep production in Serbia is quite fragmented and mainly takes place in smaller herds on smaller family farms. According to data from the Statistical Yearbook of the Republic of Serbia (2023), there are slightly more than 1,716,000 sheep in our country, although there are conditions for keeping a significantly larger number of sheep. Total production is also low due to the poor productivity of sheep (Statistical Yearbook of RS, 2023).

The Sjenica-Pešter Pramenka strain (also known as Sjenica sheep or Sjenica ruda) stands out as the largest indigenous sheep breed in the mountainous regions of Serbia. This breed is particularly notable for its production of meat, milk, and wool compared to other indigenous Pramenka strains covered by monitoring or conservation plans. Besides the Sjenica sheep, other Pramenka strains are also raised in Serbia, including the Svrljig, Šarplaninac, Bardoka, Baljuša, Kosovka, Lipska, Pirot, Krivovir, Karakačan, and Vlaško Vitorog sheep (Savić and Slijepčević, 2013).

The conditions prevailing on different farms, which encompass a wide range of non-genetic factors, from the way sheep are kept, the type of facilities and microclimatic conditions present in them, production technology and management, to the method and quality of nutrition, can significantly contribute to the variation of many economically important traits. All production performances of individual animals, measurable, are the result of the inheritance they receive from both parents and the environment in which they develop (Babar et al., 2004).

Breeders can significantly influence the production traits of animals in many ways. This includes providing proper nutrition for the herd, improving the physical environment by constructing better shelters and ambiance, as well as reducing the harmful effects that various pests can cause (Vidović, 1993). According to Petrović et al. (2009), the implementation of different levels of selection and breeding measures (non-genetic factors) on two sheep farms resulted in variations in the body weight of Pirot Pramenka lambs and Pirot upgraded sheep during the pre-weaning period. Understanding the factors that influence the development and growth of lambs will enable the adaptation of breeding and management strategies to reduce negative impacts that may diminish production efficiency (Bermejo et al., 2010).

The aim of the research was to determine the significance of the farm's influence (as a factor) on fertility traits and body weight of ewes (ewe lambs and mature ewes), as well as on the body weight of lambs, and also the significance of the mother's age (as a factor) on the body weight of lambs at birth, the impact of type and sex (as factors) on birth weight and the weight trajectory of lambs from birth to weaning, depending on the mentioned factors.

MATERIAL AND METHODS

The investigation of the influence of multiple factors on the reproductive traits of ewes and the production traits of lambs in the population of Sjenica Pramenka sheep was conducted on four family farms located in the municipality of Valjevo. The research was conducted during the year 2021.

The analysis of the influence of multiple factors included a sample of a total of 124 female breeding animals (ewe lambs and mature ewes), 149 lambs, and 4 rams of Sjenica Pramenka breed. Within each farm, there were 31 female breeding animals (ewe lambs and mature ewes) of different ages and 1 ram. The farms are located in the municipality of Valjevo, with Farm 1 and Farm 2 situated in the village of Kovačice, Farm 3 in the village of Donje Leskovice, and Farm 4 in the village of Zlatarić. They differ from each other both in terms of animal husbandry systems and sheep nutrition, food quality, and the conditions in which the animals are raised.

In this study, the influence of the farm factor, which encompassed several factors (feeding and accommodation conditions, previous selection of flocks on the farm, and others), was examined on multiple traits: fertility, body weight of lambs at birth, at 30 days of age, and at weaning, as well as the body weight of ewes. Additionally, the influence of the age of ewes at first mating on fertility (% of lambing rate) was analyzed. The body weight of female breeding animals (ewe lambs and mature ewes) was determined immediately before the first mating, while the body weight of lambs was measured at birth, at 30 and 90 days (at weaning). The determination of the body weight of ewes and lambs was performed using livestock scales, balance scales, and digital scales. Reproductive traits and the age of animals were determined based on the data from the pedigree records maintained by the primary breeding organizations

ZZ "Zoon" from Valjevo and "Selekcija-vet" from Lelić. The influence of lamb gender and birth type was observed through the traits of lamb body weight from birth to weaning.

Statistical analysis of the experimental data was performed using the SAS 9.4 statistical package. Descriptive statistics parameters were determined (mean, standard deviation, minimum, maximum, and coefficient of variation). Analysis of variance (one-way ANOVA) was applied. Differences between the mean values of the examined treatments were analyzed using the Fisher LSD (Least Significant Difference) test.

RESULTS AND DISCUSSION

From the results shown in Table 1, it can be seen that the body weight of ewes significantly varied across the observed farms (referred to as treatments), and that the farm (comprising feeding and accommodation conditions, previous selection of flocks on the farm, and others) had a highly statistically significant impact on body weight ($P < 0.001$).

Table 1. Influence of farm on the body weight and fertility of ewes

Treatment	N	BW ewes $\bar{x} \pm SD$	CV (%)	N	Fertility $\bar{x} \pm SD$	CV (%)
1	31	39.90 $\pm$ 3.13	7.84	31	1.35 $\pm$ 0.47	34.81
2	31	42.84 $\pm$ 2.82	6.58	31	1.06 $\pm$ 0.25	23.58
3	31	46.81 $\pm$ 6.47	13.82	31	1.16 $\pm$ 0.37	31.90
4	31	48.06 $\pm$ 6.84	14.23	31	1.26 $\pm$ 0.44	34.92
F exp.	124	16.270***		124	3.041*	

*** $P < 0.001$; * $P < 0.05$

The highest average body weight was observed in ewes within treatment 4, which differed by only 1.25 kg from the average body weight of ewes in treatment 3, and they significantly differed from treatment 1 and treatment 2 ($P < 0.001$), as determined by the Least Significant Difference (LSD) test. The difference in body weight between treatment 4 and treatment 1 was 8.16 kg, while the difference in weight between treatment 4 and treatment 2 was 5.22 kg. Treatment 3 differed from treatment 1 by 6.91 kg, and the observed difference between treatment 3 and treatment 2 was slightly lower at 3.97 kg. Ewe fertility, expressed through litter size, i.e., the average number of lambs per ewe, was also significantly influenced by the farm ($P < 0.05$). A highly statistically significant difference was found between ewes in treatment 1 and ewes in treatment 2 ($P < 0.01$).

Based on the F-test results presented in Table 2, it can be clearly concluded that the influence of the farm on the body weight of lambs is highly statistically significant in all three monitoring measurements ($P < 0.001$), which is consistent with the findings of Lečić et al. (2022). Specifically, they emphasize that a statistically highly significant ($P < 0.01$) influence of the farm on the body weight of Sjenica breed lambs was determined in all three monitoring periods.

Table 2. Influence of farm on lamb body weight from birth to weaning

Treatment	N	BW of lambs at birth $\bar{x} \pm SD$	CV (%)	N	BW of lambs at 30 days $\bar{x} \pm SD$	CV (%)	N	BW of lambs at weaning $\bar{x} \pm SD$	CV (%)
Treatment 1	43	2.93 $\pm$ 0.41	13.99	43	9.11 $\pm$ 1.13	12.40	43	25.44 $\pm$ 3.15	12.38
Treatment 2	33	3.46 $\pm$ 0.50	14.45	33	10.18 $\pm$ 1.29	12.67	33	23.53 $\pm$ 2.75	11.68
Treatment 3	34	3.85 $\pm$ 0.92	23.90	32	12.24 $\pm$ 1.51	12.34	32	28.30 $\pm$ 2.60	9.19
Treatment 4	39	3.38 $\pm$ 0.49	14.50	39	10.85 $\pm$ 1.25	11.52	39	25.80 $\pm$ 2.66	10.31
F exp.	149	15.293***			38.099***			15.66***	

*** $P < 0.001$

Results from Mekić et al. (2008a) indicate that the farm did not have a statistically significant effect on lamb body weight at birth, whereas statistical significance of the interaction factor on lamb body weight was observed at 60 days ($P<0.05$) and 90 days ($P<0.01$) of age.

Analysis of the influence of lamb birth type on their body weight during the observed period, when all data from the four farms were taken into account, showed that on average, singles were heavier than twins by 0.66 kg at birth, 1.49 kg at 30 days of age, and 1.96 kg at 90 days of age. The influence of birth type was highly statistically significant in all three monitoring periods ($P<0.001$).

Table 3. Influence of birth type on lamb body weight from birth to weaning

Factor	N	BW at birth (kg)			N	BW at 30 days (kg)			N	BW at 90 days (kg)		
		$\bar{x}$	SD	CV (%)		$\bar{x}$	SD	CV (%)		$\bar{x}$	SD	CV (%)
Birth type	149	3.37	0.68	20.18	147	10.48	1.71	16.32	147	25.70	3.24	12.61
Singles	100	3.59	0.68	18.94	99	10.96	1.70	15.51	99	26.34	3.41	12.95
Twins	49	2.93	0.45	15.36	48	9.48	1.23	12.97	48	24.38	2.38	9.76
F exp.		37.933***				29.344***				12.833***		

*** $P<0.001$

Jevtić-Vukmirović et al. (2007) emphasize that the influence of birth type on lamb body weight at birth, at 30 days, and at 90 days in Pirot Pramenka sheep was highly statistically significant ($P<0.001$), which is consistent with the results of this study. By comparing the results with those reported by Jevtić-Vukmirović et al. (2007), it was concluded that there are small differences in lamb body weight at all ages. Specifically, the difference in average body weight at birth was 0,19 kg, at 30 days it was 1,65 kg, and at 90 days it was 4,44 kg. The difference in average body weight at birth, at 30 and 90 days between the obtained results and those reported by Vujić (1997) for Sjenica Pramenka sheep ranged from 0,44 kg at birth, 1,05 kg at 30 days, and 3,57 kg at 90 days. Upon reviewing the results of Mekić et al. (2007) regarding the average body weight of Svrlijska Pramenka lambs at birth, compared to the obtained results for Sjenica Pramenka sheep, a less pronounced difference in lamb body weight at birth was observed, which was 0,24 kg for singles and 0,02 kg for twins. The difference in weight at birth between singles and twins of 0,92 kg in Svrlijska Pramenka sheep was highly statistically significant ($P<0,01$). Zeljić et al. (2021) emphasize that birth type had a highly statistically significant ($P<0,01$) influence on lamb body weight at birth, at 30 days, and at weaning in Bergamo sheep.

From the results presented in Table 4, it can be observed that gender did not have a statistically significant impact on lamb weight in all three monitoring periods, which is in line with the findings highlighted by Petrović et al. (2022), where gender did not exhibit a statistically significant effect in all three monitoring periods in the Sjenica breed.

Table 4. Influence of lamb gender on body weight from birth to weaning

Factor	N	BW at birth (kg)			N	BW at 30 days (kg)			N	BW at 90 days (kg)		
		$\bar{x}$	SD	CV (%)		$\bar{x}$	SD	CV (%)		$\bar{x}$	SD	CV (%)
Lamb gender	149	3.38	0.68	20.12	147	10.51	1.70	16.18	147	25.74	3.20	12.43
Male	69	3.47	0.71	20.46	67	10.52	1.78	16.92	67	25.94	3.23	12.45
Female	80	3.30	0.65	19.70	80	10.49	1.65	15.73	80	25.58	3.19	12.47
F exp.		2.279 ^{NS}				0.013 ^{NS}				0.456 ^{NS}		

^{NS} $p>0.05$

The body weight of male lambs was higher compared to female lambs at birth (0.17 kg), at 30 days (0.03 kg), and at 90 days (0.36 kg). The results obtained from the analysis of gender impact differ from those reported by Mekić et al. (2008b), Jevtić-Vukmirović et al. (2007), where they state that there is a highly statistically significant gender impact in all age groups ($P<0.001$). Ilić et al. (2013) also

emphasize that there is a significant gender impact on body weight in all age groups. Violeta Caro-Petrović et al. (2015) highlight that male lambs of all genotypes included in the study showed better growth efficiency compared to female lambs.

Table 5. Influence of ewe age on fertility

Age of ewes (month)	N	$\bar{X}$	SD	CV (%)	F exp.
do 8	35	1.19	0.40	33.61	3.562*
8 – 10	43	1.09	0.29	21.16	
10 – 12	28	1.18	0.39	33.05	
12 - 14	18	1.44	0.51	35.42	

* $P < 0.05$

Based on the values from the analysis presented in Table 5, it can be concluded that the age of ewes significantly influenced ewe fertility ($P < 0.05$), which differs in terms of significance compared to the research by Dimoski et al. (1999), where a highly statistically significant influence of age on fertility was determined ($P < 0.01$).

CONCLUSION

Based on the conducted research aimed at investigating the influence of ewe age at first mating, as well as other factors on the reproductive traits of ewes and the productive characteristics of lambs, we can conclude the following:

- The farm significantly influenced fertility ($P < 0.05$), and had a highly statistically significant impact on ewe body weight ($P < 0.001$).
- The influence of the farm on lamb body weight from birth to weaning was highly statistically significant in all monitoring periods ($P < 0.001$).
- The influence of birth type on lamb body weight from birth to weaning had a highly statistically significant impact in all three monitoring periods ($P < 0.001$).
- The influence of lamb gender on body weight from birth to weaning was not statistically significant in all three monitoring periods ($P > 0.05$).
- The age of ewes at their first mating significantly influenced the fertility of the ewes ($P < 0.05$) during their first lambing. Ewes aged 12 to 14 months at first mating exhibited the highest fertility, with a rate of 1.44, while those mated at ages 8 to 10 months showed the lowest fertility, with a rate of 1.09. Fertility in first-time mothers aged 12 to 14 months at mating significantly differed from those in the age groups of up to 8 months and 10 to 12 months ($P < 0.05$), and notably from those in the age group of 8 to 10 months ($P < 0.001$).

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