

Effect of some factors (parity, birth type and litter size) on the milk productivity in sheep from the Bulgarian Dairy Synthetic Population

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Citation: Stancheva, N., Angelova, T., Yordanova, D., & Krastanov, J. (2022). Effect of some factors (parity, birth type and litter size) on the milk productivity in sheep from the Bulgarian Dairy Synthetic Population. *Zhivotnovadni Nauki*, 59(6), 3-12 (Bg).

Abstract

The aim of the study was to determine the effect of some factors (parity, birth type and litter size) on milk productivity in the test-day (TDY), milk yield per milking period (TMM), average daily milk yield per milking period (ADMY^{milking period}) and milk yield per standard 120-day milking period (TMM¹²⁰) in sheep from the Bulgarian Dairy Synthetic population from the flock of the Agricultural Institute – Shumen. The data on the milk productivity of 1078 ewes born in 2007–2017 and produced in the period 2009–2020 were analyzed. The statistical analysis included fixed factors: parity, litter size in a specific lambing for each successive lactation, birth type, permanent environmental effect, effect on individual genetic value and effect caused by other unobserved factors. Mean values for TDY 0.903 ± 0.35 ; TMM 125.625 ± 40.16 ; The ADMY^{milking period} of 0.875 ± 0.25 and TMM¹²⁰ of 105.117 ± 30.22 were found at the suckling period of 51 ± 13.18 days and a milking period of 143 ± 19.79 days. A highly significant effect was found for the parity factor on all studied traits ($P \leq 0.001$). The birth type did not affect only the milk yield on the test day, and litter size had an effect only on the average daily milk yield for the milking period ($P \leq 0.05$).

Key words: sheep, Bulgarian Dairy Synthetic Population, milk yield, parity, birth type, litter size

Влияние на някои фактори (поредна лактация, тип на раждане и брой родени агнета) върху млечната продуктивност при овце от Синтетична Популация Българска Млечна

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Резюме

Целта на проучването беше да се установи ефектът на някои фактори (поредна лактация, тип на раждане на овцете и брой родени агнета от овца майка) върху млечната продуктивност в контролния ден (TDY), млечността за доен период (ТММ), средната дневна млечност за доен период ($ADMY^{\text{milking period}}$) и млечността за стандартен 120-дневен доен период (TMM^{120}) при овце от Синтетична популация българска млечна от стадото на Земеделски Институт – Шумен. Анализираха се данните за млечната продуктивност на 1078 броя овце майки, родени през 2007–2017 години и продуцирали в периода 2009–2020 години. Статистическият анализ включваше фиксираните фактори: поредна лактация, брой родени агнета от овца майка при конкретната агнилна кампания за всяка поредна лактация, тип на раждане на овцете, перманентен средови ефект, ефект на генетичната стойност на индивида и ефект причинен от други, ненаблюдавани фактори.

Средните стойности за TDY $0,903 \pm 0,35$; ТММ $125,625 \pm 40,16$; $ADMY^{\text{milking period}}$ $0,875 \pm 0,25$ и TMM^{120} $105,117 \pm 30,22$ бяха установени при бозаен период от $51 \pm 13,18$ дни и доен период от $143 \pm 19,79$ дни. Установен бе високодостоверен ефект на фактора поредна лактация върху всички изследвани признаци ($P \leq 0,001$). Типът на раждане на овцете не оказва ефект единствено върху млечността в контролния ден, а броят на родените агнета от овца имаше ефект само върху средната дневна млечност за доен период ($P \leq 0,05$).

Ключови думи: овце, Синтетична популация Българска млечна, млечна продуктивност, поредна лактация, тип на раждане, брой родени агнета

Introduction

The favorable natural and climatic conditions of Bulgaria and the various needs of the local population have allowed the creation of a large number of sheep breeds. They are grown both in the plains and in the mountainous and semi-mountainous areas, providing livelihood to a large part of the population in the rural areas.

According to the data of the Agro statistics Department of the Ministry of Agriculture, the total number of sheep in the country as of November 1, 2020 is 1,307,771, of which 975,531 are dairy sheep.

In the annual report of the Ministry of Agriculture, the Executive Agency for Selection and Reproduction in Livestock Breeding provides data that in 2020, information on 2,068 flocks with 355,846 animals was entered in the Register of Breeding Flocks, and 341,209 animals of 33 breeds were recorded as sheep under selection (local – 20 Bulgarian; commercial – 4 Bulgarian and 9 imported).

Of these, 161,652 sheep belong to the Bulgarian Dairy Synthetic Population (BDSP), registered in 2005. Due to their good adaptability and potential for high milk yield, they are spread throughout the country. The number of representatives of local and imported dairy breeds, which supplement dairy sheep farming in Bulgaria, is significantly smaller.

The sheep from BDSP and the other Bulgarian dairy breeds are mainly raised in low-investment, semi-intensive and extensive production systems. The average suckling period is within 55–65 days and limits the amount of milk produced (Hinkovski et al., 2008; Ivanova, 2013; Miteva, 2022; Stancheva et al., 2018; Zhelyazkova et al., 2014). This in itself means that in such breeding conditions, the realization of high milk productivity is hardly feasible. Milk productivity is known to be a genetic and individual trait, significantly influenced by both genetic and non-genetic factors and the environment (Alkass and Akreyi, 2016; Assan, 2020; Carta et al., 2009; Dikmen et al., 2007; Djibirski et al., 2006; Ja-

wasreh and Khasawneh, 2007; Libis-Márta, et al., 2021; Oravcova et al., 2006, 2007; Pacinovski et al., 2012, 2016; Pulina et al., 2007; Robles Jimenez et al., 2020; Selvaggi et al., 2017). Factors such as age, month of lambing, parity and duration of lactation, suckling period, type of birth, litter size, year of birth and production, play a key role in the phenotypic variation of milk productivity traits and the expression of genetic potential of sheep. This provoked the conduct of the present study in sheep from the main nucleus flock of the Synthetic population.

The aim of the study was to determine the effect of some factors (parity, type of birth and litter size) on test day milk yield (TDY), milk yield per milking period (TMM), average daily milk yield for milking period ($ADMY_{\text{milking period}}$) and the milk yield for a standard 120-day milking period (TMM^{120}) in ewes from the Bulgarian Dairy Synthetic population from the flock of the Agricultural Institute – Shumen.

Material and methods

Subject of the study were 1078 ewes (11 generations) from the Bulgarian Dairy Synthetic Population, raised at the Agricultural Institute – Shumen. The flock was created according to a kind of modified scheme, as a genealogical structure was formed and built already at the stage of the applied crossing schemes (Stancheva, 2003; Stancheva et al., 2014, 2016, 2017). For more than 30 years, "interlinear breeding" has been carried out with rams of our own production, applying homogeneous selection combined with moderate inbreeding. The sheep were divided into 3 flocks and were raised in a semi-intensive system. Young animals were kept separately until they reached 18 months and entered the main flock. Their feed was our own production. The breeding process took place as standard – once a year, in the months of June–July. Sheep were artificially inseminated according to an individual plan at random at 18 months after the formation of the flocks. Lambing was usually performed from the second half of November and ends by the middle of January. Milking was mechanized and took

place twice, after the lambs were weaned. The suckling period was between 55–60 days, and the duration of the milking period was between 150–180 days.

Milk yield

A total of 15,306 records of milk yield on the test day from the monthly controls are included in the study, as well as 3,231 records of milk yield per milking period, average daily milk yield per milking period, duration of suckling and milking periods, and 3,101 records of milk yield for a standard 120, daily milking period of ewes born in 2007–2017 years and produced in 2009–2020 years.

The milk yield data were obtained by measuring the amount of milk in liters milked during the lactation period of the animals according to the AC method specified in the nomenclature of the International Animal Control Committee (ICAR) and correspond to a total of 3231 lactations of the sheep during the indicated period. The first monthly controls were carried out in the months of December–February (within 4–15 days after the start of milking of the herd and up to 52 days after the weaning of the lambs, for each ewe), and the last – in May and June. The milk yield of each sheep for the test day (TDY) is the amount of milk in the morning individual control multiplied by the coefficient of the herd ($K = \text{morning} + \text{evening milk} / \text{morning milk}$). The flock coefficient is valid only for the test period during which the test was carried out. Milk yield per milking period (TMM) is the sum of the milk yield from the individual control periods of each ewe. The average daily milk yield for a milking period ($ADMY_{\text{milking period}}$) is the amount of milk received per milking period divided by the duration of the milking period in days. Milk yield for a standard 120-day milking period (TMM^{120}) is the average daily milk yield for a milking period multiplied by 120 days ($TMM^{120} = ADMY_{\text{milking period}} * 120$). TMM^{120} is calculated only for ewes with a milking period of not less than 120 days.

The average statistical parameters of the studied traits were established and the dynamics of

some of them were followed: test day milk yield (TDY), milk yield per milking period (TMM), average daily milk yield for a milking period ($ADMY_{\text{milking period}}$) and milk yield for a standard 120-day milking period (TMM^{120}) depending on:

- Birth type of the sheep – singles, twin, triplets;
- Litter size of one ewe – 1, 2, 3, 4.
- Consecutive lactation – from the 1st to the 7th lactations;

The obtained results were processed using the software Statistica.

A mathematical model was used based on the scientific hypothesis that milk productivity depends on fixed factors – consecutive lactation, litter size from one ewe during the specific lambing for each consecutive lactation, type of birth of the sheep (singles, twins, triplets), permanent environmental effect in the flock, effect of genetic value of the individual and effect caused by other, unobserved factors.

The following linear model was used to establish the variance components of the studied traits characterizing milk productivity:

$$\text{Milkday}_{ijklmn} = \text{parity}_i + \text{broilamb}_j + \text{tbs}_k + \text{animal}_l + \text{pe}_m + e_{ijklmn}$$

where:

- Milkday_{ijklmn} – n^{th} milk yield;
- parity_i – fixed effect of the i^{th} consecutive lactation;
- broilamb_j – the j^{th} litter size in a specific lambing, for each successive lactation
- tbs_k – fixed effect of the k^{th} type of sheep birth – 1 – singles, 2 – twins, 3 – triplets;
- animal_l – the l^{th} animal;
- pe_m – m^{th} permanent environmental effect;
- e_{ijklmn} – effect caused by unobserved factors.

Results and discussion

For dairy sheep, length of milking period is an important systematic source of environmental variation and variability in milk productivity. There are breeding systems (Israel, Germa-

ny) where the lambs are removed from the ewes immediately after lambing, so that the ewes are milked throughout lactation. In most sheep breeds, milk yield is calculated considering only milk yield during the milking period (Carta et al., 2009).

The milk productivity for the sheep from the Bulgarian Dairy Synthetic population is determined for a 120-day standard milking period. The statistical parameters for the studied traits of milk productivity for the period 2009–2020 are shown in Table 1. The average values for milk yield on the test day (TDY) $0.903 \text{ l} \pm 0.35$; milk yield per milking period (TMM) $125.625 \text{ l} \pm 40.16$; average daily milk yield for a milking period ($ADMY_{\text{milking period}}$) $0.875 \text{ l} \pm 0.25$ and milk yield for a 120-day standard milking period (TMM^{120}) $105.117 \text{ l} \pm 30.22$ were obtained with a suckling period of 51 ± 13.18 days and duration of the milking period of 143 ± 19.79 days. In terms of milk yield over a 120-day standard milking period, the ewes meet the minimum selection limit for the population's Elite class of 105 l, but the level achieved is well below the set breeding target of 150 l. The high standard deviations and significant differences between the established minimum and maximum values are characteristic of this kind of studies, but they are also indicative of the fact that there are significant reserves in the breeding activity carried out and the management of the production system on the farm. The obtained results are higher than those established for the full productive life of 628 ewes from the same flock for the period 2009–2019 (TDY $0.880 \text{ l} \pm 0.35$; TMM 119.868 ± 37.56 and TMM^{120} $103.177 \text{ l} \pm 29.84$), (Stancheva et al., 2021). A probable reason for this is the increase in the array of data for the studied traits, with data on the productivity of the new 5 generations of sheep (509 pcs.), produced in the period 2015–2020. Higher values for the trait of milk yield for a standard 120-day period (110.21l) were reported by Hinkovski et al. (2008) for the flock of the Institute for Animal Sciences – Kostinbrod for the year 2007, which could be explained by the influence of environmental conditions and the smaller number of animals involved in the study. Zhelyazkova et al. (2014) reported that the total

milk productivity of BDSF sheep in two private farms from the Plovdiv region was 120.09 l for a 119-day milking period. Here, we must clarify that only sheep in the 1st and 2nd lactations were included in the study, and the milking period is limited by the number of controls performed, which in most cases is 4.

The results for the studied traits of milk productivity according to the type of birth of sheep show a certain superiority of animals born as twins and triplets (Table 2). The mean values for milk yield on the test day, milk yield per milking period, average daily milk yield per milking period and milk yield per 120-day standard milking

period for these groups of ewes were above or close to the general population averages. They cover the selection limits for the Elite class for milk yield for a 120-day standard milking period (106.532 l and 106.025 l).

According to the litter size, the values of the investigated traits were generally above or close to the general averages in the ewes that gave birth to 2 or 3 lambs (Table 3). These two groups of sheep also cover the selection limits for the Elite class of the population in terms of milk yield for a 120-day standard milking period (106,381 l and 106,580 l). We should also note that the milk yield for the 120-day standard milking period

Table 1. Statistical parameters for some traits of the milk productivity (period 2009–2020 years)

Таблица 1. Статистически параметри за някои признаци на млечната продуктивност (период 2009–2020 години)

Traits / Признаци	n	x	SD	min	max
Suckling period, (days) / Бозаен период	3231	51	13.18	15	97
Milking period, (days) / Доен период	3231	143	19.79	58	213
TDY, (l) / Млечност за контролен ден	15 306	0.903	0.35	0.200	3.143
TMM, (l) / Млечност за доен период	3231	125.63	40.16	39.600	308.611
ADMY ^{milking period} , (l) / Средна дневна млечност за доен период	3231	0.875	0.25	0.303	2.072
TMM ¹²⁰ , (l) / Млечност за 120-дневен стандартен доен период	3101	105.12	30.22	36.303	248.656

(TDY) – Test-day milk yield; (TMM) – Milk yield per milking period; (ADMY^{milking period}) – Average daily milk yield per milking period;

(TMM¹²⁰) – Milk yield per standart 120^{-day} milking period

Table 2. Statistical parameters for some traits of the milk productivity by type of sheep birth (period 2009–2020 years)

Таблица 2. Статистически параметри за някои признаци на млечната продуктивност според типа на раждане на овцете (период 2009–2020 години)

Traits / Признаци	Singles / Единаци			Twins / Близнаци			Triplets / Тризнаци		
	n	x	SD	n	x	SD	n	x	SD
TDY, (l) / Млечност за контролен ден	5 952	0.888	0.35	8951	0.914	0.36	403	0.904	0.33
TMM, (l) / Млечност за доен период	1294	122.220	40.56	1855	128.01	40.11	82	124.768	30.27
ADMY ^{milking period} , (l) / Средна дневна млечност за доен период	1294	0.856	0.25	1855	0.888	0.25	82	0.885	0.21
TMM ¹²⁰ , (l) / Млечност за 120-дневен стандартен доен период	1205	103.004	30.54	1816	106.532	30.13	80	106.025	25.33

(TDY) – Test-day milk yield; (TMM) – Milk yield per milking period; (ADMY^{milking period}) – Average daily milk yield per milking period;

(TMM¹²⁰) – Milk yield per standart 120^{-day} milking period

of the ewes born as singles (103.004 l) and the ewes that gave birth to 1 lamb each (104.125 l) exceeds the requirements for the 1st class of 95 l and approaches the limit of 105 l for the Elite class of the population. Our results correspond with the studies of Abecia, J. and C. Palacios (2018); Kasap et al. (2019); Miteva (2022); Prpić et al. (2016); Robles Jimenez et al. (2020), Selvaggi, et al. (2017), who also found that ewes that gave birth to 2 or more lambs have higher milk productivity.

A number of our and foreign researchers reported that the milk productivity of sheep depends on parity, being the lowest in the first lactation and increases in subsequent successive lactations (Hinkovski, et al., 2008; Ivanova, 2013; Iliev et al., 2021; Kasap et al., 2019; Miteva, 2022; Slavova et al., 2015; Robles Jimenez et al., 2020; Selvaggi, et al., 2017; Sezenler et al., 2016). Our results for the studied traits by parity generally did not follow a similar trend (Table 4). Mean values for test day milk yield, milk yield per milking period, average daily milk yield and 120-day standard milk yield increased steadily until the 3rd lactation of ewes and were higher than the overall popula-

tion averages. The insignificant differences in the milk yield of the animals between the 1st and the 2nd lactation simultaneously indicate that the selection, teaming and selection of the sheep were carried out in a positive direction and the animals showed their genetic potential for high milk yield already in the 1st lactation and that at their first lambing the ewes were well developed. Similar results were found by Pollott and Gootwine (2004) in sheep of the Assaf breed and Elvira et al. (2012) in the Lacaune breed. Although the ewes from the 1st to the 3rd lactations cover the selection limits for the Elite class in terms of milk yield for a 120-day standard milking period (106.280 l, 106.424 l and 107.784 l), we must note that there is much to be desired in relation reaching more significant positive differences in milk productivity values. In the next two lactations, the average values of the studied traits decrease, but the milk yield reached for a 120-day standard milking period still approaches the population Elite class limit in ewes of the 4th lactation (103.887 l) and exceeds the requirements for the first class at the animals of the 5th lactation (99.328 l). We find a significantly lower milk productivity in the animals of the sixth and

Table 3. Statistical parameters for some traits of the milk productivity by litter size (period 2009–2020 years)
Таблица 3. Статистически параметри за някои признаци на млечната продуктивност според брой родени агнета от овца (период 2009–2020 години)

Признаци / Traits	1 lamb / 1 агне			2 Lambs / 2 агнета			3 Lambs / 3 агнета			4 Lambs / 4 агнета		
	n	x	SD	n	x	SD	n	x	SD	n	x	SD
TDY, (l) / Млечност за контролен ден	8386	0.893	0.35	6643	0.916	0.36	247	0.887	0.36	30	0.833	0.24
TMM, (l) / Млечност за доен период	1782	124.78	39.86	1393	126.81	40.59	50	123.92	39.79	6	118.333	32.23
ADMY ^{milking period} , (l) / Средна дневна млечност за доен период	1782	0.867	0.25	1393	0.886	0.25	50	0.888	0.28	6	0.79	0.15
TMM ¹²⁰ , (l) / Млечност за 120-дневен стандартен доен период	1707	104.13	30.08	1338	106.38	30.29	50	106.58	33.67	6	95	18.21

(TDY) – Test-day milk yield; (TMM) – Milk yield per milking period; (ADMY^{milking period}) – Average daily milk yield per milking period;

(TMM¹²⁰) – Milk yield per standart 120^{-day} milking period

Table 4. Statistical parameters for some traits of the milk productivity by parity (period 2009–2020 years)
Таблица 4. Статистически параметри за някои признаци на млечната продуктивност по поредна лактация (период 2009–2020 години)

Traits / Признаци	Parity / Поредна лактация				
	n	x	SD	min	max
1 st lactation / 1 ^{-ва} лактация					
TDY, (l) / Млечност за контролен ден	4 692	0.922	0.35	0.200	2.575
TMM, (l) / Млечност за доен период	1078	126.400	40.87	40.000	297.000
ADMY ^{milking period} (l) / Ср. дн. млечност за доен период	1078	0.885	0.25	0.322	1.822
TMM ¹²⁰ (l) / Млечност за 120-дневен стандартен доен период	1025	106.280	29.78	39.000	219.000
2 nd lactation / 2 ^{-ва} лактация					
TDY, (l) / Млечност за контролен ден	4356	0.905	0.35	0.200	2.803
TMM, (l) / Млечност за доен период	867	127.080	38.15	46.000	269.000
ADMY ^{milking period} (l) / Ср. дн. млечност за доен период	867	0.887	0.24	0.382	1.842
TMM ¹²⁰ (l) / Млечност за 120-дневен стандартен доен период	843	106.424	29.20	46.000	221.000
3 rd lactation / 3 ^{-та} лактация					
TDY, (l) / Млечност за контролен ден	2933	0.929	0.36	0.200	3.143
TMM, (l) / Млечност за доен период	601	127.73	40.88	45.000	309.000
ADMY ^{milking period} (l) / Ср. дн. млечност за доен период	601	0.898	0.26	0.345	2.072
TMM ¹²⁰ (l) / Млечност за 120-дневен стандартен доен период	583	107.78	31.24	41.000	249.000
4 th lactation / 4 ^{-та} лактация					
TDY, (l) / Млечност за контролен ден	1648	0.887	0.36	0.286	2.456
TMM, (l) / Млечност за доен период	337	127.44	39.20	41.000	227.000
ADMY ^{milking period} (l) / Ср. Дн. млечност за доен период	337	0.863	0.25	0.343	1.743
TMM ¹²⁰ (l) / Млечност за 120-дневен стандартен доен период	321	103.89	30.09	41.000	209.000
5 th lactation / 5 ^{-та} лактация					
TDY, (l) / Млечност за контролен ден	982	0.852	0.35	0.200	2.720
TMM, (l) / Млечност за доен период	197	123.81	41.95	40.000	236.000
ADMY ^{milking period} (l) / Ср. дн. млечност за доен период	197	0.827	0.25	0.303	1.469
TMM ¹²⁰ (l) / Млечност за 120-дневен стандартен доен период	186	99.328	30.36	36.000	176.000
6 th lactation / 6 ^{-та} лактация					
TDY, (l) / Млечност за контролен ден	573	0.767	0.35	0.359	2.568
TMM, (l) / Млечност за доен период	124	106.21	36.31	43.000	220.000
ADMY ^{milking period} (l) / Ср. Дн. млечност за доен период	124	0.766	0.25	0.385	1.415
TMM ¹²⁰ (l) / Млечност за 120-дневен стандартен доен период	115	91.771	29.80	46.000	170.000
7 th lactation / 7 ^{-ма} лактация					
TDY, (l) / Млечност за контролен ден	117	0.658	0.31	0.200	1.974
TMM, (l) / Млечност за доен период	27	84.44	32.18	40.000	163.000
ADMY ^{milking period} (l) / Ср. дн. млечност за доен период	27	0.629	0.20	0.364	1.024
TMM ¹²⁰ (l) / Млечност за 120-дневен стандартен доен период	26	75.04	24.50	44.000	123.000

(TDY) – Test-day milk yield; (TMM) – Milk yield per milking period; (ADMY^{milking period}) – Average daily milk yield per milking period;

(TMM¹²⁰) – Milk yield per standart 120^{-day} milking period

seventh lactations, as the milk yield for a 120-day standard milking period (91.777 l and 75.040 l) did not cover the selection limits for the first class of the population.

In summary, we can say that the total milk productivity of the flock for a 120-day standard milking period corresponded to the selection limits for the Elite class of the population. It also keeps its high values in the animals born as twins and triplets, which gave birth to 2 and 3 lambs and in sheep from the 1st to the 3rd lactations. The observed decrease in the milk productivity of the following lactations probably stems both from the change of various environmental and technological factors, as well as from untimely removal of the lower productive animals according to milk yield, after the 1st to 3rd lactations. Due to the fact that sheep are expected to produce a greater number of lambs, the possible reason for these decisions is their higher fertility.

Variance component analysis reports a highly significant effect of the consecutive lactation factor on all the studied traits. The influence of the factor of type of birth on milk yield per lactation period, average daily milk yield per milking period and milk yield over a 120-day standard milking period ($P \leq 0.001$) is similar (Table 5). The litter size as a factor has a significant effect only on the trait average daily milk yield for milking period ($P \leq 0.05$).

Conclusions

- The total milk productivity of sheep for a 120-day standard milking period (105.117 l \pm 30.22), in the period 2009–2020, corresponds to the minimum threshold limit for the Elite class of the population. It also maintains high values in animals born as twins and triplets, which gave

Table 5. F-criterion for the analysis of variance for some milk productivity traits

Таблица 5. F-критерий на достоверност при анализа на варианса за някои признаци на млечната продуктивност

Sources of variation / Източници на вариране	Traits / Признаци	Effect	df	MS	df	MS	F
	(F/R)	Effect	Effect	Error	Error		
Млечност за контролен ден / TDY, (l)							
Birht type / Тип на раждане	Fixed	1	0.357	2860.409	0.143	2.491	
Parity / Поредна лактация	Fixed	7	1.115	3029.915	0.143	7.782***	
Litter size / Брой родени агнета от овца	Random	3	0.117	3047.000	0.143	0.819	
Млечност за доен период / TMM, (l)							
Birht type / Тип на раждане	Fixed	1	24671.78	3015.121	1453.169	16.977***	
Parity / Поредна лактация	Fixed	7	12035.95	3048.426	1459.147	8.248***	
Litter size / Брой родени агнета от овца	Random	3	573.54	3047	1462.984	0.392	
ADMY ^{milking period} , (l) / Средна дневна млечност за доен период							
Birht type / Тип на раждане	Fixed	1	0.579	2603.884	0.062	9.348559***	
Parity / Поредна лактация	Fixed	7	0.570	2988.840	0.062	9.219055***	
Litter size / Брой родени агнета от овца	Random	3	0.078	3047.000	0.062	4.268746*	
Млечност за 120-дневен стандартен доен период / TMM ¹²⁰ , (l)							
Birht type / Тип на раждане	Fixed	1	7619.361	2709.3	891.9677	8.542193***	
Parity / Поредна лактация	Fixed	7	8406.771	3006.955	891.3827	9.431158***	
Litter size / Брой родени агнета от овца	Random	3	978.071	3047	891.007	1.097714	

birth to 2 and 3 lambs, and in sheep from the 1st to the 3rd lactations.

• A highly significant effect of the factor type of birth on milk yield per milking period, average daily milk yield per milking period and milk yield over a 120-day standard milking period, as well as for the factor parity, was found on all studied traits. The litter size has a significant effect only on the trait average daily milk yield for milking period.

Acknowledgements

This study became possible thanks to Project G 106 "Possibilities for acceleration of genetic progress through achievement of continuous evaluation of breeding value in sheep from Bulgarian Dairy Synthetic Population" to the Agricultural Academy.

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