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MILK YIELD AND MORPHOLOGICAL CHARACTERISTICS OF THE UDDER OF SHEEP FROM THE BREED LACAUNE IN BULGARIA

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Abstract

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The study was conducted with 50 ewes from the breed Lacaune imported from France. The imported animals (female lambs at 5 months of age) were inseminated at 9-10 months of age, after reaching live weight around 50 kg, after synchronization of the estrous cycle and artificial insemination. After the birth and weaning of the lambs, a test on the milk yield was conducted according to the Method AC by ICAR. It was established that the studied sheep had a very good milk yield – an average 213.29 L for the 150 days milking period. The highest was the milk yield on the first test day – an average 2.279 L, with maximum deviation 3.310 L. A 77% of the ewes had a milk yield over 180 L, a relatively smaller part (6.5%) had a milk yield under 150 L, while 14.5% of the ewes had a milk yield over 270 L, and the maximum value was 298.38 L. The milk of the studied animals had a very high content of dry matter (20.06%), fat (7.60%), and protein (7.09%) and excellent technological qualities. The total number of microorganisms was 754 000 CFU g/mL, and the somatic cells count – 147 000 CFU g/mL. From the studied animals 56.3% had a normal udder, 41.7% had an udder bigger than normal and there was only one animal with a registered small udder. 52.1% of all the ewes had udders with low lateral teat placement, 10.4% - with high lateral teat placement, and 33.3% - with very high lateral teat placement. The main measurements, used to characterize the udder of the studied animals had values similar to those of some of the best modern dairy breeds. The udder width of the ewes was 12.35 cm, the depth - 16.85 cm, and the circumference - 41.46 cm. The teat length was 2.70 cm, the teat width was 1.38 cm and the distance between teats – 15.78 cm.

Key words: Lacaune dairy sheep, milk yield, milk composition, udder measurements

Introduction

The breed Lacaune is the main and most popular dairy sheep breed in France and one of the most milk yielding breeds in the world. According to data from ICAR (2014) in France were raised about 890 000 sheep from the breed Lacaune in 2500 flocks, and the controlled part of the population was 172 462 sheep in 366 flocks. On average from the ewes at first lactation the milk yield is 237 L (for 149 days), and from the grown ewes (at second and more lactations) – about 306 L (for 174 days).

As a result of the wide use of artificial insemination (in about 85% of the population), the constant improvement of the Selection program and the updating of the selection indexes, a high yearly genetic progress in milk yield has been recorded – an average 5.8 L, which led to a 110 L increase for a period of 20 years. At the same time for that period there has been an increase in butterfat and milk protein, respectively 0.19 g/L and 0.16 g/L on average per year (Barillet et al., 2009).

During the last 30 years regularly were changed and improved the breeding purposes, as well as the type of the selection index – the number of included traits. Larroque (2011) indicates that until 1985 the selection of the breed Lacaune was only according to milk yield (MY), in 1985-1990 there was included the amount of protein yield (MY + PY); during the period 1990-2005 to them were added the fat content (F%) and protein content (P%), giving the index the following look

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- MY + PY+F%+P%; after 2005 the traits somatic cell count and udder assessment (U) were added, giving the index the following look MY+PY+F%+P%+SCC+U. The economic weight of each of the selection traits had also shifted - where in the beginning the milk yield was 100% of that weight, in the last period the milk yield trait was only 50%, and the other 50% were comprised of the rest of the traits.

Sheep from the breed Lacaune were first imported in Bulgaria in 2007. The imported animals (120 ewes and 5 rams) were placed in the region of town Elhovo. There is an increased interest in the Lacaune breed in Bulgaria in recent years, and as a result the number of purebred animals at the moment is more than 10 000.

The aim of the present study was to analyse the milk yield and morphological characteristics of the udder of sheep from the breed Lacaune, raised in Bulgaria.

Material and methods

In order to achieve the established aim 50 ewes from the Lacaune breed imported from the Roquefort region in South France were used. The imported animals (female lambs at 5 months of age) were placed in a base of the company Verde Foods, village Tsalapitsa, Plovdiv Province, where they were barn raised yearly similar to the technology used in France. Standardized feeding of the animals with lucerne, meadow hay and concentrated feed in quality and content, suitable for their physiological condition, was applied.

At 9-10 months of age, after reaching live weight around 50 kg, the ewes were inseminated, after synchronization of the estrous cycle and artificial insemination with semen from the 5 rams, also imported from France. After the birth and weaning of the lambs (at 35-40 days of age), the studied animals were machine milked with a milking parlour 1 X 12 and were included in a system for individual control, analogical to the one applied in the selection flocks for the breed Lacaune in France.

During the testing of the milk yield was used the Method AC (by ICAR, 2011). During the milking period each of the studied animals passed five individual test days (one each month), on the basis of which was calculated their milk yield for a 150 days milking period.

On the third test day of the milk yield of all ewes individual samples in order to determine the composition of the milk were taken. The analysis was made with "Milkoscan 133" according to the following traits: fat content, %; protein content, %; lactose content, %; and solid non-fat, %.

Along with the indicated individual samples, the composition of the milk and some of its most important technological characteristics, as well as the somatic cell count (CFU g/mL) and the total number of microorganisms (CFU g/mL), were determined for a composite sample of milk. The indicated analysis was conducted according to the classic reference methods.

During the individual expert assessment of the sheep (between the 90th and 120th day after lambing) were expertly determined some of the morphological characteristics of the udder, related to the compatibility for machine milking (udder size and teat placement).

Between the 110th and 120th day after lambing (before morning milking) were measured the udders of the studied ewes. With the use of Wilkens' compass, centimeter tape, and caliper were taken the following measurements: 1) Udder width; 2) Udder depth; 3) Udder circumference; 4) Teat length; 5) Teat width; 6) Distance between teats.

The statistical data analysis was made with the software package Statistica for Windows 2010.

Results and Discussion

On Table 1 are presented the summarized data for the obtained milk during the conducted five individual test days. The received results showed that the milk yield of the studied

Table 1
Milk yield of sheep

Traits	x ± Sx	C	min	max
1. Milk yield for 1-st test day, L	2.279 ± 0.064	19.57	1.608	3.310
2. Milk yield for 2-nd test day, L	1.601 ± 0.060	25.92	0.634	2.457
3. Milk yield for 3-th test day, L	1.349 ± 0.056	28.85	0.635	2.858
4. Milk yield for 4-th test day, L	1.061 ± 0.054	35.56	0.313	1.878
5. Milk yield for 5-th test day, L	0.608 ± 0.050	56.58	0.150	1.422
Milk yield for 150 days milking period, L	213.29 ± 0.631	20.49	139.29	298.38

animals was good, and as a result the average milk yield for the 150 days milking period was 213.29 L. Similar milk yield (around 210 L) indicates Oravcova (2015) for the controlled flocks of the breed Lacaune in Slovakia. Such milk yield, for some of the Bulgarian dairy breeds, like the Bulgarian Dairy Synthetic Population and Pleven Blackhead sheep, can be achieved for about a 200 days milking period (Stancheva, 2003; Panayotov et al., 2008).

The daily milk yield of the tested sheep for the first test day was the highest – an average 2.279 L, and for some of the animals the milk yielded was more than 3.000 L (maximum 3.310 L). On the second test day the average milk yield had decreased with 680 mL in comparison to the first, and on the third, fourth and fifth – respectively with 260, 290 and 460 mL in comparison to the previous test days.

The results from the five individual test days showed that the majority of the sheep reached their maximum milk yield on the first test day. If we accept the milk yield from the first test day as 100%, then the average milk yield on the second test day was 73%, on the third – 60%, on the fourth – 48%, and on the fifth – 27%. Despite the clearly defined and reliable tendency ($p<0.001$) for a decrease in the average milk yield on every following test day, it was observed that some of the animals maintained their milk yield significantly over the indicated average values, which was an indicator for the stability of the lactation.

The distribution of sheep according to their milk yield for the 150 days milking period (Fig. 1) showed that 77% of the ewes had a milk yield over 180 L and only 6.3% a milk yield under 150 L while 14.5% had a milk yield over 270 L, with a maximum value of 298 L.

The composition and characteristics of the obtained milk are of great significance to the dairy industry, because of their defining influence on the technological indicators of the produced dairy products. With regard to this, some of the milk indicators, like butterfat, protein and the somatic cell count (SCC) have been accepted as basic selection traits and are used for the selection in modern dairy sheep farming.

The summarized results for the composition of milk of the analysed individual samples (Table 2) showed that the milk of the studied ewes had a very high content of fat and protein, respectively 7.60% and 7.09%. Significantly lower values for these traits received Oravkova et al. (2007), respectively 6.97% for fat and 5.62% for protein content in the milk of sheep from the breed Lacaune in Slovakia. According to content of fat, some of the dairy breeds used in Bulgaria were near the indicated value, while their protein content was significantly lower.

In studies of the Pleven Blackhead sheep made by Panayotov et al. (2008), from the first to the fourth test day the fat content of the milk varied from 5.96 to 7.64%, and the pro-

Table 2
Milk composition (individual samples)

Traits	Number	x ± Sx	C
1. Fat, %	46	7.60 ± 0.115	10.25
2. Protein, %	46	7.09 ± 0.130	12.42
3. Lactose, %	46	3.67 ± 0.056	10.38
4. Solid non fat, %	46	11.42 ± 0.082	4.86

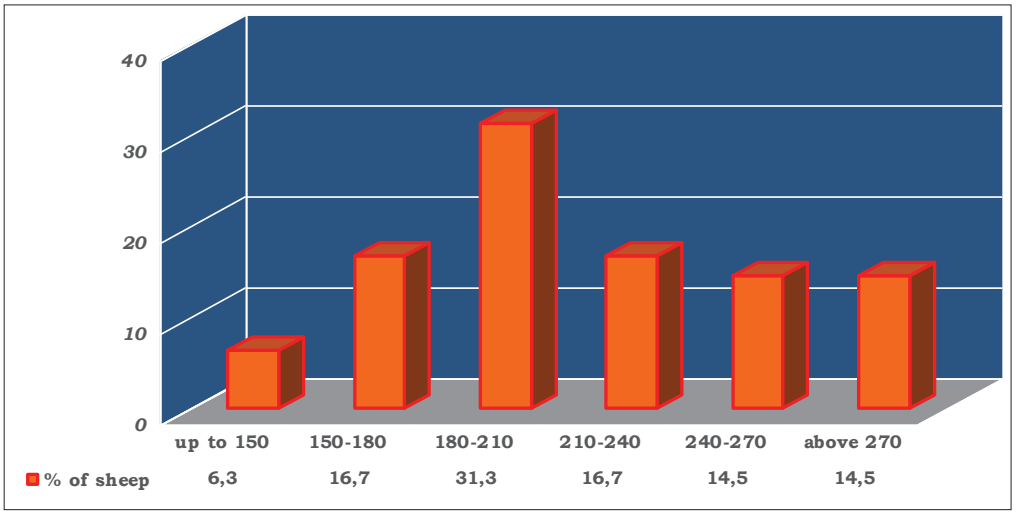

Fig. 1. Sheep distribution according to milk yield

tein – from 5.70 to 6.19%. De la Fuente et al. (2006) determined for the Assaf breed in Portugal and Spain – 7.2% and 6.82% fat content; 5.5% and 5.43% protein content, and for the breeds Churra and Awassi, respectively 7.24% and 6.97% fat content and 5.62% and 5.45% protein content. The higher content of protein in the milk of the studied sheep could be explained with the prolonged selection of the Lacaune breed according to milk composition, where protein is the main selection trait.

The results for the composition and technological characteristics of milk, received during the analysis of the composite sample also showed that the milk of the studied ewes had very good indicators (Table 3).

The active acidity of milk (pH) was 6.57 and the titratable acidity – 16°T – significantly lower than the permitted levels. The density of milk was also within the permitted levels – 1.032 g/cm^3.

The milk had a very high content of dry matter – 20.06% and solid non-fat – 13.46% (around 2% higher than the one received from the individual samples). The content of fat and protein was insignificantly lower than the one received from the individual samples, respectively – 7.48% and 6.81%.

The total number of microorganisms and the somatic cells count are significant indicators for the purity of the produced milk and for the health of the udder of the studied animals. The total number of microorganisms in the analysed milk was 754 000 CFU g/mL, or two times lower than the permitted levels for sheep milk.

Almost three times lower than the permitted levels was also the determined somatic cells count (SCC) – 147 000 CFU g/mL. These results are proof for the high quality of hygiene of the milk production in the studied farm and for the lack of mastitis in the studied sheep. Significantly higher than these results received De la Fuente et al. (2006) when studying the milk of the breeds Churra, Assaf and Awassi in Spain, respectively 700 000, 800 000 and 900 000 CFU g/mL.

The morphological characteristics of the udder and the teat placement were also of great significance for the milk yield of the ewes and their suitability for machine milking.

The summarized data from the expert assessment of the udder, made during individual assessment of the ewes (Fig. 2) showed that 56.3% of the studied ewes had a normal udder (B). While 41.7% had an udder bigger than normal (B+), which is typical (desirable) for the specialized dairy breeds, where the selection is purposefully in that direction, and there was only one with a registered small udder (B-).

In the present study a modified system for expert assessment of udder teat placement was used, which included the following placements: 1) Vertical teat placement; 2) Low lateral teat placement; 3) High lateral teat placement; 4) Very high lateral teat placement; 5) Asymmetric udder.

The udders of 52.1% of the ewes were with low lateral teat placement – placement, near the ideal one for machine milking (Fig. 3). Unfortunately, however, vertical teat placement was not registered for any of the studied animals. A 10.4% of the sheep had udders with high lateral teat placement, and

Table 3
Composition and technological characteristics of the milk (composite sample)

Parameters	Values	Permitted levels
1. Active acidity, pH	6.57	-
2. Titratable acidity, °T	16.0	21 – 23 °T
3. Density, g/cm^3	1.032	≤ 1.032
4. Dry matter, %	20.06	-
5. Milk fat, %	7.48	≤ 6.5%
6. Protein, %	6.81	≤ 5.2%
7. Lactose, %	3.90	-
8. Solid non fat, %	13.46	≤ 10%
9. Total number of microorganisms, CFU g/mL	754 000	Up to 1 500 000
10. Somatic cells count, CFU g/mL	147 000	Up to 400 000

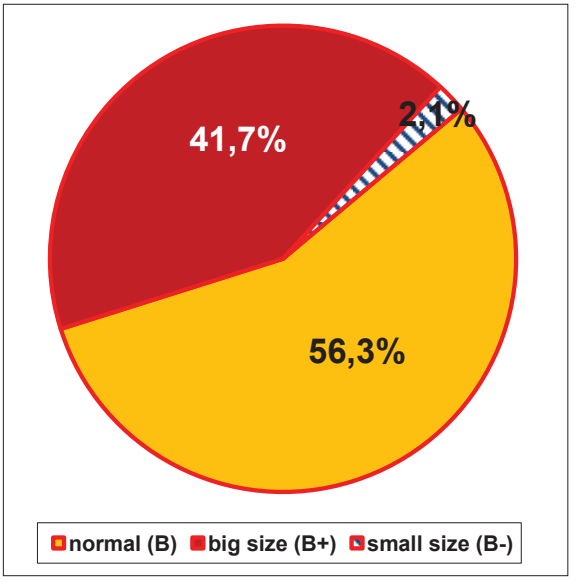

Fig. 2. Sheep distribution according to udder size

33.3% - with very high lateral teat placement. It was discovered that udders with those two types of teat placement and especially the latter were not suitable for machine milking, because they required additional interference in the milking process with regard to the normal flow and the full milking of the ewes. Two of the studied animals had unevenly developed halves of the udder, i.e. asymmetric udder.

On Table 4 are shown the results from the measurements of the udder. The data showed that some of the main measurements, used to characterize the udder of the studied ewes had values similar to those indicated by authors in recent years for the most widely used specialized dairy breeds – Lacaune and Assaf.

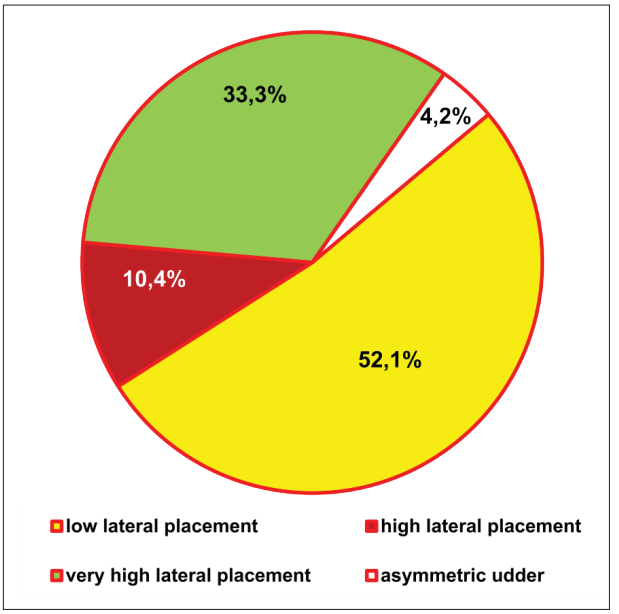

Fig. 3. Sheep distribution according to udder teat placement

Table 4
Udder measurements of sheep

Traits	x ± Sx	C
1. Udder width, cm	12.35 ± 0.349	5.04
2. Udder depth, cm	16.85 ± 0.300	12.31
3. Udder circumstance, cm	41.46 ± 0.417	6.97
4. Teat length, cm	2.70 ± 0.076	19.58
5. Teat width, cm	1.38 ± 0.021	10.47
6. Distance between teat, cm	15.78 ± 0.381	16.73

The average udder width of the ewes was 12.35 cm, and the depth was 16.85 cm. Regarding the first trait this value was significantly lower than the one determined by Kominakis et al. (2009) for the breed Frizarta in Greece (14.47 cm) and by Panayotov and Simeonov (2014) for Pleven Blackhead sheep (15.96 cm in ewes at I and 16.13 cm for ewes at II lactation). In the present study, the average value of the udder depth was very close to those obtained by Rovai et al. (1999) for the breeds Lacaune and Manchega, respectively – 17.8 cm and 17.2 cm.

Significantly higher values for the udder depth were received by Kominakis et al. (2009) и Legaz et al. (2011) for the breeds Frizarta – 19.47 cm and Assaf – 19.53 cm.

The horizontal circumference of the udder is directly related to the udder volume and the amount of yielded milk. In the studied ewes the circumference of the udder was an average 41.46 cm, with individual variation from 36 to 48 cm. This allows us to consider that the possibilities for purposeful selection based on this trait would be successful. The received average value for the studied trait was slightly lower than the one, received by Dochevski (1975) for fully grown sheep from the Pleven Blackhead breed – 43.43 cm and by Kominakis et al. (2009) for the breed Frizarta – 43.00 cm.

The average values for both measurements of the teats (length and width) were respectively 2.70 cm and 1.38 cm. Insignificantly higher than the indicated value for teat length received Rovai et al. (1999) and Legaz et al. (2011) for the breeds Lacaune and Assaf (2.91 cm and 3.06 cm), and slightly higher than that Kominakis et al. (2009) for the breed Frizarta (3.42 cm). Very noticeable was the significant variation in the length, as well as the width of the teats, but analogical results were received by the mentioned authors. The individual variation in the teat length was from 1.5 to 4.0 cm. The average distance between teats was 15.78 cm and the variation for this trait was relatively high.

The phenotypic correlations between the measurements of the udder had predominantly positive average values (Table 5). Relatively the highest and most reliable was the correlation between the width and horizontal circumference of the udder – 0.631. Reliable, with average values were also the received correlations between the width and the horizontal circumference and the milk yield of the sheep – respectively 0.287 and 0.350. The correlation between the two measurements of the teats (length and width) was 0.274.

Conclusions

The studied sheep from the Lacaune breed are characterized: a) by very good milk yield – an average 213.29 L for the 150 days milking period, the highest was the milk yield of the

Table 5
Phenotypic correlations between udder measurements and milk yield for the 3-rd test day

Traits	r	p
1. Udder width – Udder depth	-0.078	
2. Udder width – Udder circumstance	0.631	***
3. Udder depth – Udder circumstance	0.054	
4. Teat length – Teat width	0.274	
5. Udder width – Milk for the test day	0.287	*
6. Udder depth - Milk for the test day	0.262	
7. Udder circumstance – Milk for the test day	0.350	*
8. Teat length – Milk for the test day	0.125	
9. Teat width – Milk for the test day	0.087	
10. Distance between teats – Milk for the test day	-0.025	

*P < 0.05 **P < 0.01 ***P < 0.001

sheep on the first test day – an average 2.279 L, with maximum deviation 3.310 L; 77% of the ewes had a milk yield over 180 L, 14.5% - 270 L, with maximum value 298.38 L and 6.5% - 150 L, respectively; b) with milk, containing very high level of dry matter (20.06%), fat (7.60%) and protein (7.09%), average total number of microorganisms 754 000 CFU g/mL (two times lower than the permitted levels), average somatic cells count 147 000 CFU g/mL (three times lower than the permitted levels), and excellent technological qualities; c) with udder normal at 56.25% of the ewes, bigger than normal at 41.67% and smaller only at one animal; 52.25% of the ewes had udders with low lateral teat placement, 10.42% - with high lateral teat placement, and 33.33% - with very high lateral teat placement; the udder dimensions were: width - 12.35 cm, depth - 16.85 cm, circumference - 41.46 cm; the teat length was 2.70 cm, the teat width - 1.38 cm and the distance between teats – 15.78 cm, values, which are similar to those of some of the best modern dairy sheep breeds; d) with relatively high and reliable correlation between the width and the horizontal circumference of the udder – 0.631 level of reliability, and between the width and the horizontal circumference and the milk yield of the sheep – 0.287 and 0.350, respectively.

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