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THE QUANTITATIVE and QUALITATIVE INDICATORS of MILK the DIFFERENT BREEDS of SHEEP DURING MANUAL and MACHINE MILKING

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Aim. *To study the quantitative and qualitative indicators of milk the different breeds of sheep with different methods of milking.* ***Methods.*** *To determine the dynamics of the average daily milk yield and biochemical parameters of milk, control milking was carried out at the beginning, every 10 days, and at the end of the experimental period. The total microbial contamination of milk was determined by the method of deep seeding on a selective nutrient medium to count the number of mesophilic aerobic and facultative anaerobic microorganisms. The level of somatic cells was determined using the "Keno-test" test system. Milk samples to determine the indicators of sanitary quality of milk were taken at the beginning and at the end of the experiment.* ***Results****. Milking the sheep after weaning the lambs in 1.5 months lasted 45 days. During machine milking, milking technology developed by the Askania-Nova employees of the IZHSR was used. It was revealed that in the ewes of the Ascanian Karakul breed, the fat content in milk during the experimental period was 9–19% significantly higher (6–9.7%) than in the ewes of the Ascanian Karakul breed (5.2–8.4%).*

In ewes of both breeds, a tendency toward a decrease in the total microbial contamination of milk during machine milking was observed compared to manual milking. At the beginning of the experiment, the difference between the two milking methods for this indicator in the Fine-Fleeced breed was 14.3%, in the Karakul breed - 11.1%. At the end of the experiment, the microbial contamination of milk in both breeds decreased slightly, and the difference between the two milking methods for this indicator was: 10% for Fine-Fleeced and 8% for Karakul sheep, re-

spectively.

According to the level of somatic cells, Karakul ewes unreliably prevailed over Fine-Fleeced sheep by 1.3–1.5 times at the beginning and at the end of the study period. An increase in this indicator in sheep of both studied breeds was found to be 1.9–2.2 times 45 days after the start of milking (end of the third month of lactation). ***Conclusions****. According to the research results, breed features were revealed in terms of indicators the microbial contamination of milk (KUO) and the level of somatic cells. At the same time, the sanitary quality of milk obtained by manual and machine milking met the EU requirements: bacterial contamination was at the level of 1.9–2.7×10^{6}/cm^{3} and 1.7–2.4×10^{6}/cm^{3}, respectively. The level of somatic cells was in the range 46.9–133.4×10^{4}.*

Keywords: ewes, milk, bacterial contamination, somatic cell level.
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КІЛЬКІСНІ ТА ЯКІСНІ ПОКАЗНИКИ МОЛОКА ОВЕЦЬ РІЗНИХ ПОРІД ЗА РУЧНОГО ТА МАШИННОГО СПОСОБІВ ДОЇННЯ

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Мета. *Дослідити кількісні та якісні показники молока овець різних порід за різних способів доїння.* ***Методи.*** *Для визначення динаміки показників середньодобових надоїв та біохімічних показників молока овець асканійської тонкорунної (n=17) та асканійської каракульської порід (n=23) здійснювали контрольні доїння на початку, через кожні 10 днів та у кінці дослідного періоду. Загальну мікробну забрудненість визначали методом глибинного посіву на селективне поживне середовище для визначення кількості мезофільних аеробних і факультативних анаеробних мікро-організмів. Рівень соматичних клітин визначали за допомогою тест-системи «Кенотест». Проби молока для встановлення показників санітарної*

якості молока відбирали на початку та у кінці дослідного періоду. ***Результати.*** *Доїння овець після відлучення ягнят у 1,5 місяці тривало 45 днів. За машинного доїння використовували технологію доїння овець, розроблену науковцями ІТСР «Асканія-Нова». Виявлено, що у вівцематок асканійської каракульської породи вміст жиру в молоці впродовж дослідного періоду був на 9–19% вірогідно більшим (6–9,7%), ніж у вівцематок асканійської тонкорунної породи (5,2–8,4%).*

Спостерігали лише тенденцію до зменшення загальної мікробної забрудненості молока при машинному доїнні порівняно з ручним у вівцематок обох порід. На початку досліду різниця за цим показником у тонкорунної породи між двома способами доїння складала 14,3%, у каракульської – 11,1%. Наприкінці досліду мікробна забрудненість у обох порід дещо зменшилася і різниця між двома способами доїння за цим показником складала: 10 % – у тонкорунних і 8% – у каракульських овець відповідно.

За рівнем соматичних клітин каракульські вівцематки невірогідно переважали тонкорунних овець у 1,3–1,5 разів на початку та у кінці дослідного періоду. Виявлено зростання даного показника у овець обох досліджуваних порід в 1,9–2,2 рази через 45 днів від початку доїння (кінець третього місяця лактації). ***Висновки.*** *За результатами досліджень виявлено породні особливості за показниками мікробної забрудненості молока (КУО) та рівнем соматичних клітин. При цьому, санітарна якість молока, отриманого ручним та машинним доїнням, відповідала вимогам ЄС: бактеріальна забрудненість була на рівні 1,9–2,7х10^6/см^3 та 1,7–2,4х10^6/см^3 відповідно. Рівень соматичних клітин був у межах 46,9–133,4х10^4.*

Ключові слова: вівцематки, молоко, бактеріальна забрудненість, рівень соматичних клітин.
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КОЛИЧЕСТВЕННЫЕ И КАЧЕСТВЕННЫЕ ПОКАЗАТЕЛИ МОЛОКА ОВЕЦ РАЗНЫХ ПОРОД ПРИ РУЧНОМ И МАШИННОМ ДОЕНИИ

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Цель. *Исследовать количественные и качественные показатели молока овец разных пород при различных способах доения.* ***Методы.*** *Для определения динамики показателей среднесуточных удоев и биохимических показателей молока проводили контрольные доения в начале, через каждые 10 дней, и в конце опытного периода. Общее микробное загрязнение молока определяли методом глубинного посева на селективную питательную среду для подсчета количества мезофильных аэробных и факультативных анаэробных микроорганизмов. Уровень соматических клеток определяли с помощью тест-системы «Кено-тест». Пробы молока для определения показателей санитарного качества молока отбирали в начале и в конце опыта.* ***Результаты.*** *Доение овец после отбивки ягнят в 1,5 месяца длилось 45 дней. При машинном доении использовали технологию доения, разработанную сотрудниками ИЖСР «Аскания-Нова». Выявлено, что у овцематок асканийской каракульской породы содержание жира в молоке на протяжении опытного периода было на 9–19% достоверно больше (6–9,7%), чем у овцематок асканийской тонкорунной породы (5,2–8,4%).*

У овцематок обеих пород наблюдали тенденцию уменьшения общей микробной загрязненности молока при машинном доении по сравнению с ручным. В начале опыта разница между двумя способами доения по этому показателю у тонкорунной породы составила 14,3%, у каракульской – 11,1%. В конце опыта микробное загрязнение молока у обеих пород несколько уменьшилось, и разница между двумя способами доения по этому показателю составила: 10% – у тонкорунных и 8% – у каракульских овец соответственно.

По уровню соматических клеток каракульские овцематки недостоверно преобладали над тонкорунными овцами в 1,3–1,5 раза в начале и в конце периода исследования. Выявлено увеличение этого показателя у овец обеих исследованных пород в 1,9–2,2 раза через 45 дней от начала доения (конец третьего месяца лактации). ***Выводы.*** *По результатам исследований выявлены породные особенности по показателям микробной загрязненности молока (КУО) и уровнем соматических клеток. При этом сани-*

тарное качество молока, полученного при ручном и машинном доении, отвечало требованиям ЕС: бактериальная загрязненность была на уровне 1,9–2,7х10^6/см^3 и 1,7–2,4х10^6/см^3 соответственно. Уровень соматических клеток был в пределах 46,9–133,4х10^4.

Ключевые слова: овцематки, молоко, бактериальное загрязнение, уровень соматических клеток.
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Formulation of the problem. The determination of the content the main biochemical parameters of milk: fat, protein, lactose is provided for by the sanitary and hygienic requirements for its quality. These indicators are indicators of the milk quality and its ability to store. In addition, at the present stage of production and processing of sheep's milk, the determination of bacterial contamination and the level of somatic cells in milk are also mandatory criteria for assessing its quality.

Microorganisms from the air and litter, where their concentration is very high, fall on the nipples, spreading in the milk channel. How deeply they get into the mammary gland depends on many factors (method of milking, quality of animal care, hygiene, etc.). Microorganisms located in the nipple canal have little effect on the total number of bacteria in the milk, subject to the rules of milking, in particular, the discharge of the first portions of milk. It is clear that the contamination of milk with microorganisms from the environment during manual milking is more intense. As for machine milking, the problem of contamination is no less relevant with this method. When using milking equipment (pumps, hoses, prefabricated tanks, filters), biofilm pollution forms on its surface. The reason for the formation of such contamination is the adhesion and crystallization of fat globules on the surface of the equipment in the form of gel-like deposits [1, 2, 3], which is a good nutrient medium for the development of microorganisms.

Regarding the level of somatic cells (SC) in sheep's milk, the issues of diagnosing mastitis, and hence the quality of milk, are controversial in terms of the level of SC. Unlike cows, in which the correlation between the level of somatic cells and the health of the udder is clearly defined [4, 5]. The influence of sheep breeds on milk quality remains as little studied. Therefore, the goal of our study is to establish quantitative and qualitative indicators of milk of sheep of different breeds with different milking methods.

Material and methodology. In order to compare the quantitative and qualitative indicators of sheep's milk with different milking methods, we conducted a scientific experiment on the basis of SE "Askania-

Nova", Kherson region. The studied animals were two breeds of ewes the different productivity directions. This is the Ascanian Fine-Fleeced breed of Tavrian Type - woolly direction of productivity (n = 17) and sheep of the Ascanian Karakul breed - coarse, dressed lambskin direction productivity (n = 23). We used sheep milking technology developed by scientists of the Ascania-Nova ITSR. It is based on the use of a two-station milking machine of a linear type using elements manufactured by Mlkline (Italy) [6].

Clinically healthy animals of 3-5 years old were selected to form dairy sheep groups. At the same time, weaning of lambs at the age of 1.5 months was carried out. During the selection, the mandatory components of the clinical examination of animals were: visual and palpation assessment of the udder, assessment of the suitability of animals for machine milking (size and placement of the nipples, sensitivity of the udder). At the beginning and at the end of the experiment, the animals were weighed. In order to control the physiological state of animals at the end of the study period, blood was sampled for morphological and biochemical studies.

Sheep milking lasted 45 days. Double milking was carried out in two ways - manual and machine. Manual milking was carried out in the first three days, in the last three days and during the control milking for sampling milk. Control milking was carried out: at the beginning of the experiment, then - every 10 days and at the end of the study period. Such an algorithm was chosen to determine the dynamics of the average daily milk yield and biochemical parameters of milk.

Total microbial seeding was determined by the method of deep seeding on a selective nutrient medium KMAFAnM (to determine the number of mesophilic aerobic and facultative anaerobic microorganisms). The level of somatic cells was determined using the "Keno-test" test system according to the instructions for the drug [7]. Sampling of milk for the above studies was carried out at the beginning and at the end of the experiment.

To remove contamination from the milk pipelines of the milking unit, after each milking, several washes were performed under warm running water, then soaking was used in solutions containing surfactants (surfactants), followed by washing with alkaline detergents and rinsing.

Research results. The average live weight at the beginning of the experiment was 51.6 ± 0.79 kg for sheep of the Fine-Fleeced breed, and 56.7 ± 1.53 kg of sheep of the Karakul breed. By the end of the experiment, the live weight of Fine-Fleeced ewes increased by 11% ($p < 0.05$), Karakul ewes, on the contrary, lost 5.5% of live weight ($p < 0.05$). A possible reason for the decrease in live weight in ewes of the Askanian Karakul breed was the stress due to the simultaneous weaning of lambs

and the movement of animals from one farm to another for the experiment. Another reason, in our opinion, was that the ewes of the Askanian Karakul breed at the beginning of the experiment were in a state of negative energy balance. It happens when animals are at the peak of lactation with intensive protein intake and a simultaneous lack of carbohydrates in the ration. The proof of this assumption is the total protein content in the blood. Karakul ewes on average in the group was at the level of the upper physiologically acceptable limit - 75.3 ± 0.6 g / l (normal - 65-75 g / l). That is, 80% of the studied animals of this breed group recorded an increased amount of total protein in the blood.

The results of the study of milk in every ten days during the study period are presented in tables 1 and 2.

A gradual decrease in milk production was noted, which in the third month of lactation is a naturally caused phenomenon. Nevertheless, for Karakul ewes this decrease was more noticeable, which may be another evidence of the presence this breed animals in a negative energy balance.

Table 1. The average daily milk yield for the study period (ml), M ± m

Date of control milking	Ascanian Fine-Fleeced breed (n=17)	Ascanian Karakul breed (n=23)
11.05.18 (Beginning of the experiment)	377,6±27,3	392,0±28,5[a]
21.05.18	428,2±43,7	353,3±30,4
01.06.18	389,4±38,2	335,2±26,1
08.06.18 (End of the experiment)	337,6±36,6	292,8±29,1[b]

Note: the indicators of one column with different subscrites differ with a confidence level p <0.05.

The research results showed that the chemical composition of milk in both groups had certain changes associated with a natural decrease in lactation and the accompanying changes in milk quality, in particular a decrease in fat content (table 2).

Between the breed groups there was a difference in the fat content in milk. So, among the Ascanian Karakul sheep ewes, this indicator at the beginning and during the study period was 15.5 and 9-19% more, respectively, than the Ascanian Fine-Fleeced ewes.

Table 2. Dynamics of indicators of the chemical composition of milk in the study period,%, M ± m

Date of con-trol-milk-ing	Ascanian Fine-Fleeced breed (n=17)			Ascanian Karakul breed (n=23)		
	fat	protein	lactose	fat	protein	lactose
11.05	8,4±0,32^{f}	4,7±0,08	6,7±0,11^{ab}	9,7±0,37^{f}	4,7±0,06 ^{a}	6,6±0,09^{ab}
21.05	5,2±0,17^{a}	4,6±0,03	6,6±0,04^{a}	6,2±0,22^{ab}	4,4±0,04 ^{e}	6,4±0,06^{b}
01.06	5,5±0,15^{a}	4,6±0,04	6,7±0,06^{ab}	6,0±0,15^{a}	4,5±0,04 ^{be}	6,6±0,05^{a}
08.06	5,9±0,18^{e}	4,7±0,05	6,8±0,07^{b}	6,5±0,15^{b}	4,6±0,04 ^{abc}	6,7±0,05 ^{af}

Note: the indicators of one column with different subscrites differ from each other with a confidence level: a: b - p <0.05, a: c - p <0.01, a: e - p <0.001, a: f - 0.0001.

The ratio in the compared groups of animals of the average indicators of fat and protein in milk at the beginning of the experiment was increased: 1.8 - in Fine-Fleeced breed, 2.1 - in Karakul breed with a norm of 1-1.5. This indicator, especially in Karakul ewes, is dangerous and may indicate metabolic disorders with the subsequent occurrence of a subclinical form of ketosis. Studies in Dairy Cattle Breeding have shown that with a lack of carbohydrates, there is an increased release of glycogen from the liver. And this, after excessive consumption of glycogen, begins the mobilization of fatty acids from fat depots. There is a weight loss of animals - the so-called " loosing live weight of body after too much milking" and, as a result, a sharp decrease in milk yield [8]. Something similar, in our opinion, happened with the Karakul ewes. It should be noted that in the future the ratio: fat - protein in both studied groups became normal. Fine-Fleeced ewes had an indicator of 1.1-1.25, and Karakul - 1.3-1.4. This probably happened due of the full feeding, which was provided during the study period, and also due to the reduction of the lactation load at the beginning of the experiment after lambs weaning.

The dynamics of lactose during the study period was identical for both studied groups: its unreliable decrease in the second decade of the study period with subsequent restoration to the initial level and increase at the end of the experiment.

A sanitary indicator of milk quality is determined by the number of detected colony forming units - an indicator of fecal contamination. There was only a tendency to decrease the total microbial contamination of milk during machine milking compared to manual milking (table 3). So, at the beginning of the experiment, the difference in Fine-Fleeced ewes between the two milking methods was 14.3%, in the Karakul breed - 11.1%. At the end of the experiment, this difference decreased and amounted to 10% and 8%, respectively. In total, at the end

of milking, both breeds showed a clear tendency to decrease the overall contamination of milk. This can be explained by the observance of appropriate animal health conditions during milking. Also, a planned shearing of sheep during the study period could be a reason for the reduction of pollution.

In the milk of sheep of the Askanian Karakul breed, there was a clear tendency to an increased amount of CFU compared to the Ascanian Fine-Fleeced breed, regardless of the method or the milking period. In our opinion, this is due to the presence of a fat tail in Karakul sheep. This anatomical structure of this sheep breed, the corresponding coat in this area creates constant pollution; compose a specific microclimate and the corresponding microbial landscape in the area of the udder.

Table 3. The content of colony forming units (CFU) and somatic cells in the milk of sheep of different breeds during manual and machine milking, M ± m

Indicator	Ascanian Fine-Fleeced breed (n=17)	Ascanian Karakul breed (n=23)
CFU content in cm^3		
Manual milking:		
- start of experiment	$(2,1±0,43) \times 10^6$	$(2,7±0,43) \times 10^6$
- end of experiment	$(1,9±0,21) \times 10^6$	$(2,5±0,31) \times 10^6$
Milking Machine:		
- start of experiment	$(1,8±0,10) \times 10^6$	$(2,4±0,35) \times 10^6$
- end of experiment	$(1,7±0,14) \times 10^6$	$(2,3±0,52) \times 10^6$
Somatic cell level in cm^3		
- start of experiment	$(46,9±13,4) \times 10^{4\ a}$	$(71,7±13,7) \times 10^{4\ a}$
- end of experiment	$(105,3±24,2) \times 10^{4\ b}$	$(133,4±21,5) \times 10^{4\ b}$

Note: indicators of one column with different subscritams differ from each other with a confidence level: a: b - $p < 0.05$.

In terms of the level of somatic cells, Karakul ewes prevailed over Fine-Fleeced sheep 1.5 and 1.3 times at the beginning and at the end of the experiment. Perhaps this is a pedigree feature that was formed evolutionarily due to the increased primary contamination of the udder and milk in these animals due to the presence of a fat tail. After all, it is known that the basis of the population of somatic milk cells is neutrophils and lymphocytes, which have the highest phagocytic activity.

The level of somatic cells (SC) in the milk of sheep of both breeds at the end of the research period increased significantly: in Fine-Fleeced ewes by 2.2 times, in Karakul ewes - by 1.9 times. This state of affairs can be associated with the start of the stopping milking of animals (the

end of lactation for most animals) and, at the same time, constant mechanical irritation during machine milking.

To date, there is no consensus on the physiologically acceptable level of SC in sheep's milk. It is known that it is bigger than for cows. Regulatory indicators have been developed for goats and sheep in individual countries, which do not always coincide. So, in the USA 1000 thousand / cm3 is permissible, according to the results of research in Norway and Austria - not more than 500 thousand / cm3 [9, 10].

In general, the established levels of somatic cells in the studied sheep breeds are identical to those that were established by us using the Prescott-Brid method in previous studies of sheep milk of these breeds.

Conclusions. Breed features were revealed by indicators of microbial contamination of milk (CFU) and the level of somatic cells. So, in terms of somatic cells, Karakul ewes prevailed over Fine-Fleeced sheep 1.3-1.5 times at the beginning and at the end of the study period. The growth of this indicator in sheep of both studied breeds was observed 1.9-2.2 times 45 days after the start of milking (end of the third month of lactation). According to the research, the sanitary quality of milk obtained by different milking methods meets the requirements of the EU, according to which the number of colony forming units (CFU) should not exceed 3.0x106 / cm3. In the studied breeds, these indicators during manual and machine milking did not exceed 1.9-2.7x106 / cm3 and 1.7-2.4x106 / cm3, respectively. The level of somatic cells was 46.9-133.4 x 104.

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