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Dairy Productivity of the Azerbaijanian Buffalo Breed under the Conditions of the Duane-S Farm

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Abstract

Buffaloes are the most valuable gene pool that they are popularly called the "black pearl" or the golden gene pool of the animal husbandry of the republic. An important problem today is to identify the genetic potential of milk productivity, milk fat and milk protein of the Azerbaijan buffalo breed. Thus, this article studied the milk productivity of the Azerbaijan buffalo breed, in the DUANE-S farm of the Barda region of the republic. In the experiment to assess buffaloes' milk productivity, control milking was carried out with the determination of fat and protein in milk, the amount of 1% milk and milk with a basic fat of 3.6%, the average daily milk yield, the yield of milk fat and protein were calculated, the lactation period, the rate of milk transfer were determined. Two groups of 7 heads each were formed according to the principle of pairs-analogues, taking into account age, live weight, udder shapes as to the suitability for machine milking and the physiological state of buffaloes. Insemination was carried out artificially, but for the heifers of the first group, the seed of the breeding Azerbaijani buffalo-producer "Goshgar-4345", the successor of the well-known genealogical line "Chardakh-342", which in turn was the successor of the legendary line "Kazbek-2", was used, to pass to their offspring their valuable breeding qualities, to obtain large quantitative and high-quality milk from first-calf heifers. The amount of milk produced in the first group on average per head was 1196 kg with a fat content of 8.1% and with a content of protein of 4.8%, this indicator was very close to the indicators of buffaloes from the second group, with a difference in milk yield of 109 kg and 0.2% for protein, which indicates the correct selection of the buffalo-producer.

Disciplinary: Animal Husbandry, Dairy Science.

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1 Introduction

Animal husbandry is one of the key sectors of Azerbaijan's economy since ancient times. During the Soviet Union, there was stagnation in the development of animal husbandry. The turning point occurred after Heydar Aliyev came to power.

Buffalo breeding is an integral part of Azerbaijan's animal husbandry. Buffaloes are the most valuable gene pool, which is popularly called the "black pearl" or the golden gene pool of animal husbandry in Azerbaijan. Such valuable products as high-fat milk, the meat of heavy carcasses, high-quality leather raw materials, etc. are obtained from this industry [1].

According to the zoological classification, buffaloes belong to the class of mammals (*Mammalia*), the genus *Bubalus Bubalus*, the *Bovidae* family, the suborder of *Ruminante* or *Selenodonta*, and the order of *Artiactula* [2].

According to scientists from the Chinese Agricultural University Zhang, Y., the Italian University Cattolica del Sacro Cuore Colli L. and the Australian University of New England, Armidale, New South Wales, Barker, J.S.F., domestic Asian water buffalo (Bubalus bubalis) lives on all five continents, and its global population is about 202 million heads. In some countries, more people depend on this species for their livelihood than on any other domestic animal. Two different types (river and swamp) originated from different populations of wild Asian water buffaloes (*Bubalus arnee*), which separated about 900 thousand years ago and then spread to different geographical regions of the planet. [3].

Based on Hungarian scientists K. Bodnár, Tibor Konyves, Zoltan Jerney, river buffaloes make up approximately 70 percent of the global water buffalo population. River buffalo milk accounts for a significant proportion of the total milk production in India and Pakistan; it is also of significant importance in the Middle East. Swamp buffaloes are smaller and have lower yields than river buffaloes. They are mostly found in East Asia and are mainly grown for draught power [4].

The Azerbaijani buffalo is a domesticated Asian water buffalo, which has 25 pairs of chromosomes unlike the swamp buffalo, which has 48 chromosomes [5].

The average withers height is 130-132 cm; the live weight of adult female buffaloes is 450-500 kg, in males - 500-800 kg. In Azerbaijan, buffaloes are bred mainly for milk production. Annual milk yields of buffaloes amounted to 1300-2000 kg; record milk yields reached 3200 kg and above. Buffalo milk has a white color with a bluish shade. It has a high-fat content of 8.0-8.1%, which is on average twice as high as cow's milk. Fresh milk has a strong specific smell. The average duration of lactation is 283 days. Udder weight - 4.2 kg. Carcass weight is 40-50% [6].

The milk of the Azerbaijani buffalo breed has a pleasant delicate taste; it is odorless, white with a subtle bluish shade and a large number of important components such as fat and protein; therefore, special attention was paid to these milk indicators. The high content of solids with good indicators of vitamins A and D and lack of vitamin C allows the local population to process buffalo milk to obtain such dairy products as katyg (yogurt, sour milk), kaymag (cream), shor, kyasmig (cottage cheese), ayran (buttermilk), etc. [7].

Data from Indian scientists Sumit Arora and Yogesh Khetra show that most popular cheese types (Cheddar, Gouda, Emmental, etc.) are preferably made from cow's milk, while Mozzarella, Paneer, Domiati, Queso Blanco and other cheeses are made from buffalo milk. Due to chemical composition differences between cow's and buffalo milk, the production of cheese from buffalo milk leads to high buffering capacity, faster rennet formation and reduced hydration of casein, which leads to the formation of a dense, elastic, and dry mass in some cheese types, which limits its use as raw materials. In recent years, homemade cheeses have been made from buffalo milk in Azerbaijan; finely packaged kaymag - which is in great demand - is produced in industrial conditions. [8, 9].

According to the research staff of the Department of Dairy Chemistry, ICAR-National Research Institute of Dairy Products, Karnal, Haryana, India J.S. Sindhu, Sumit Arora and Yogesh Khetra, more than 12% of the world's milk production accounts for buffalo milk; in the Indian subcontinent, most of the milk from the total milk production is produced by buffaloes of India - 53% and Pakistan - 68% [10].

Buffaloes have been bred for centuries in Azerbaijan in the areas around the Kura, in the valley of the Araz River, in the flat territories of the Gazakh and Karabakh zones. However, in recent years, the number of these valuable animals has been declining in many respects. If buffaloes were previously kept on large farms, now they can be found only on small farms [11].

According to Swedish scientist Hallqvist (2019), buffaloes are unique in that they manage to survive in very difficult conditions of feeding, keeping, and rearing. This makes them profitable milk producers in certain places with severe climatic conditions [12].

2 Object and Methodology

Animal husbandry in Azerbaijan is developing based on the formation principles and regularities of the market economy considering the traditional features of the population's employment. The development of animal husbandry leads to the use of cropland plots for feed. Irrigated lands are mostly used as crops for producing clover, barley, and wheat and serve to provide fodder supplies in winter. About 98% of agricultural products are produced on farms in the republic. In households, the provision of farm animals significantly affects the social condition of the population. The distribution of land among farms employs animal husbandry and satisfies the need of families for meat and dairy products. However, the processing of animal products is not carried out.

Based on the regulations on food security of Azerbaijan were approved on November 13, 2017, by President Ilham Aliyev to determine food security priorities, stimulate high-quality production of livestock products and increase the number of thoroughbred cattle in the republic [13].

The city of Barda located on the Kura-Araz lowland at an altitude of 87 meters above sea level in the center of the Karabakh plain is well developed in terms of agriculture. The economy is based mainly on cattle breeding, cotton growing, vegetable growing, and sericulture [14].

A scientific and production experiment was conducted in 2021 on the farm "DUANE-S" of the Bardinsky district of the republic. The specialization of the farm is the cultivation of cotton, grain, and buffalo milk. (Figure 1)

The structure of the herd consists of 28 heads of the Azerbaijani buffalo breed. Those are 10 heads of milk buffaloes after the first lactation, 10 heads of buffalo heifers ready for the first insemination, 6 heads of young female buffaloes of different ages and 2 heads of two-month-old buffaloes.

Figure 1: Experimental buffaloes of the Azerbaijani breed

Two groups of 7 heads each were formed to assess the milk productivity of Azerbaijani breed buffaloes: the 1st group consisted of buffalo heifers of the first insemination, the 2nd group - of buffaloes after the first lactation. The animals were selected according to the principle of pairs of analogues considering age, live weight, udder shapes according to suitability for machine milking and physiological condition.

Milk productivity and its accounting were studied by control milking based on a generally available methodology; milk quality was determined using an analyzer, i.e. a device that determines the content of protein, fat, lactose, dry matter, ph, water, the mass fraction of skim solids, etc. in milk.

Buffaloes' milking was carried out twice a day with a special three-stroke milking machine for buffaloes using a 42 cm Hg vacuum and a pulsation frequency of up to 60 per minute.

Insemination of buffaloes is carried out artificially. The insemination of the first group's buffalo heifers was performed using the seed of the breeding buffalo producer Goshgar-4345, the successor of the famous genealogical line Chardakh-342, which in turn was the successor of the legendary Kazbek-2 line bred by Professor Turabov T.M. and employees of the Department of

"Breeding and Feeding of Farm Animals" of the Azerbaijan State Agrarian University (ASAU) in the buffalo breeding plant "Dashyuz" of the Sheki region of Azerbaijan.

The infusion of fresh blood from the prepotent buffalo producer Goshgar-4345 into the buffalo livestock of the DUANE-S farm will transfer its good breeding qualities, improve exterior performance and increase fertilization in buffalo heifers. Milk productivity and milk quality will increase due to the ongoing selection work, i.e. selection.

For the insemination of the second group's buffaloes after the first calving, the seed of buffalo producers from the Republican center for artificial insemination of farm animals was used. Unfortunately, it was not possible to compare the indicators of milk productivity of the previous and current lactation in the DUANE-S farm due to the lack of accurate accounting of buffaloes' milk productivity for the first lactation.

Feeding and keeping were the same for all milking buffaloes. The animals were kept in one room on a leash on the farm; the diet was compiled by the farmer based on the prepared feed available on the farm considering productivity and live weight. In the summer, pasture feeding and an artificial pond for bathing animals were provided.

3 Research Results

The studies were carried out according to the following scheme: formation of the first and second groups of 7 heads each, control milking during lactation, calculation of the lactation period, determination of milk ejection rate, the content of the main components of milk fat and protein, calculation of the average daily milk yield during lactation, the amount of 1% milk, conversion to cow's milk with a basic fat content of 3.6%, the yield of milk fat and protein and their total yield, calculation of milking capacity coefficient of buffaloes. The indicators of buffaloes for groups' formation are shown in Table 1.

Table 1: Indicators of buffaloes for groups' formation

Buffaloes of the 1st group (n=7)				Buffaloes of the 2nd group (n=7)			
Animal number	Live weight (kg)	Udder shape	Age (years)	Animal number	Live weight (kg)	Udder shape	Age (years)
09131	412	Rounded	2.1	09111	421	Rounded	3.3
09133	465	Cup-shaped	1.9	09112	514	Cup-shaped	3.0
09134	433	Cup-shaped	2.0	09114	472	Cup-shaped	3.1
09136	435	Cup-shaped	2.0	09115	463	Cup-shaped	3.2
09137	402	Rounded	2.0	09116	482	Cup-shaped	3.0
09138	441	Cup-shaped	2.0	09120	495	Cup-shaped	3.0
09140	457	Cup-shaped	2.0	09121	499	Cup-shaped	3.0

* calculated by the authors

Experimental groups were formed based on the presence of lactating buffaloes' herd considering age, live weight, and the number of lactations. The 1st group's first-calf buffaloes of 7 heads had an average live weight of 435 kg, which is 43 kg less than the buffaloes of the second

group, also consisting of 7 heads, but after the first lactation. This pattern persists with respect to buffaloes' age. (Figure 2)

Figure 2: First-calf buffalo cow

According to the suitability for machine milking, two buffaloes had a rounded udder shape in the first calf group and one in the second, which further affected the dairy productivity of these animals. The remaining 11 heads in both groups had cup-shaped udders.

Long-term breeding in extreme conditions of feeding and keeping has made the buffaloes late-maturing. Buffaloes go first breeding at the age of 3-4 years [17].

As a result of large-scale breeding started back in the 90s, the buffaloes of the Azerbaijani breed significantly exceed the initial form (local buffaloes) not only in milk yield, butterfat content, protein content, live weight, but also in reproductive ability. Thanks to this, it became possible to appoint buffaloes in the first breeding at the age of 2 years instead of 3 years and older. So, the average age of the first group's buffalo heifers coming into heat was 2 years; this indicator was 3.2 years for the buffaloes of the second group.

Buffalo calves from buffaloes of the second group were born in the amount of 10 heads, of which two buffalo calves (females) were left on the farm, and the remaining 8 heads of different sexes were sold to another farm; therefore, the reproductive ability of female buffaloes has not been studied by the authors, although the yield of buffaloes was 100%.

Buffalo milk contains a lot of nutrients, calories, vitamins, and minerals, but the main indicators of buffalo milk quality are fat and protein, which have higher quantities compared to cow milk. (Figure 3)

The milk productivity of female buffaloes from the first and second groups was studied by conducting control milking on the 4th day of each lactation month with the content determination

of the main milk components - fat and protein - using the "Lactoscan MCC" analyzer to determine the milk quality. The rate of milk ejection was determined in the second month of lactation.

The milk productivity of the 1st group's first-calf buffaloes per lactation is presented in Table 2.

Table 2: Indicators of milk productivity of first-calf buffaloes per lactation

Indicators	Collar numbers of the 1st group's buffaloes (n=7)						
	09131	09133	09134	09136	09137	09138	09140
Live weight (kg)	412	465	433	435	402	441	435
Milk yield (kg)	1056	1355	1143	1233	1025	1270	1289
Fat content in milk (%)	8.2	8.0	8.1	8.0	8.2	8.1	8.0
Protein content in milk (%)	5.0	4.7	4.9	4.7	5.0	4.8	4.8
Amount of 1% milk by fat (kg)	8659	10840	9258	9864	8405	10287	10312
Amount of 1% milk by protein (kg)	5280	6368	5600	5795	5225	6096	6187
Amount of milk with base fat content 3.6% (kg)	2405	3011	2572	2740	2335	2857	2864
Milk fat yield (kg)	86.6	108.4	92.6	98.6	84.0	102.9	103.1
Milk protein yield (kg)	52.8	63.7	56.0	57.9	52.2	60.9	61.9
The total yield of milk fat and protein (kg)	139.4	172.1	148.6	156.5	136.2	163.8	165.0
Lactation period (days)	273	286	275	273	271	274	291
Average daily milk yield during lactation (kg)	3.9	4.7	4.1	4.5	3.8	4.6	4.4
Average daily milk yield with milk fat content of 3.6% (kg)	8.8	10.5	9.3	10.0	8.6	10.4	9.8
Milking capacity coefficient by actual milk yield (kg)	256.3	291.4	264.0	283.4	255.0	288.0	296.3
Milking capacity coefficient of milk yield with fat content 3.6% (kg)	583.0	647.5	594.0	630.0	580.8	647.8	658.4
Average daily milk yield at the peak (second month) of lactation (kg)	6.2	7.5	6.9	7.2	6.1	7.4	7.3
Milk ejection rate (kg/min)	0.69	0.83	0.76	0.80	0.67	0.82	0.81

* calculated by the authors

The difference in live weight of the first group's buffaloes was 63 kg; this indicator was 330 kg according to the actual milk yield - recalculated to cow's milk with a republican base fat content of 3.6%, milk yield amounted to 676 kg. Increased fat and protein content in milk was observed in buffaloes with low milk yield and with a rounded udder shape, which was reflected in the calculations of individual and total milk fat and protein yield. (Figure 4)

Figure 3: Buffalo cow of the first group

Figure 4: Buffalo cow of the 2nd lactation

The lactation period in all buffaloes in the group corresponded to the standard and exceeded the limit of 270 days; no shortened lactation was observed. The difference between the average daily milk yield of actual milk and milk with 3.6% fat content during lactation was 0.9 kg and 1.9 kg, respectively. At the peak of lactation, the highest indicator was 7.5 kg, and the lowest was 6.1 kg, which affected the determination of the milk ejection rate. This indicator was slightly lower in two buffaloes No.09131 and No. 09137 with a rounded udder shape and low productivity (breed standard 0.7-1.01 kg/min) by 0.01 and 0.03 kg/min, respectively.

The milking capacity coefficient according to the actual value and recalculated to cow's milk was the highest in the buffalo No. 09140 by 296.3 kg and 658.4 kg, respectively, which was 41.3 kg according to the actual and 77.6 kg with a 3.6% base fat content more than in the buffalo with low milk yield in the group with the number No. 09137.

Milk productivity of buffaloes of the 2nd group per lactation is presented in Table 3.

Table 3: Indicators of milk productivity of buffaloes during lactation

Indicators	Collar numbers of the 2nd group's buffaloes (n=7)						
	09111	09112	09114	09115	09116	09120	09121
Live weight (kg)	421	514	472	463	482	495	499
Milk yield (kg)	1194	1387	1285	1261	1244	1396	1371
Fat content in milk (%)	8.2	8.0	8.1	8.2	8.1	7.9	8.0
Protein content in milk (%)	5.2	4.9	5.0	5.0	5.1	4.8	5.0
Amount of 1% milk by fat (kg)	9791	11096	10408	10340	10076	11028	10968
Amount of 1% milk by protein (kg)	6209	6796	6425	6305	6344	6701	6855
Amount of milk with base fat content 3.6% (kg)	2720	3082	2891	2872	2799	3063	3047
Milk fat yield (kg)	97.9	111.0	104.1	103.4	100.8	110.3	109.7
Milk protein yield (kg)	62.1	68.0	64.2	63.0	63.4	67.0	68.5
Total milk fat and protein yield (kg)	160.0	179.0	168.3	166.4	164.2	177.3	178.2
Lactation period (days)	270	285	271	273	272	287	283
Average daily actual milk yield during lactation (kg)	4.2	4.9	4.7	4.6	4.6	4.9	4.8
Average daily milk yield with milk fat content of 3.6% (kg)	10.0	10.8	10.7	10.5	10.3	10.7	10.8
Coefficient of milking capacity by actual milk yield (kg)	283.6	269.8	272.2	272.3	258.1	282.0	274.7
Coefficient of milking capacity with 3.6% fat content (kg)	646.1	599.6	612.5	620.3	580.7	618.8	610.6
Average daily milk yield at the peak (second month) of lactation (kg)	7.9	8.5	8.7	8.2	8.1	8.5	8.4
Milk ejection rate (kg/min)	0.87	0.94	0.96	0.91	0.90	0.94	0.93

* calculated by the authors

The highest live weight was in a female buffalo No. 09112, which was 93 kg more than in a buffalo with low live weight, although the milking capacity coefficient was 13.8 kg higher in actual milk yield and with a base fat content of 3.6% by 46.5 kg than in a heavyweight peer.

The difference between the highest and lowest milk yield in the second group was 202 kg for actually produced milk, and 362 kg for milk recalculated to cow's milk, although these were not the same animals. (Figure 5)

Figure 5: Buffalo cow of the second group

The fat and protein content in milk fluctuated between 7.9-8.2% and 4.8-5.2%, respectively; when calculating the individual and total yield of milk fat and protein, it found its pattern.

The lactation period in three buffaloes was long compared to the other four peers; there was no shortened lactation in the group.

The average daily milk yield with basic milk fat content of 3.6% fluctuated within 10 kg and above; in terms of the actual milk yield, the difference between the highest and lowest milk yield in female buffaloes was 0.7 kg, and at the peak of lactation, the highest daily milk yield was in buffalo No. 09114, which was 0.8 kg more than in low-productive buffalo No. 09111.

The rate of milk ejection in all animals met the breed standard and ranged from 0.87-0.96 kg/min.

The average indicators of buffaloes' milk productivity of the 1st and 2nd groups per lactation period are shown in Table 4.

Table 4: Average indicators of buffaloes milk productivity in both groups per lactation (n=7)

Indicators	Female buffaloes of the 1st group	Female buffaloes of the 2nd group
Live weight (kg)	435	478
Milk yield (kg)	1196	1305
Fat content in milk (%)	8.1	8.1
Protein content in milk (%)	4.8	5.0
Amount of 1% milk by fat (kg)	9687.6	10570.5
Amount of 1% milk by protein (kg)	5740.8	6525.0
Amount of milk with base fat content 3.6% (kg)	2691.0	2936.2
Milk fat yield (kg)	968.7	1057.0
Milk protein yield (kg)	574.0	652.5
Total milk fat and protein yield (kg)	1542.7	1709.5
Lactation period (days)	277.6	277.3
Average daily actual milk yield per lactation (kg)	4.3	4.7
Average daily milk yield with milk fat content of 3.6% (kg)	9.7	10.6
Coefficient of milking capacity by actual milk yield (kg)	274.9	273.0
Milking capacity coefficient of milk yield with fat content 3.6% (kg)	618.6	614.3
Milk ejection rate (kg/min)	0.77	0.92

* calculated by the authors

The first-calf buffaloes of the first group weighed 43 kg less than their peers from the second group, although some individuals were heavier than the animals from the second group. This pattern was observed in relation to the actual milk yield (109 kg) and milk yield recalculated to cow's milk with a basic fat content of 3.6% (245.2 kg), but some heifers from the first group exceeded the milk yield of female buffaloes from the other group for the second lactation.

The fat content in the milk of both groups was the same - 8.1%, but the difference in milk yield was reflected in the amount of 1% milk in fat content, which was 882.9 kg higher in buffaloes of the second group than in the first, hence the yield of milk fat was 88.3 kg higher. The difference in milk protein was 0.2% lower in first-calf buffaloes than in animals of the other group; the difference in milk protein yield was 78.5 kg in favor of the second group.

The lactation period in the groups was almost the same; the average daily actual milk yield and yield with a fat content of 3.6% in first-calf buffaloes was 4.3 kg and 9.7 kg, respectively, which was 0.4 kg and 0.9 kg less than in buffaloes from the second group.

The actual milk yield and the yield recalculated to cow's milk per 100 kg of live weight were 274.9 kg and 618.6 kg, respectively, and were higher than that of buffaloes from the second group by 1.9 kg and 4.3 kg, respectively.

In terms of the milk ejection rate, the buffaloes of the second group were ahead by 0.15 kg/min than the first heifers from the first group.

4 Conclusion

Based on the scientific and production experiment conducted on the farm "DUANE-S" of the Barda region of Azerbaijan and based on the results obtained, it can be concluded that buffaloes' breeding is taking a new turn in the republic in the production of high-fat buffalo milk. From time immemorial, buffalo breeding has been considered one of the main priority branches of animal husbandry in the republic, which means that these animals' breeding is economically profitable and efficient.

The live weight and physiological condition of the experimental female buffaloes corresponded to the requirements for setting up an experiment in commodity farms for buffalo milk production. An average of 1250.2 kg of milk per head was produced from buffaloes of both groups, which amounted to 2812.9 kg of milk in recalculation to cow's milk with a base fat content of 3.6%.

The quality indicators of buffalo milk met the standards of the Azerbaijani buffalo breed. The total yield of milk fat and protein per head averaged 1542.7 kg. The lactation period in both groups slightly exceeded the milestone of 277 days, which meets the requirements of the standard. The actual average daily milk yield and the yield recalculated to cow's milk per lactation in the first heifers were slightly inferior to the indicators of buffaloes from the second group.

The coefficient of milking capacity, which indicates the direction of metabolic processes in the body of buffaloes, was higher in the first heifers than in more mature animals from the second group. The milk ejection rate was higher in more adult buffaloes from the second group than in

the first heifers, although all animals met the requirements of the standard for the Azerbaijani buffalo breed.

5 Availability of Data and Material

Data can be made available by contacting the corresponding author.

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