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Lactation And Reproductive Functions Of Holstein Cows In Conditions Of Intensive Technology.

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ABSTRACT

The aim of the study was to assess the lactation activity and reproductive function of Holstein cows in the conditions of modern dairy complex on loose technology content. As a result of researches high milk productivity of animals of the investigated population (8818-10164 kg) is revealed. However, the discrepancy between the diets of the biological status of the animals intense dairy type were kept down milking with age lactations. Milk yield of cows in the second lactation compared to the first was higher by 1346 kg ($p<0.001$), and the third, on the contrary, lower than the second by 330 kg ($P>0.05$). The dairy herd was characterized by high protein content and optimal fat content. With the age of lactation, these main indicators of milk composition also tended to decrease. As a result of higher milk yield of cows on the second lactation, milk fat, protein production was higher compared to the first lactation by 90.1 kg ($P<0.001$), and the difference relative to the third lactation was only 26.5 kg ($P>0.05$). In Holstein cows, the peak of milking was in the second month after calving. The fall of milk yield by months of lactation from the maximum (on the 2nd month.) to the minimum (before launch) was 54 %. The low coefficient of full value of lactation of cows (75,3 %) indirectly testified also to discrepancy of conditions of their contents. Lactation of Holstein cows was characterized by high variability: 26% by milk yield, 16% by fat, 8% by protein, which indicated the possibility of selection. The negative relationship between milk yield and fat content in milk suggests the need for measures to improve the feeding of cows, and directed selection of bulls to increase the fat content in the offspring. Milk of Holstein cows produced in the conditions of industrial technology had good parameters of thermal stability and suitability for production of cheese. Animals Holstein breed precocious. Service-period at cows in longer established norms (144,1), but the third lactation it was close to the optimum value and was 102.5 days. The coefficient of reproductive function of cows during three lactation was low, but with the age of lactation was approaching normal.

Keywords: Holstein breed, milk yield, fat, protein, lactation curve, thermal stability, suitability for production of cheese, service period.

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INTRODUCTION

Increasing milk production and improving its quality is one of the priorities of animal husbandry in Russia [1]. It is possible to implement it only by intensifying the dairy cattle industry, and first of all, the use of animals that meet the requirements of modern industrial technology. The genetic potential of dairy breeds, their species variability and adaptive capacity should ensure the sustainable and independent development of the dairy cattle industry and the production of high-quality raw milk. Currently, with the reduction in the number of dairy cattle in Russia has clearly been a tendency of transition to monobreed – Holstein. This was made possible by the import of purebred animals and the transfer of domestic Holstein herds of other breeds. In different natural and economic conditions the Holstein breed has, undoubtedly, the distinctive characteristics, but keeps the main qualities: high level of dairy productivity and good adaptability to modern industrial production. According to FAO, Holstein is bred in more than 160 countries, and, as a rule, the raw milk produced from them was used for the production of drinking milk, especially in the United States, as it had a low fat and protein content. Significant changes in the selection and technology of feeding and milking cows occurred in the last 25-30 years, which contributed to a significant increase in fat and protein content of Holstein [2].

The Voronezh region is a major producer of raw milk and dairy products on the Russian market. In the context of the crisis of milk production in the whole country, the region annually increases this figure by 40-60 thousand tons. the Successful operation of the dairy industry depends only on the production of high-quality milk, which is largely provided by the breed of animals, feeding and housing conditions. In this regard, the dairy industry is taking measures for its further development: the number of dairy cows is stabilized, modern technologies of production and primary processing of milk are introduced. The greatest contribution to the solution of this problem is made by large dairy companies equipped with high-tech equipment and used as a basis for the production of Holstein animals [3].

Therefore, it is relevant in theoretical and practical terms to assess the economic and biological characteristics of animals of Holstein breed, the quality of dairy raw materials in terms of industrial technology in order to improve the efficiency of their use.

MATERIAL AND METHODS

To achieve this goal in 2015-2017, an experiment was conducted in the limited liability company (LLC) "Don" of the Khokholsky district of the Voronezh region. Dairy herd (1200 cows)of the dairy complex of the agricultural enterprise is formed by Holstein cows. Animals feeding all year round was the same type of feed mixtures on the feed table. For milking cows and primary processing of milk it was used milking equipment of firm "Westfalia". Milking parlor equipped rotary "Carousel" with machines "Tree". The shortage of rough and juicy forages are relatively low and their quality is determined during the studies concentrate type of feeding cows, with the proportion of concentrates in the ration (energy density) of 47.3 %, rude – juicy and the 26.4 – 26.3 percent. Per IF will be in the rations of animals it was kept to 96.7 g of digestible protein. The lack of sugar-rich feed determined a low value of sugar-protein ratio (0.6), which reduced the efficiency of feed protein ruminants. The demand for minerals was fully satisfied [4].

Milk productivity of Holstein cows for 1-3 lactation was studied individually on to the results of control milkings according to the" Rules of evaluation of milk productivity of cows for lactation " [5].

The coefficient of milk content of experimental cows proposed By D. I. Startsev [5] was calculated by the formula:

$$\text{KM} = \frac{\text{milk yield}}{\text{live weight}} \times 100\%. \quad (1)$$

For the stability analysis of lactation curves were calculated the coefficient of usefulness of lactations according to the formula V. B. Veselovsky [5]:

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$$CPL = \frac{\text{actual milk yield}}{\text{higher daily milk yield} \times \text{number of days}} \times 100\% \quad (2)$$

The quality of milk during standard lactation was studied on 12 first-calf heifers. Sampling of milk for analysis was monthly carried out according to GOST 26809.1-2014 [6]. Chemical composition of milk was determined in the biological laboratory of the VoronezhStateAgrarianUniversity according to standard techniques: the thermal stability of milk according to GOST 25228 [7] and cheese production ability GOST R 53430 [8]

The resulting research digital material processed biometrically [9], with the use of PC and software applications of Microsoft Excel.

RESULTS AND DISCUSSION

The level of dairy productivity of cows is a determining factor in the efficiency of the dairy cattle industry. It should be noted that the level and type of feeding on the farm as a whole provided a sufficiently high milk productivity of Holstein cows (table. 1).

Table 1: THE MILK YIELD OF COWS

Indicator	Lactation Rate		
	First	Second	third
Milk yield, kg	8818±211,4	10164±178,4	9804±141,4
Mass fraction of protein, %	3,49±0,012	3,42±0,017	3,42±0,011
Mass fraction of fat, %	3,82±0,040	3,81±0,023	3,80±0,035
Milk protein, kg	307,7±5,71	347,3±6,00	335,7±5,92
Milk fat, kg	336,8±8,11	387,3±7,82	372,4±7,82
Live weight of cows, kg	570±7,9	611±8,5	658±11,2
Milk protein + milk fat, kg	644,5±11,11	734,6±15,14	708,1±21,11
Milk production per 100 kg of live weight	1547±37,2	1664±58,3	1490±33,9
Milk protein + milk fat / 100 kg live weight, kg	113,1±7,91	120,2±5,12	107,6±5,51

The General pattern of age variability of cowsmilk yield is expressed in a uniform increase to a certain level, and then a gradual decrease. This feature is due to the fact that the secretory activity of the breast is directly dependent on the development of the reproductive system, all internal organs and tissues, body size and general life of the body. The more precocious the cattle, the better the young are grown, the more intensively the milk content increases. The nature of these changes is influenced by the usefulness of the subsequent feeding and the comfort of the cows. Milk yield of cows, heifers under optimum condition of the content is little different from milk yield of Mature cows [3, 10, 11, 12, 13, 14].

In order to identify the characteristics of milk production of Holstein animals in the conditions of the industrial dairy complex, we have studied the following features: milk yield, fat mass fraction, protein mass fraction, milk fat and protein yield, fat+protein production per 100 kg of live weight for 1-3 lactation.

The discrepancy of diets to the biological status of animals of intensive milk type restrained the milking of cows with the age of lactation. Therefore, the milk yield of cows on the second lactation relative to the first higher by 1346 kg ($p<0.001$), and the third relative to the second, on the contrary, lower by 330 kg ($P>0.05$).

The quality of milk is primarily determined by the content of fat and protein. The studied animal population was characterized by high protein content and optimal fat content. With the age of lactation, these main indicators of the quality of milk tended to decrease. However, due to the higher milk yield of cows on the second lactation production of milk fat+protein from them was higher relative to the first lactation by 90.1 kg ($P<0.001$), and the difference relative to the third lactation was only 26.5 kg ($P>0.05$).

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Live weight of dairy cows is the main feature, which is closely related to the value of milk yield. It is considered that the milk yield of a highly productive dairy cow should exceed the live weight by 8-10 times [5]. It should be noted that the parameters of cows ' development in the studied population were not high enough, since in the homeland of Holstein (USA and Canada) the live weight of cows is 700 kg and above [15]. According to the production of milk per 100 kg of live weight, the studied herd belongs to the intensive milk type.

Thus, the conditions of Holstein cows in the agricultural enterprise did not contribute to the full manifestation of high milk productivity. During the third lactation, despite the high adaptive capacity of animals, in specific conditions there was a decrease in milk yield, the mass fraction of fat and protein.

Increased requirements to the quality of milk, creation of optimal conditions for keeping animals with high productive potential and effective breeding work on their improvement, cause the need for a more detailed study of the level of milk yield and milk composition in the dynamics of lactation, as well as the interdependence between them.

The level of milk productivity of cows for lactation is influenced by physiological factors that cause an increase in milk yield to a certain maximum in the first half of the lactation period, and then a gradual decrease and even a sharp drop to the end of it [16, 17].

The lactation curve is a graphical representation of the daily milk yield of a cow. Their analysis provides the opportunity to examine some features of the physiology of lactation and the General laws of this process. In specific terms it provides additional information on the potential milk yield of the animal and effects on the physiology of lactation the conditions of feeding and maintenance [3].

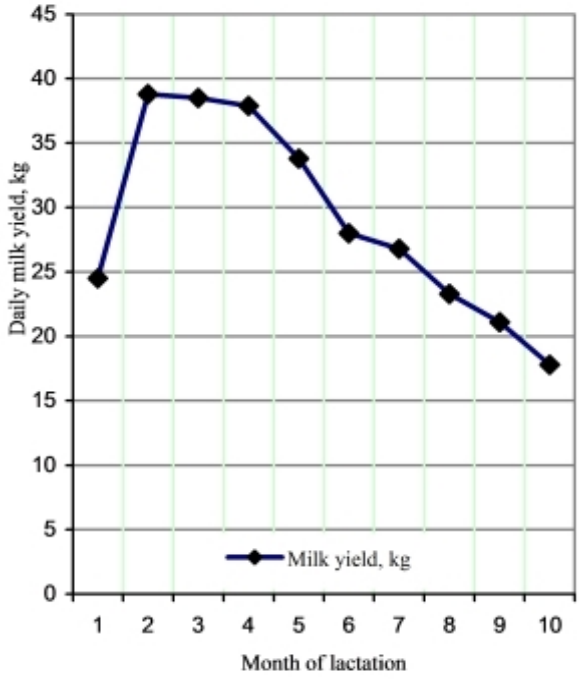

Fig 1: lactation curve cows first-calf

One of the zootechnical criteria for the quality of the diets of cows is the coefficient of usefulness of lactation. If the level and full value of feeding correspond to the genotype of animals, the lactation curve is equalized, and the CLE is 80% or more [3].

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Table 2: Characteristics Of Lactation First-Calfcows

Month milk	milk yield, kg	% of milk yield for 305 days of lactation
I	741	8,4
II	1173	13,3
III	1164	13,2
IV	1146	13
V	1023	11,6
VI	847	9,6
VII	811	9,2
VIII	705	8
IX	670	7,6
X	538	6,1
A total of	8818	100
Higher daily milk yield, kg / month of lactation		38,8/II
Lactation efficiency (CPL), %		75,3
Milk yield for 1 day of lactation, kg		28,9
Intensity of lactation, kg / min		2,47

In the course of research it was revealed that cows of Holstein breed had the peak of milking in the second month after calving. The fall of milk yield for months of lactation, in General, the maximum (on the 2nd month.) to the minimum (before launch) was 54 %. The coefficient of lactation value is only 75.3 %, which indirectly indicates that the conditions of animals did not fully correspond to the optimal value.

The concentration of the main components of milk has its own peculiarity (Fig. 2): fat was high in the first (4.32%), and in the last three months of lactation (4.09−4.37%), and protein – stable growth after the peak of lactation before starting, with an overall increase of 0.76 %.

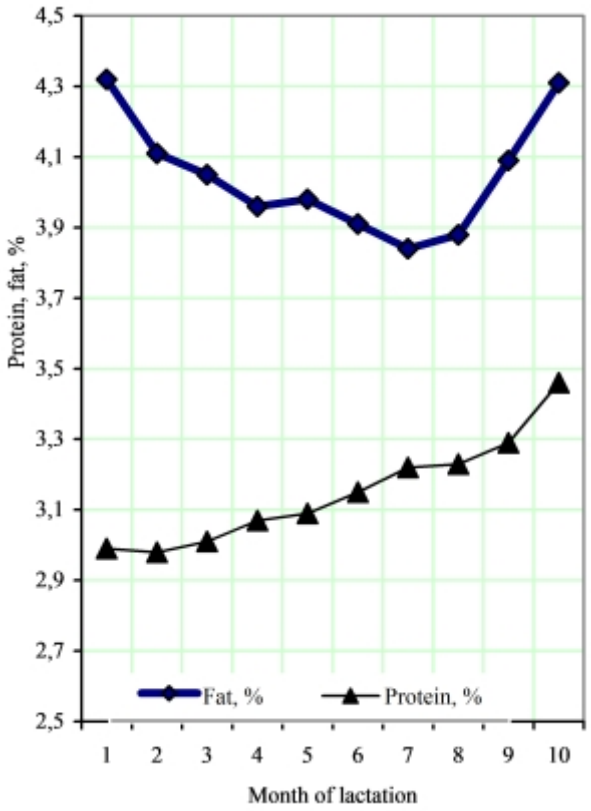

Fig 2: Dynamics Of A Mass Fraction Of Fat And Protein In Milk Of First-Calfcows

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In general, the lactation of Holstein cows is characterized by high variability in the studied indicators of productivity-by milk yield of 26 %, fat-16, protein-8 % (table.3).

able 3: Selection And Genetic Parameters Of The Indicators Of Breast Productivity Of The Cows By Months Of Lactation

Indicator	*Month of lactation*									
	1	2	3	4	5	6	7	8	9	10
The relationship of the characteristics (correlation coefficient)										
Milk yield - fat	0,095	0,094	-0,072	0,080	0,009	0,021	0,069	-0,078	-0,412	-0,341
Milk yield-protein	0,240	0,245	0, 336	0,286	0,201	0,299	0,387	0,465	0,491	0,560
Protein-fat	0,026	0,205	0,264	0,229	0,258	0,143	0,141	0,341	0,536	0,553
Variability, Cv, %										
Milk yield	18,6	20,5	21,5	19,9	19,8	20,4	22,1	26,4	30,4	40,0
Fat	13,5	11,8	11,6	13,3	12,5	12,4	18,2	15,5	18,6	23,1
Protein	6,3	6,01	5,4	6,2	6,2	6,9	7,2	9,0	7,1	13,4

The negative relationship between milk yield and fat content in milk suggests the need for measures to improve the feeding of cows and directed selection of bulls to increase the fat content in the offspring.

Milk as a raw material for the production of dairy products should not only have high food quality, but also have good technological properties. The technological properties of milk are the properties that ensure the correct conduct of the technological process and the production of a dairy product that meets the requirements of standards. Since milk is a secret of the breast, its technological properties depend on the metabolism inherent in each breed, that is, they have interbreed differences. In this regard, when assessing animals by the complex of economically valuable characteristics absolutely necessary was the study of technological manufacture them from raw milk. The main technological properties of raw milk include thermal stability and rennet coagulation [18, 19].

Under heat resistance it is understood the property of milk to withstand high temperatures without visible coagulation of proteins. The ability of the milk protein system to withstand high temperatures is a unique property and allows for operations such as pasteurization, ultra-high temperature processing and sterilization. It is caused by many factors acting simultaneously [18].

In the dairy industry in assessing the thermal stability of milk using an alcoholic sample based on the interaction of ethyl alcohol and milk proteins. Proteins are fully or partially denatured by mixing equal amounts of milk with alcohol. Depending on what concentration it did not cause the precipitation of flakes in the test sample of milk (80 %, 75, 72, 70 and 68%), it is divided into groups I, II, III, IV, respectively, the higher the concentration of alcohol withstands milk, so it is heat-resistant [7].

The use of the method of alcohol test revealed quite high parameters of thermal stability of milk of Holstein cows (table. 4).

Table 4: Technological properties milk cows

Indicator	Value indicator's	
Thermal stability:		
the maximum alcohol concentration that causes coagulation of milk proteins, %	74,9±0,92	
the thermal stability of group	II	
the distribution of samples of milk by the thermal stability of groups:	number of samples	%

I	25	20,8
II	39	32,5
III	23	19,2
IV	9	7,5
V	2	1,7
not heat-resistant	22	18,3
The ability of rennet coagulation:		
rennet clotting time, min.	24,5±1,29	
distribution of milk samples by duration of coagulation:	(n=120)	
up to 10 min	2	
10-15 min	13	
over 15 min	105	
the average quality class of milk by rennet-fermentation test	1,8±0,058	
the distribution of milk samples according to the class of rennet and fermentation of samples:	number of samples	%
initial	61	50,8
second	43	35,8
third	16	13,4

The average limit concentration of alcohol that does not cause coagulation of proteins, of 120 samples of milk studied during lactation, on average corresponded to group II. Of these, 25 samples (20.8 %) were stable when exposed to 80% concentration of ethyl spite (group I thermal stability), 39 (32.5) – at 75% (group II), 23 (19.2) – at 72% (group III), 9 (7.5) – at 70% (group IV) and 2 (1.7) – at 68% (group V), and 22 samples (18.3 %) were non-thermally stable. In the dynamics of lactation there was a general trend of changes in the thermal stability of milk-an increase from the third to the sixth month, when it reached the highest values and a decrease to the end of it.

The cheese-making capacity of milk is characterized by a complex of chemical, physico-chemical, technological and hygienic quality criteria. Milk used for cheese production should form a dense curd under the action of rennet, which separates the whey well, and be a favorable environment for the development of lactic acid bacteria [18, 19].

The cheese-making capacity of milk was evaluated by the rate of curd formation under the action of rennet, and the quality of the curd by rennet-fermentation sample [8].

The time from the moment of introduction of the rennet solution to the formation of a curd characterizes the coagulability of milk. At 37 °C incubation the milk of the samples was rapidly curtailed under the action of rennet. In an average lactation this parameter was 24.5 min. Of 120 samples of cow milk were investigated during lactation, with the duration of clotting to 10 min revealed a 1.7 % (2 samples), 10-15 min and 10.8 % (13) more than 15 min – 87,5 % (105 samples),

Analysis of the results of the rennet-fermentation sample obtained after 12-hour incubation of milk samples (t=38,l±l °C) indicates a fairly good quality of the curd: 66 samples (50.8 %) corresponded to the first class, 43 (35.8 %) — the second class. Improving the quality of the curd in the sample of milk was started from the second month of lactation cows, the best was observed at the sixth to seventh month, and 9 month quality testified to the unsuitability of milk for cheesemaking. In general, milk of Holstein cows produced in the conditions of industrial technology had good parameters of thermal stability and cheese making.

The most complete realization of the productive potential of dairy cattle can be carried out only under the condition of high reproductive function of dairy cattle, which is the main biological condition limiting the growth of livestock [20, 21, 22].

In this regard, the problem of increasing the degree of reproduction of highly productive cows in the conditions of industrial milk production, despite the achievements in the physiology of animal reproduction, is currently one of the main tasks of science and practice [23, 24, 25, 26, 27, 28].

Reproductive function-a complex physiological characteristic, including many indicators, which basically have a low coefficient of heredity. Their deviations, as a rule, are caused by paratypical factors: level and full value of feeding, conditions of the maintenance of animals, and all complex of organizational and economic actions [29].

It should be noted, with a deficit in the diets of easily digestible carbohydrates amino acids of the protein component of the diet are spent on energy needs, which greatly increases the need for them. The use of carotene by ruminants, is reducedthere is a violation of energy and carbohydrate-fat metabolism, and there are problems with reproduction.

The age of the first calving and their live weight are important for the formation of dairy productivity of cows. As a result of the study, we found that the animals of Holstein breed are precocious. Their calving took place at the age of 27.2±0.23 months (818 days) with a live weight of 570±7.9 kg.

A very important point for the organization of herd reproduction is the economically justified duration of the interbody cycle. Interbody cycle is a period of time from one calving to another. It needs to be in the range of 365-395 days [5]. Increasing the interval between calving over this period is economically and biologically impractical. The interbody period is an integral indicator of the reproductive function of the cow, including the service period and the duration of pregnancy. If we consider that the duration of pregnancy value is quite constant, the greater impact on the interbody cycle has a service period.

The duration of pregnancy is due to the species characteristics of animals, and in cattle the average duration of pregnancy is 285 days with fluctuations from 260 to 310 days. Extreme deviations from the average norm lead to a decrease in the viability of calves. In this regard, the period of pregnancy in controlled animals was within the physiological norm (table. 5).

Table 5: Characteristics Of Reproductive Function Of Cows

Indicator	Lactation Rate		
	first	Second	third
Service - period days:	**144,1±4,71**	121,8**±5,57**	**102,5±5,36**
Duration of pregnancy, days:	**284,3**±1,52	**285,4±0,79**	**284,1±1,22**
Interbody period, days:	**427,5±4,87**	**407,3±5,58**	**384,1±5,69**
Coefficient of reproductive function	**0,86±0,011**	0,90**±0,014**	0,95**±0,015**

The optimal duration of the service period should not exceed 80-110 days. The value of the service period is significantly influenced by the choice of the optimal period for insemination of the cow after the end of uterine involution. For its determination there has been taken into account the state of fatness of the animal, the level of productivity, as well as the specific conditions of the dairy herd [5]. In modern conditions of industrial milk production animals are rarely capable of fertile insemination in optimal terms, and the duration of the service period is from 18 to 200 days or more [30, 31].

In the course of the research we found that the parameters of the service period in the controlled livestock were also below the established norm. As a rule, in cows of first-calf heifers, the restoration of reproductive organs takes longer than in full-aged individuals and in the remaining animals for the second and third lactation, the duration of the service period was reduced, approaching the norm, and amounted to 102.5±5.36.

In practice, dairy cattle breeding as an assessment of herd reproduction using the coefficient of reproductive function of cows (CRF). With good fertility of the cow, it is within 1. It is determined by the formula: 365days / interbody period [30, 31]. Because of the extended interbody period, the coefficients of reproductive function in cows during three lactations were low (0.86−0.95), but with the age of lactation they approached the norm. Thus, animals of Holstein breed in the conditions of intensive technology had low rates of reproduction.

CONCLUSION

Holstein cows in terms of intensive technology have a fairly high milk production. However, the discrepancy between the diets of the biological status of the animals intense dairy type were kept down by milking with age lactations. Milk yield of cows on the second lactation relative to the first higher by 1346 kg ($p<0.001$), and the third, on the contrary, below the second 330 kg ($P>0.05$).

The studied animal population was characterized by high protein content and optimal fat content. With the age of lactation, these main indicators of the quality of milk tended to decrease. However, due to the higher milk yield in the second lactation production of milk fat+proteinwas higher relative to the first lactation by 90.1 kg ($P<0.001$), and the difference relative to the third lactation was only 26.5 kg ($P>0.05$).

In Holstein cows the peak of milking falls on the second month after calving. The fall of milk yield for months of lactation, in general, the maximum (on the 2nd month.) to the minimum (before launch) is 54 %. The coefficient of usefulness of lactation is only 75.3 per cent, which indirectly also indicates the lack of conformity of the conditions for the animals.

Lactation of Holstein cows is characterized by high variability: 26% by milk yield, 16% by fat, 8% by protein, which indicates the possibility of selection. The negative relationship between milk yield and fat content in milk suggests the need for measures to improve cow feeding and directed selection of bulls to increase fat content in offspring.

Milk of Holstein cows produced in the conditions of industrial technology had good parameters of thermal stability and cheese making ability. The limit concentration of alcohol, causing coagulation of milk proteins, during lactation, on average corresponded to group II. At 37 °C incubation the milk of the samples was rapidly curtailed under the action of rennet. In general, during lactation, this option was 24.5 min. Average grade of milk by rennet-fermentation test (1,8) evidenced good quality of the curd.

Animals of Holstein breed are precocious, but in general had low rates of reproductive function. Service-period at cows in longer established norms (144,1), but the third lactation it was close to the optimum value and was 102.5 days. As a result, the coefficients of reproductive function of cows during the three lactations were low (0.86−0.95), but also with the age of lactation they also approached the norm.

In order to form a high-producing dairy herds for the major modern enterprises use of Holstein cows should be used. To increase the degree of realization of the productive potential for milk yield, improve the quality characteristics of milk and the reproductive function of animals, it is necessary to more deeply detail their diets, optimizing the structure and improving the quality of feed.

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