

STUDY ON PRODUCTIVITY OF COWS OF HOLSTEIN BREED IN THE DYNAMICS OF LACTATION AND CORRELATION BETWEEN THE MAIN ECONOMICALLY USEFUL FEATURES

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Abstract

The article presents the results of studies of milk productivity of Holstein cows in the dynamics of lactation, correlations between the level of milk yield, fat content, amount of milk fat, and live weight. The research was carried out in the herd of the breeding farm of Society of limited liability "Doksancom", on Holstein cows in the dynamics of lactation, as well as first-calf heifers of various origins. For each subsequent lactation, the milk yield of cows in the herd of Society of limited liability "Doksancom" increases. It was established that milk productivity for the second lactation was by 1468 kg of milk, for the third - 1215 kg of milk, for the fourth-sixth lactation - 1199 kg of milk more than for the first lactation, the difference is significant at $P < 0.001$, $P < 0.001$ and $P < 0.01$ respectively. Comparative analysis of the milk yield of first-calf heifers raised in various farms showed that first-calf cows raised in the herd of Society of limited liability "Doksancom" had the highest productivity - 9518 kg of milk, which is by 925 kg more than first-calf cows purchased from the breeding farm of Joint-Stock Company "Aydyn", the difference is significant ($P < 0.05$) and per 1200 kg - first-calf cows imported from Holland ($P < 0.01$). The relationship between milk yield and the percentage of fat in milk of cows was in a negative correlation from weak -0.154 (IV-VI lactation) to moderate -0.409 - -0.449 , II and III lactation, respectively.

Key words: correlation, first-calf cow, heifer, live weight, milk yield.

INTRODUCTION

In modern conditions, one of the priorities is to increase the productivity of cattle, and not the increase of their number. Industrial production of milk requires a certain concentration of animals on farms, its narrow specialization, a high level of mechanization and automation of animal services. At the same time, a great attention is paid not only to production technology, but also to the quality of the livestock used for production (Gorelik et al., 2014). In the dairy cattle breeding of the developed countries of the world, the leading place is occupied by the highly productive Holstein breed.

The determining factor in the qualitative transformation of cattle breeding in the Republic of Moldova is the further development of livestock breeding, the presence of highly productive dairy cattle, adapted to modern technologies, climatic and feed conditions of the republic, as well as

improving the food supply and the creation of advanced technologies for keeping animals.

As it is known, the milk productivity of cows is an important economically useful sign, one of the main indicators of animal husbandry. As a biological feature, it fluctuates depending on a number of factors, such as: season of the year, lactation in a row, membership in genealogical lines, generation and types. When breeding cows of dairy breeds and especially Holstein breed, it is taken into account the complex of economically useful traits, it is paid attention to the productivity and quality of milk - milk fat and protein milk.

Thus, under optimal feeding and keeping conditions, milk yield of Holstein cows in the breeding herd of Society of limited liability "Doksancom" amounted to 8980 kg of milk (first lactation), 10082 kg (second lactation) and 10530 kg (third lactation) milk per lactation (Foksha & Konstandoglo, 2019).

The realization of the genetic potential for milk production and amounted to higher for the third

lactation and amounted to 108.3%, which is on average by 7.1% more than at the animals of the first two lactations. Milk productivity of cows is the result of the interaction of a complex of physiological processes of the body, which are controlled by many gene systems and determine the hereditary status of the breed. The study of the relationship between economic and useful traits has a great importance for breeding and pedigree work, as these dependencies can be used in the selection of animals of the desired types in the process of creation (Nicoro et al., 1968).

The practical value of correlations between signs is that they allow selection for a smaller number of signs with a positive relationship between them. At the same time, the rates of genetic improvement of herds are significantly accelerated (Belyaev, 1966).

The relationship between features is by the correlation coefficient, while the correlation is observed between both quantitative and qualitative signs (Stenkin & Mulyanov, 2014; Abrompolsky & Abylkasymov, 2005; Gaidukova & Tyutyunikov, 2013). In dairy cattle breeding, the most important is the identification of the nature and magnitude of correlation between the level of milk yield and the mass fraction of fat in milk. The correlation between milk yield and the mass fraction of fat and protein in milk is usually negative (Ruzsky, 1982; Osipenko et al., 1985; Yeghiazaryan & Braginets, 2010; Smith & Omoas, 1984; Sonderegger, 1986; Vleck, 1985; Abrompolsky & Abylkasymov, 2005). Therefore, in each individual case, it is necessary to determine the form, direction and degree of correlation (Dautbaev, 1995; Egiazaryan & Braginets, 2010; Stenkin & Mulyanov, 2014).

The data of many scientists confirm the positive relationship between milk productivity and live weight, and the fact that bigger animals have greater milk productivity (Kutrovsky, 2006, 2007; Brillung, 1985; Ratheises, 1972). According to many scientists and practitioners of livestock science, the relationship between milk yield, qualitative indicators of milk with age is positive (Shmeleva & Basonov, 2014; Vilver, 2015).

As it is known, the milk production of cows during lactation is subject to significant fluctuations. After calving, the daily milk

yields of cows increase, reaching a maximum at 2-3 months of lactation, then gradually decrease (Katmakov, 2004), this process is graphically reflected by the lactation curve. The nature of the lactation curve depends on the maximum daily milk yield, the subsequent degree of its decrease and the duration of lactation. High-yielding cows within each breed are characterized by a large increase in productivity in the second or third months of lactation and its slow decline thereafter. It is known that the increase of milk productivity per lactation depends (among other conditions) from the maximum milk yield and on till the degree of its preservation during lactation. At the same maximum milk yield, this increase per lactation will be greater than the more constant lactation curve (Ernst et al., 1992; Kostomakhin, 2007).

The aim of our research was to study the milk productivity of Holstein cows in the dynamics of lactation, the correlation between the main economically useful traits, and also to compare the milk productivity of first-calf cows raised in different farms.

MATERIALS AND METHODS

The research was carried out in 2019-2020 in the herd of the breeding farm (of Society of limited liability) - of SLL "Doksancom" on Holstein cows (n = 259), including: 112 heads - first lactation; 90 heads - second lactation; 36 heads - third lactation; 21 heads - fourth - sixth lactation. Of the 112 first-calf cows, 67 were raised in the herd of SLL "Doksancom", 20 heads were purchased from the breeding farm of (Joint-Stock Company) J-SC "Aydyn", 25 goals - imported from Holland.

The main data on the milk production of animals were taken from forms of zootechnical and pedigree accounting. All the analyzed number of cows was kept in optimal conditions of feeding and keeping in accordance with the basic zootechnical and hygiene requirements.

Were used zootechnical research methods with biometric processing of materials by the method of variation statistics according to Plokhinsky (1978) and Mercurieva (1983): arithmetic mean (\bar{X}), arithmetic mean error (S_x), coefficient of variability (C_v), correlation coefficient (r) and correlation coefficient error (m).

Lactation curves of cows were constructed, and was calculated the milk coefficient (MC - of milk produced per 100 kg of live weight), proposed by Startsev (1965) using the formula: $MC = MY / LW$, where MC is the milk coefficient, kg; M Y- milk yield for 305 days of lactation, kg; LW - live weight, kg. The relationship between milk productivity indicators and milk quality, live weight was determined by calculating the correlation

coefficient using Microsoft Excel, the reliability of the indicators was determined by Student.

RESULTS AND DISCUSSIONS

The results of studying the nature of milk production of cows of the breeding farm of Society limited liability "Doksancom" in the dynamics of lactation are shown in Table 1.

Table 1. Dynamics of milk production of cows of SLL "Doksancom" ($X \pm Sx$)

No	Indicators	Lactation			On average fourth - sixth lactation
		first	second	third	
1.	The number of cows, head	112	90	36	21
2.	Live weight, kg	578±2.1	642±4.5	678±3.4	687±6.4
3.	Milk, kg	9085±183.5	10553±231***	10300±313***	10284±400**
4.	Fat content, %	3.88±0.01	3.92±0.01	3.89±0.016	3.91±0.014
5.	Amount of fat, kg	352±7.0	412±8.7	402±11.4	402±15.5
6.	MC*, kg	1558±33.7	1629±35.4	1502±44	1498±61

Note: **P>0.01; ***P>0.001; MC* - of milk produced per 100 kg of live weight

It was established that primiparous cows in first lactation had milk production at 88.2% compared to mature cows (standard 70-75%), which averaged 9085 kg of milk fat of 3.88%. With increasing number of lactations it also increased the production of milk per lactation, the amount of fat. Thus the milk production on second lactation was by 1468 kg more milk and constituted on average 10553 kg of milk, on third lactation - by 1215 kg, on fourth - sixth lactations - by 1199 kg, the difference being significant, with $P<0.001$, $P<0.001$ and $P<0.01$ respectively. The amount of overall fat spotted to the second lactation by 60 kg, with the third lactation and more - by 50 kg, the difference being significant, with $P<0.001$ - $P<0.01$ correspondingly.

Live weight corresponded to and was higher than the breed standard at the end of the first, second, third and older lactations. First heifers had a live weight higher than the standard by 28 kg (550 kg), second lactation - by 42 kg (600 kg), third lactation - by 28 kg (650 kg), and third lactation and more - by 37 kg (Figure 1).

For a more complete characterization of milk productivity and the efficiency of using animals, it was calculated the milk production coefficient, which can be used to establish the highlighting of the dairy type of cattle.

The highest milk production coefficient per 100 kg of live weight, have the cows of the second

lactation - 1629 kg of milk. The milk production coefficient of first-calf heifers was 1558 kg, according to the third - 1502 kg. The relatively high indices of the milk production coefficient can be explained by the fact that cows have relatively high milk productivity for a number of analyzed lactations, which indicates the highlighting of the milk type.

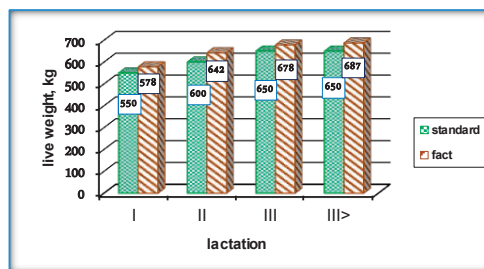


Figure 1. Live weight of cows in lactation dynamics, SLL "Doksancom"

The change in milk yield at highly productive cows of herd of the SLL "Doksancom" is shown in the following figures of lactation curves (Figures 2-5).

As it can be seen from the figures, at cows no. 7320 and no. 7582 lactation curve increases by the 2nd month lactation and within 2-3 months of lactation stabilizes, by the fourth month it rises to the peak of lactation. Then it gradually decreases until the end of lactation by an

average of 9.6% with fluctuations from 4.5 to 18.1% (no. 7320) and by 10.6% with fluctuations from 6.6 to 19.8% (no. 7582).

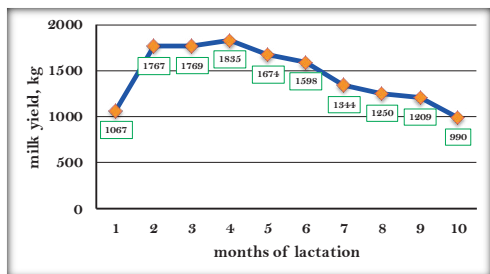


Figure 2. Lactation curve of cow no.7320, fourth lactation, milk yield 14513 kg of milk

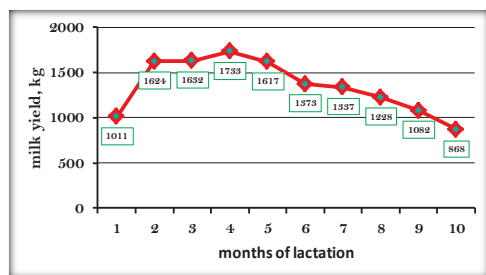


Figure 3. Lactation curve of cow no. 7582, of the third lactation, milk yield 13,422 kg of milk

At cow no. 1667 from the first to 4 months of lactation, there is a gradual increase in the average monthly milk yield, the peak of the lactation curve falls on 4 months of lactation, and then over the next months the curve gradually and smoothly decreases until the end of lactation. Lactation curve of cow no. 2967 (Figure 4) is somewhat different from the others in that the average monthly milk yield for the second month of lactation is slightly less (by 38 kg) of the first month of lactation.

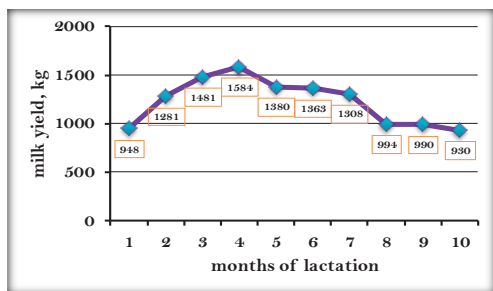


Figure 4. Lactation curve of cow no. 1667, fourth lactation, milk yield 12556 kg of milk

The peak of lactation occurs in the third month, followed by a gradual decrease until the end of lactation. It should be noted that the results of our studies are consistent with the data (Nekrasov et al., 2011), which also fixed the maximum values of the average monthly milk yield for 2-3-4 months lactation and the conclusion (Devyatov, 1983; Aldrich, 1987) that the lactation curve, regardless of productivity, has a certain optimal form with balanced feeding.

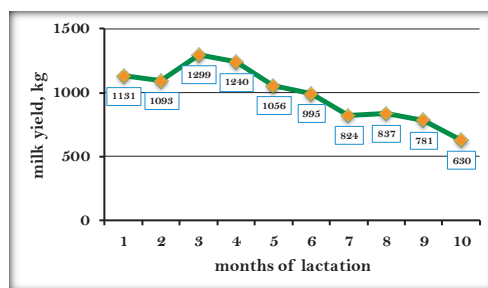


Figure 5. Lactation curve of cow no. 2967, of the second lactation, milk yield 9886 kg of milk

Thus, the lactation curve at all analyzed Holstein cows of the herd of SLL "Doksancom" changes with a certain regularity and has a leveled character, characterized by a high stable type, which is characteristic to animals with a strong constitution and high milk production.

The milk productivity of cows, as it is known, depends on a large number of factors, one of which is compliance with the technology of breeding and exploitation of animals in various farms and countries. In this regard, we carried out a comparative analysis of the milk yield of first-calf heifers raised in the herd of SLL "Doksancom", purchased from the breeding farm of J-SC. "Aydyn" and imported from Holland, tab. 2.

Analysis of Table 2 showed that the highest productivity was observed at first-calf cows raised in the herd of SLL "Doksancom" - 9518 kg of milk, which is by 925 kg more than heifers purchased from the breeding farm of J-SC "Aydyn", the difference is significant ($P < 0.05$) and for 1200 kg - heifers imported from the Netherlands ($P < 0.01$).

The amount of milk fat per lactation of first-calf heifers of all groups was high, but the

superiority should be given to first-calf cows raised in SLL "Doksancom", which exceeded by this feature first-calf cows from J-SC "Aydyn" by 39 kg, from Holland - 53 kg.

In terms of live weight, all first-calf heifers assessed averaged 578 kg, which exceeds the breed standard at the end of the first lactation by 28 kg (standard 550 kg).

Table 2. Milk productivity of first-calf cows, depending on origin ($X \pm Sx$)

No	Indicators	Society of limited liability "Doksancom"	Joint-Stock Company "Aydyn"	From the Netherlands	On average
1.	The number of cows, head	67	20	25	112
2.	Live weight, kg	581±2.9	577±3.6	571±4.0	578±2.1
3.	Milk, kg	9518±275.3	8593±243.2	8318±220.3	9085±183.5
4.	Fat content, %	3.91±0.01	3.86±0.01	3.83±0.01	3.88±0.01
5.	Amount of fat, kg	371±10.4	332±9.4	318±8.1	352±7.0

Of great importance in breeding work with dairy cattle has the correlation between economically useful traits. So, for example, the variability of the mass content and the amount of fat in milk, as well as the live weight,

depend on the variability of the milk yield of cows for lactation.

The results of studying the correlation between productivity indicators in the herd of SLL "Doksancom" are given in Table. 3.

Table 3. Correlation between productivity indicators and live weight, $r \pm m$

No	Correlated trait	I lactation	II lactation	III lactation	IV-VI lactations
1.	milk yield (X) - fat, % (Y)	-0.156±0.09	-0.409±0.1	-0.449±0.15	-0.154±0.05
2.	milk yield (X) - fat, kg (Y)	+0.993±0.0	+0.989±0.01	+0.986±0.02	0.995±0.02
3.	milk yield (X) - live weight (Y)	+0.189±0.08	+0.103±0.11	+0.271±0.16	-0.083±0.23

The relationship between milk yield and the percentage of fat in milk of cows was in a negative correlation from weak -0.154 (IV-VI lactation) to moderate -0.409 - -0.449 (II - III lactation), respectively. As it can be seen, one-way selection for the level of milk yield led to an increase in the negative relationship between these features. The presence of a negative relationship between the level of milk yield and fat content in milk makes it difficult to conduct successful selection and indicates the need for simultaneous selection for milk yield and fat content in milk.

It should be noted a high correlation between the amount of milk and the amount of milk fat, which for the first lactation is +0.993, second lactation - +0.989, third lactation - +0.986 and fourth-sixth lactation - +0.995. A comparative analysis of the results of the relationship between milk yield and the amount of milk fat established a high reliable positive relationship between the second and the first ($P<0.001$), between the third and first lactations ($P<0.05$). Between the milk yield of the live weight of cows, a weak positive correlation was revealed

for the first (+0.189), second (+0.103) and third (+0.271) lactations, a weak negative (-0.083) - for the fourth-sixth lactations. Low correlation coefficients between milk yield for all lactations and live weight indicate non-linear relationships between them, which characterizes the uniformity of the herd in terms of live weight.

CONCLUSIONS

1. With increasing number of lactations it also increased the production of milk per lactation, the amount of fat. Thus the milk production on lactation II was by 1468 kg more milk and constituted on average 10553 kg of milk, on lactation III - by 1215 kg, on lactations IV-VI - by 1199 kg, the difference being significant, with $P<0.001$, $P<0.001$ and $P<0.01$, respectively.
2. The high indicators of the milk production ratio are explained by the fact that cows have relatively high milk productivity for a number of lactations, which indicates the highlight of

the dairy type of the analyzed population of Holstein cattle.

3. A comparative analysis of the milk yield of first-calf heifers showed that first-calf cows raised in the herd of Society of limited liability "Doksancom" had the highest productivity - 9518 kg of milk, which is by 925 kg more than that of first-calf cows purchased from the breeding farm of Joint-Stock Company "Aydyn", the difference is significant ($P < 0.05$) and for 1200 kg - first-calf cows imported from Holland ($P < 0.01$). The lactation curve of Holstein cows of the herd of Society of limited liability "Doksancom" changes with a certain regularity and has a flattened character.

4. Low correlation coefficients between milk yield for all lactations and live weight indicate a non-linear nature of the relationships between them, which characterizes the uniformity of the herd of Society of limited liability "Doksancom" in terms of live weight.

5. In order to increase the productivity of the population when selecting animals for their own reproduction in JSC "Aydyn" and SLL "Doksancom" it should be taken into account the stability of the lactation curves and milk production coefficients.

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