

## STUDY OF THE INFLUENCE OF LIVE MASS ON THE INDICATORS OF MILK PRODUCTIVITY OF HOLSTEIN COWS OF DIFFERENT ORIGINS

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### Abstract

*The article presents the results of studying the impact of live weight on the milk productivity of Holstein cows of various origins after the first completed lactation in three breeding herds. To assess the influence of live weight on the productive traits of cows, the analyzed population in all herds was divided into three groups. Cows with a live weight up to 600 kg (Group I) and from 601-630 kg (Group II) in the herd of SLL "Gomerj Efram" positively correlated with milk yield and the amount of milk fat. In SLL "Dastocom", a positive moderate correlation (live weight – 305-day yield) was identified at cows of the first lactation of German selection up to 600 kg (Group I) ( $r = 0.448$ ), and with an increase in live weight, the correlation coefficient acquired a negative value. In the breeding herd of SLL "Total Gnatiuc", an advantage was found in favor of locally generated cows by 537 and 302 kg for French and Dutch breeds, respectively, with no significant differences observed.*

**Key words:** correlation, fat content, first lactation, live weight, milk yield.

### INTRODUCTION

Milk productivity of cows, being a genetically determined trait, is dependent on the influence of numerous factors. In the selection and breeding work with cattle, it is crucial to consider an indicator such as live weight, which provides the breeder with information about the development of body structure, constitution, as well as the health of the animal (Rogers et al., 1989; Khakimov & Mudarisov, 2014).

The milk productivity of a cow largely depends on its live weight, as live weight is an indicator of overall development and reflects the degree of animal nutrition. High milk productivity of cows is associated with significant physiological stress on the entire organism, so they must be well-developed, capable of consuming a large amount of feed and converting it into milk, and have a robust constitution and health.

The milk productivity of cows is influenced by both genotypic and paratypic factors and its significance is largely dependent on their live weight. Therefore, the study of the impact of

paratypic factors on the milk productivity of cows, including live weight, is highly relevant and has practical importance (Bakay et al., 2013; Fedorovich et al., 2016; Lepekhina et al., 2020; Mehtieva et al., 2021).

Live weight, as an indicator, often positively correlates with an important selection trait, such as milk yield, which, in turn, determines the level of milk productivity for an individual animal and the herd as a whole (Kostomakhin et al., 2006; Moskalenko et al., 2018). It is worth noting that each breed has its own standard for live weight, reaching which, the animal can maximize its genetic potential for milk productivity. Exceeding the breed standard for live weight indicates a tendency to obesity, and instead of an increase in productivity, a reverse correlation may occur, leading to a decrease.

Studies by various authors on the Holstein breed have shown (Gaydukova & Tyutyunikov, 2013; Santos et al., 2013) that during selection, the variability of one phenotypic indicator depends on the variability of other economically useful traits. The variability of the fat content in milk

depends on the variability of cow milk yield during lactation. According to some foreign scientists, for most breeds of cattle, the correlation between these traits is negative (Ropstad et al., 1988; Van Raden, 2001). In turn, the variability of milk yield depends on live weight, the age of animals at first calving, the duration of the dry period, and other factors (Sudarev, 2008; Belenkaya, 2018).

It should be noted that one of the assessments of the milk productivity of cows is the calculation of the milkiness coefficient, which characterizes milk production per 100 kg of the animal's live weight. It is considered that a cow should produce 8-10 times more milk than its weight. It is widely accepted that the optimal milkiness coefficient is in the range of 1000-1200 kg (Makartsev et al., 2002; Kostomakhin et al., 2006).

An analysis of literary sources regarding the study of the impact of live weight on the milk productivity of cows in the first completed lactation has shown that there have been few publications on this topic in recent decades. In studies (Tatarkina et al., 2017), the first heifer of Holstein breed with a living weight of more than 400 kg were distinguished by high productivity, the yield of which amounted to 8863.2 kg. A positive but weak correlation was observed between the live mass indicators and the productivity of the first calf heifer.

As a result of studying the correlation between yield of milk and body weight in the Holstein first heifer in the Society of limited liability "Dastocom" herd, a weak positive relationship was revealed (Foksha et al., 2021)

**The aim of the study** was to investigate the relationship between milk productivity and live weight of Holstein cows of different origins during the first completed lactation.

## MATERIALS AND METHODS

The research was focused on Holstein cows of various origins during their first completed lactation. The studies were conducted in breeding herds of SLL (Society of limited liability) "Gomert Efrem" – cows of local generation, SLL (Society of limited liability) "Dastocom" – cows of German breed, SLL (Society of limited liability) "Total Gnatiuc" –

cows of French and Dutch breed, as well as local generation.

The main studied traits included indicators of milk productivity over the study period (milk yield, kg; milk fat content, %; quantity of milk fat, kg; live weight, kg). The based selection-genetic parameters used in calculations were the arithmetic mean ( $\bar{X}$ ), standard error of the mean ( $\pm Sx$ ), coefficient of variation ( $Cv$ , %), and correlation coefficient ( $r$ ).

The milkiness coefficient ( $MC$ ), proposed by Startsev (1965), was calculated using the formula:  $MC = Y/LW$ , where  $MC$  is the milkiness coefficient, kg;  $Y$  is the milk yield for 305 days of lactation, kg;  $LW$  is the live weight, kg.

To study the influence of live weight on the milk productivity of cows during the first completed lactation in all herds, three groups of animals were formed. The selection of animals was carried out using a random sampling method from the general population of the herd, employing a selective research method. For the herd of SLL "Gomert Efrem," the first group included animals with a live weight up to 600 kg ( $n = 17$ ), the second group included animals with a live weight from 601 kg to 638 kg ( $n = 20$ ), and the third group included animals with a live weight from 640 to 656 kg ( $n = 13$ ). For the herd of SLL "Dastocom", the first group included animals with a live weight up to 600 kg ( $n = 17$ ), the second group included animals with a live weight from 601 kg to 638 kg ( $n = 20$ ), and the third group included animals with a live weight from 640 to 656 kg ( $n = 13$ ).

For SLL "Total Gnatiuc", the first group consisted of cows of French breed ( $n = 12$ ) with an average live weight of 629 kg, the second group consisted of cows of Dutch breed ( $n = 33$ ) with an average live weight of 596 kg, and the third group consisted of local generation cows ( $n = 27$ ) with an average live weight of 582 kg.

The correlation coefficient ( $r$ ) was calculated on the computer using the CORREL function in the Excel software environment. To determine the statistically significant differences in the data was used Student's test ( $t$ -criterion). Statistical data processing was performed using the Microsoft Office Excel 2010 computer application.

## RESULTS AND DISCUSSIONS

The results of studying the impact of live weight on the milk productivity of locally bred cows in the first completed lactation are presented (SLL "Gomerç Efreml") in Table 1. The maximum yield - 8437 kg - was obtained from cows with an average live weight of up to 600 kg.

Statistically insignificant differences in milk yield for 305 days of lactation were found between the first group of cows with low live weight (up to 600 kg) and the second group (with a live weight of 601-630 kg), with a difference of 174 kg, and between the first and the third group (with a live weight of 634-680 kg), with a difference of 275 kg.

Table 1. Influence of live weight on the milk productivity of locally bred Holstein cows in the first completed lactation SLL "Gomerç Efreml" ( $X \pm S_x$ )

Specification	Live weight for the first lactation, kg		
	First group up to 600 kg (n = 3)	Second group 601-630 kg (n = 13)	Third group 634-680 kg (n = 7)
Milk yield for 305 days of lactation, kg	8437±82.7	8263±62.0	8162±98.3
Fat content, %	3.99±0.01	3.98±0.03	3.99±0.05
Amount of fat, kg	336±4.1	329±4.0	325±5.6
Live weight, kg	584±7.0	619±2.0***	660±6.4***

Cows in the second and third groups, on average by live weight, significantly exceeded cows in the first group by 35 kg and 76 kg, respectively ( $P < 0.001$ ).

The results of studying the correlation between the live weight of cows and productivity indicators are presented in Figure 1.

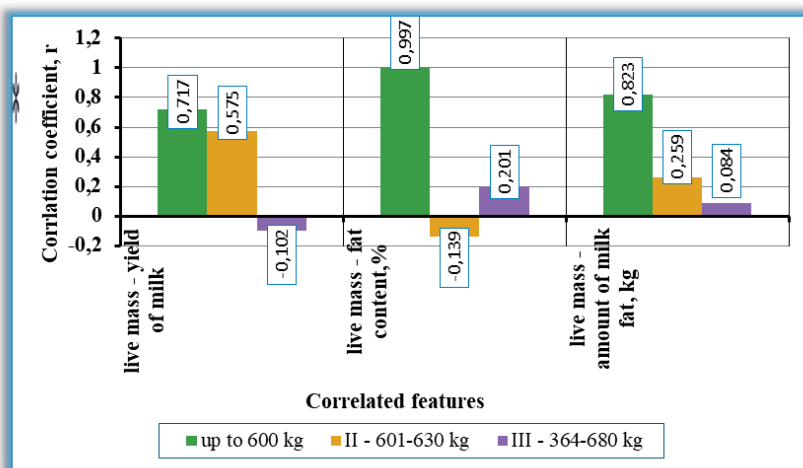


Figure 1. Correlation between key productivity indicators and live weight of locally bred Holstein cows, of SLL "Gomerç Efreml"

As evident from the data in Figure 1, a high positive correlation was observed between live weight and milk yield, as well as between live weight and the quantity of fat in milk for the first group of cows ( $r = 0.717$ ) and ( $r = 0.823$ ), respectively. A moderate positive correlation (live weight - milk yield) was established for cows in the second group (0.575) with a live weight of 601-630 kg. For the third group with a live weight of 634-680 kg, the correlation coefficient between milk yield took a negative

value ( $r = -0.102$ ), indicating a low degree of correlation.

A negative correlation was identified between live weight and fat content for the second group, with a weak correlation strength ( $r = -0.139$ ), while for the third group, the correlation was positive with weak strength. Comparative analysis (live weight - fat content) between the first and second groups showed a statistically significant difference of 0.858,  $t_d = 2.76$  ( $P < 0.005$ ).

In the second and third groups of analyzed animals, weak and very weak positive correlation coefficients were observed between live weight and the quantity of milk fat ( $r = 0.259$ ) and ( $r = 0.084$ ), respectively.

Thus, Holstein cows of local generation with a live weight up to 600 kg and from 601-630 kg in the SLL "Gomerç Efrem" herd positively correlated with milk yield and the quantity of milk fat. Further increase in the live weight of

locally bred cows in the SLL "Gomerç Efrem" herd from 620 kg is undesirable due to a decrease in milk yields.

The study of the impact of live weight on the milk productivity of Holstein cows of German breed in the first completed lactation in the SLL "Dastocom" herd showed that the maximum yield - 9316 kg - was obtained from cows with an average live weight of up to 600 kg, as presented in Table 2.

Table 2. Influence of live weight on the milk productivity of cows in the first completed lactation, of SLL "Dastocom" ( $X \pm Sx$ )

Specification	Live weight for the first lactation, kg		
	up to 600 kg (n = 17)	601-638 kg (n = 20)	640-656 kg (n = 13)
Milk yield for 305 days of lactation, kg	9316±127.2	9065±116.8	9282±84.3
Fat content,%	3.88±0.01	3.89±0.01	3.87±0.01
Amount of fat, kg	361±4.3	354±4.2	359±3.5
Live weight, kg	587±2.1	628±2.4***	646±1.5***
Milk coefficient, kg	1587±20.1***	1444±21.0	1437±13.5

Note: \*\*\* -  $P < 0.001$

A difference in milk yield for 305 days of the first lactation was identified between the first group of cows with low live weight (up to 600 kg) and the second group (with a live weight of 601-638 kg) by 251 kg, but the difference was statistically insignificant.

Cows in the second and third groups, on average by live weight, significantly exceeded cows in the first group by 41 kg and 59 kg, respectively ( $P < 0.001$ ).

For a more objective assessment, we analyzed the milkiness coefficient (MC). As observed, the milkiness coefficient also varies depending on live weight. The milkiness coefficient for the first group was 1587 kg of milk and with an increase in live weight, a significant decrease of

143 kg and 150 kg was observed for the second and third groups, respectively.

Therefore, milk production is most efficient at cows with a live weight of up to 600 kg. The obtained values of the milkiness coefficient for the analyzed groups of first-calving cows suggest that high-yielding dairy cows are utilized in the SLL "Dastocom" herd.

It is known that live weight positively correlates with milk yield for 305 days of lactation and has negative correlation coefficients with qualitative milk indicators. As a result of studying the correlation between the live weight of cows and their milk productivity, a moderate positive correlation was identified for the first group with a live weight of up to 600 kg (0.448), as shown in Table 3.

Table 3. Correlation between key productivity indicators and live weight of Holstein cows of German breed in the first lactation, of Society of limited liability "Dastocom",  $r \pm m_r$

No	Correlated trait	Live weight for the first lactation, kg		
		up to 600 kg (n = 17)	601-638 kg (n = 20)	640-656 kg (n = 13)
1.	live weight – milk yield 305 days	0.448±0.23	-0.285±0.22	-0.015±0.3
2.	live weight – fat content, %	-0.386±0.24	0.069±0.23	0.421±0.3
3.	live weight – amount of fat, kg	0.427±0.23	-0.353±0.22	0.125±0.3
4.	live weight – milk production rate	0.208±0.25	-0.527±0.20	-0.266±0.3

The live weight of cows in the second and third groups exceeds the breed standard requirements for cows in the first lactation by an average of 78 kg and 96 kg, as shown in Table 2. This is

reflected in the direction of the correlation between the correlated traits, meaning that an increase in the live weight of animals leads to a decrease in milk yields. The obtained results

confirm the statements made by Moskalenko et al. (2018) and Rusanova (2018) that exceeding the breed standard for live weight can result in a reverse correlation relationship, leading to a decrease in productivity instead of an increase. A positive moderate correlation was established (live weight – milk yield for 305 days) at heifers for the first group (0.448). However, with an increase in the live weight of first-calving cows, the correlation coefficient takes a negative value. For the second group of cows, a negative correlation coefficient was identified ( $r = -0.285$ ), indicating a low degree of correlation, and for the third group, the correlation coefficient was also negative, with a very weak or practically non-existent degree of correlation ( $r = -0.015$ ).

A negative correlation was found between live weight and fat content for the first group, with a moderate degree of correlation ( $r = -0.386$ ), while the correlation between live weight and the quantity of milk fat was positive, with a moderate degree of correlation ( $r = 0.427$ ).

In the second and third groups of analyzed animals, low and moderate positive correlation coefficients were established between live weight and fat content, as well as between live weight and the quantity of milk fat. However, the interdependence of live weight and the

quantity of milk fat in the second group of cows had a negative correlation, with a moderate degree of correlation ( $r = -0.353$ ).

Live weight also positively correlates with the milkiness coefficient. For heifers of the first group, a positive correlation coefficient was established, with a weak degree of correlation ( $r = 0.208$ ). However, with an increase in the live weight of animals, the correlation with the milkiness coefficient takes on a negative value: for the second group (live weight 601-638 kg), the correlation coefficient is negative, and the degree of correlation is noticeable ( $-0.527$ ), and for the third group, it is ( $-0.266$ ), with a weak degree of correlation.

Thus, cows with a live weight up to 600 kg in the SLL "Dastocom" herd positively correlate with key productivity indicators, except for fat content.

Research was conducted at the breeding farm SLL "Total Gnatiuc" to study the productive qualities of Holstein cows of different origins. Currently, at SLL "Total Gnatiuc", are bred Holstein cows of French, Dutch, and local generations.

The results of studying the milk productivity of cows of different origins for the first completed lactation in the breeding farm SLL "Total Gnatiuc" are presented in Table 4.

Table 4. Characteristics of Holstein cows of different origins based on milk productivity for 305 days of the first lactation, of SLL "Total Gnatiuc" (X±Sx)

Indicators	Origin			Average, n = 72
	French n = 12	Dutch n = 33	The local generation n = 27	
Milk yield, kg	9018±451.8	9253±218.7	9555±211.8	9327±147.8
Cv, %	17.4	13.6	11.5	13.4
Fat content, %	3.92±0.02	3.89±0.01	3.80±0.01	3.87±0.01
Cv, %	0.1	2.1	1.5	2.3
Amount of fat, kg	353±16.1	360±7.8	362±7.8	359±5.2
Cv, %	15.8	12.4	11.2	12.4
Body mass, kg	629±6.6***	596±4.2**	582±2.9	596±3.1
Cv, %	3.7	4.1	2.6	4.4
Milk yield coefficient, kg	1443±88.8	1558±40.9	1644±36.7***	1571±28.3
Cv, %	21.3	15.1	11.6	15.3

Note: \*\* -  $P < 0.01$ ; \*\*\* -  $P < 0.001$

The level of milk productivity for a 305-day lactation period showed an advantage in favor of local generation cows by 537 and 302 kg compared to French and Dutch breeds, respectively, with no significant differences observed.

Regarding the live weight, local generation cows lagged behind their peers of French breed

by 47 kg ( $P < 0.001$ ) and Dutch breed by 14 kg ( $P < 0.01$ ).

Analysis of variability indicators of milk productivity revealed that cows of different breeds had sufficient coefficients of variability for conducting breeding and breeding work, ranging from 11.5 to 17.4%.

French breed cows showed higher variability in milk yield, milk fat quantity, and milkiness coefficient compared to their peers, with coefficients of variation for these traits being 17.4%, 15.8%, and 21.3%, respectively. As for Dutch breed cows and especially local generation, it should be noted that their genetic diversity is somewhat reduced.

Calculation of the milkiness coefficient showed that all analyzed groups of animals had different

milkiness coefficient values. Local generation cows significantly exceeded their French breed counterparts by 201 kg ( $P < 0.001$ ).

The next stage of the research was to determine the magnitude of the correlation coefficient.

Data on the correlation between milk yield and milk quality indicators, as well as live weight at Holstein cows of different breeds, are presented in Table 5.

Table 5. Correlation coefficients between productivity indicators of cows of different breeds, SLL "Total Gnatiuc",  $r \pm m$ .

Indicators	Origin		
	French	Dutch	The local generation
milk yield – fat content, %	-0.720±0.22	-0.659±0.11	-0.319±0.19
milk yield – amount of fat, kg	0.996±0.02	0.992±0.02	0.981±0.04
live weight - milk yield	-0.813±0.18**	-0.288±0.18	0.078±0.20
live weight – fat content,%	0.459±0.30	-0.280±0.17	-0.198±0.20
live weight – amount of fat, kg	-0.822±0.18**	0.233±0.17	0.065±0.20

Note: \*\* -  $P < 0.01$

From the presented data in Table 5, it can be concluded that there is a high inverse correlation (French origin), moderate (Dutch origin), and noticeable (local generation) correlation between milk yield and fat content, meaning that an increase in milk yield results in a decrease in milk fat content. Similar findings were reported in the research by Abrompolsky & Abylkasymov (2005).

The correlation coefficients (yield-content) for fat at French and Dutch breed cows were by 0.401 and 0.340 higher than in local generation cows.

Between live weight and milk yield, a high inverse (French origin), weak inverse (Dutch origin), and weak positive (local generation) correlation were identified. Comparative analysis between cows of different breeds based on indicators (live weight - yield) and

(live weight - fat quantity) showed that French breed cows significantly exceeded local generation cows by 0.735 and 0.757 ( $P < 0.01$ ). For local generation cows, a weak positive relationship was found between live weight and milk yield (+0.078) and live weight and milk fat quantity (+0.065). Similar results were obtained in the research by Vorobyev et al. (2016), where the correlation between traits (yield - live weight) was very low, ranging from 0.063 to 0.187.

Therefore, the optimal live weight for cows of the first completed lactation in the "Total Gnatiuc" herd should be in the range of 570-580 kg, that is., up to 600 kg.

## CONCLUSIONS

In SLL "Gomerę Efrem," a high positive correlation was identified between live weight and milk yield, as well as between live weight and the quantity of fat in milk for the first group of cows ( $r = 0.717$ ) and ( $r = 0.823$ ), respectively, where the live weight of local generation cows in the first completed lactation was not more than 600 kg.

The study on the influence of live weight on the milk productivity of German breed Holstein cows in the first completed lactation at the SLL "Dastocom" herd showed that the maximum yield of 9316 kg was obtained on average for cows with a live weight of up to 600 kg. A difference in yield for the first 305 days of lactation was identified between the first group of cows with low live weight (up to 600 kg) and the second group (with a live weight of 601-638 kg) at 251 kg, but the difference was not significant.

Comparative analysis between cows of different breeds at the breeding farm SLL "Total Gnatiuc", based on indicators (live weight - yield) and (live weight - fat quantity), showed that the cows of the French breed are reliable

they outperformed cows of local generation by 0.735 and 0.757 ( $P < 0.01$ ).

When selecting cows based on yield, it is necessary to consider live weight, which for Holstein cows should not exceed 600 kg, regardless of their origin, breeding, and maintenance in herds located in different climatic zones of the Republic of Moldova (northern, central, and southern).

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