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INFLUENCE OF LIVE WEIGHT OF FIRST-CALF COWS FROM INSEMINATION TO THE FIRST 100 DAYS OF LACTATION ON SUBSEQUENT MILK PRODUCTION

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The article presents the results of determining the influence of the live weight of primiparous cows from fertilization to the first 100 days of lactation on subsequent milk productivity.

The study was conducted on primiparous cows of the Ukrainian black-and-white dairy breed, which are kept at the breeding plant of the State Enterprise "Hontarivka" of the Chuguyiv district of the Kharkiv region. During the experiment, the influence of various technological regimes on changes in live body weight during the first 100 days of lactation was studied. The main parameters studied were the live weight of primiparous cows at the stages of fertilization, after calving and in the first 100 days of lactation, as well as their milk productivity for 305 days of the lactation period. The determination of milk productivity included accounting for the gross milk yield of natural fat content on the 100th, 200th and 305th days, as well as an estimate of the mass fraction of fat and protein in milk for the entire lactation period. For the analysis, a retrospective study of cow productivity over the past decade was conducted.

For the study, four groups of primiparous cows were formed depending on their live weight at the time of fertile insemination: Group I - up to 380 kg, Group II - 380–399 kg, Group III - 400–419 kg, Group IV - over 420 kg.

The average live weight at insemination was: in Group I - 358.8 ± 1.51 kg, Group II - 387.7 ± 0.49 kg, Group III - 406.3 ± 0.65 kg, Group IV - 445.5 ± 3.66 kg. Animals of Group IV exceeded their peers from other groups by 39.2–86.7 kg, which corresponded to an increase in weight by 8.8–19.5%. The live weight of cows after calving was: in group I – 573.9 ± 3.56 kg, II – 583.4 ± 3.58 kg, III – 590.3 ± 6.01 kg, IV – 591.1 ± 5.51 kg. However, after calving, the difference between the groups began to decrease: cows of group IV outweighed animals of group I by only 17.2 kg (2.9%), group II – by 7.7 kg (1.3%), group III – by 0.8 kg (0.1%).

On the 100th day after calving, the difference in live weight between group IV and other groups increased again. The average weight in group IV was 561.7 ± 4.54 kg, which exceeded the indicators of group I by 5.5% (530.6 ± 3.00 kg), group II by 3.1% (544.1 ± 2.95 kg), group III by 1.6% (552.8 ± 4.90 kg).

Live weight losses from the moment of calving to the 100th day of lactation were: in group I - 43.2 ± 8.6 kg (7.5%), in group II - 39.3 ± 8.3 kg (6.7%), in group III - 37.6 ± 11.2 kg (6.4%), in group IV - 29.3 ± 9.2 kg (5.0%).

Analysis of the obtained data showed that the first-born cows of group III had better adaptation to further productive use. The implementation of these results in production will help optimize the feeding of heifers and cows in the post-calving period, which will increase the efficiency of herd management.

Keywords: *replacement heifers, first-born, analysis, live weight, milk productivity.*

ВПЛИВ ЖИВОЇ МАСИ КОРІВ-ПЕРВІСТОК ВІД ЗАПЛІДНЕННЯ ДО ПЕРШИХ 100 ДНІВ ЛАКТАЦІЇ НА НАСТУПНУ МОЛОЧНУ ПРОДУКТИВНІСТЬ

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У статті наведено результати визначення впливу живої маси корів-первісток від запліднення до перших 100 днів лактації на послідуючу молочну продуктивність.

Дослідження було проведено на коровах-первістках української чорно-рябої молочної породи, які утримуються на племінному заводі ДП ДГ «Гонтарівка» Чугуївського району Харківської області. У ході експерименту вивчали вплив різних технологічних режимів змін живої маси тіла протягом перших 100 днів лактації. Основними досліджуваними параметрами були жива маса корів-первісток на етапах запліднення, після отелення та в перші 100 днів лактації, а також їх молочна продуктивність за 305 днів лактаційного періоду. Визначення молочної продуктивності включало облік валового надою молока натуральної жирності на 100-й, 200-й і 305-й дні, а також оцінку масової частки жиру та білка в молоці за повний лактаційний період. Для аналізу було проведено ретроспективне вивчення продуктивності корів за останнє десятиріччя.

Для дослідження сформували чотири групи первісток залежно від їх живої маси під час плідного осіменіння: I група – до 380 кг, II – 380–399 кг, III – 400–419 кг, IV – понад 420 кг.

Середні показники живої маси при осіменінні становили: у I групі – 358,8 ± 1,51 кг, II – 387,7 ± 0,49 кг, III – 406,3 ± 0,65 кг, IV – 445,5 ± 3,66 кг. Тварини IV групи перевищували своїх ровесниць з інших груп на 39,2–86,7 кг, що відповідало збільшенню маси на 8,8–19,5 %. Жива маса корів після отелення становила: у I групі – 573,9 ± 3,56 кг, II – 583,4 ± 3,58 кг, III – 590,3 ± 6,01 кг, IV – 591,1 ± 5,51 кг. Проте після отелення різниця між групами почала зменшуватися: корови IV групи переважали тварин I групи лише на 17,2 кг (2,9 %), II групи – на 7,7 кг (1,3 %), III групи – на 0,8 кг (0,1 %).

На 100-й день після отелення різниця у живій масі між IV групою та іншими групами знову збільшилася. Середня маса у IV групі становила 561,7 ± 4,54 кг, що перевищувало показники I групи на 5,5 % (530,6 ± 3,00 кг), II групи – на 3,1 % (544,1 ± 2,95 кг), III групи – на 1,6 % (552,8 ± 4,90 кг).

Втрати живої маси від моменту отелення до 100-го дня лактації склали: у I групі – 43,2 ± 8,6 кг (7,5 %), у II групі – 39,3 ± 8,3 кг (6,7 %), у III групі – 37,6 ± 11,2

кг (6,4 %), у IV групі – 29,3 ± 9,2 кг (5,0 %).

Аналіз отриманих даних показав, що корови-первістки III групи мали кращу адаптацію до подальшого продуктивного використання. Впровадження цих результатів у виробництво сприятиме оптимізації годівлі нетелів та корів у післяотільний період, що дозволить підвищити ефективність управління стадом.

Ключові слова: *ремонтні телиці, первістки, аналіз, жива маса, молочна продуктивність.*

Introduction. One of the main modern global problems that humanity needs to solve is the shortage of food in certain regions. The latest report of the FAO (2023) "State of Food Security and Nutrition in the World" states that in 2022 from 691 to 783 million people faced the problem of hunger. This is 122 million people more than in 2019, before the start of the COVID-19 pandemic.

One of the ways to solve this problem is to increase the production of livestock products, in particular milk and beef.

In modern conditions, it is possible to increase the profitability of agricultural enterprises producing milk only by increasing animal productivity. A special role in the formation of milk productivity of cows and the manifestation of its genetic potential is given to the improvement of milk production technology (Voytenko S.L., Zheliznyak I.M., 2019).

Studies by Khmelnychy and Bardash (2019) have proven that different environmental conditions in which animals are during their growth and development can both contribute to high milk productivity and suppress it. According to Kostenko V. (2020), low and very high levels of feeding when raising dairy cows are inappropriate, as they negatively affect further milk productivity and reproductive ability. Scientists have found that when heifers are overfed and inseminated at an older age, they have increased fat deposition in the body, reproductive functions develop worse, and milk productivity subsequently decreases. In underdeveloped dairy cows, the economic value decreases sharply, since they have a low manifestation of almost all economic useful traits, and animals with excessive mass do not fully pay for the feed spent on its production with products (mainly milk). Milk productivity of cows is the result of the interaction of many factors, among which the live weight of primiparous cows in the first 100 days of lactation is singled out as one of the key indicators. This period is critical for the formation of both the productivity of the animal and its health. Many studies confirm that maintaining optimal body weight at this time is an important condition for achieving high results in subsequent lactation (Dymchuk A. V., Ponko L. P., 2022).

Also, the age of the first insemination (L. Karlova et al., 2018), body weight at fertile insemination (Vedmedenko O. V., 2019) have a significant impact on the subsequent milk productivity of animals.

According to the results of their own studies, Piddubna et al. (2021) concluded that with increasing calving age, milk productivity and milk quality indicators tend to decrease.

At the same time, according to Turiello et al. (2020), first-born cows with an earlier calving age had lower milk productivity in the first 5 months of lactation.

According to the studies of Kusaka et al. (2022) found that the frequency of difficult calvings and the prevalence of stillbirths were significantly higher in animals with low body weight compared to heifers with medium and high body weight.

At the same time, scientists and practitioners have long been interested in the impact of post-calving weight loss on the milk production of cows and primiparous cows. Unfortunately, such studies have been conducted quite rarely, especially in Ukraine. This

was due to the complexity of recording the necessary indicators. But recently, with the introduction of modern automatic accounting systems on farms, these studies can provide more interesting information.

For example, according to the results of a study by Berry et al. (2017), cows that lost more weight at the beginning of lactation had higher milk production with an increased content of fat and protein. However, this trend changed in those cows that significantly reduced their condition after calving, while cows with higher weight demonstrated an inverse relationship. Milk production was observed to increase with increasing body weight, but this effect decreased as the animals recovered.

Zahout and Moallem (2017) found in their study that cows that experienced significant body weight loss (7% to 17%) during the first five weeks of lactation had an average 30-day milk yield of 1.4 kg/day more compared to animals whose weight loss was only 3–6%. This suggests that more intense body weight loss after calving may be associated with increased milk production in the early stages of lactation.

According to Wathes et al. (2008), heifers that calve with higher fatness (3.8–3.9 points) subsequently mobilize more tissues for milk production and recovery, which also has detrimental consequences for fertility.

This relationship requires further research to clarify the causes and possible consequences for animal health. This and the small amount of information on this problem in Ukraine served as an impetus for our research.

The purpose of the work is to establish the influence of heifer live weight and its decrease in the first 100 days after calving on the milk productivity of first-born heifers.

To achieve this goal, the following tasks were set:

– to analyze the dynamics of live weight of primiparous cows during their rearing period, after calving, in the first 100 days of lactation;

– to determine the dynamics of live weight, milk productivity and milk quality indicators of primiparous cows for 305 days of lactation.

Materials and methods of the study. The study was conducted on primiparous cows of the Ukrainian black and white dairy breed of the breeding plant of the State Enterprise “Hontarivka” of the Chuguyiv district of the Kharkiv region using different technological regimes of changes in live body weight during the first 100 days of lactation. The key paratypic factors were the live weight of primiparous cows from the moment of fertilization, after calving and in the first 100 days of lactation, as well as milk productivity during 305 days of lactation. Milk accounting was carried out taking into account the gross milk yield of natural fat content on the 100th, 200th and 305th days and the mass fraction of fat and protein content for 305 days of lactation. For this purpose, a retrospective analysis of the productive indicators of the livestock over the past 10 years was conducted.

The implementation of the tasks of the work at their various stages involved the use of standard and generally accepted research methods: zootechnical (growth and development of heifers, milk productivity of primiparous cows), abstract-logical (theoretical generalizations, critical analysis of publications by domestic and foreign scientists, formation of conclusions); retrospective, analytical and probabilistic methods; variational statistics (biometrics of the reliability of the conducted research); statistical and economic (for processing and analysis of statistical data), multi-criteria analysis.

Four technological groups of primiparous cows were formed depending on the live weight at fertile insemination according to the scheme (Table 1).

Table 1

Scheme for forming groups of primiparous cows

Indicators	Group			
	I	II	III	IV
Number of animals in the sample, head	149	150	96	52
Live weight at fertile insemination, kg	to 380	380-399	400-419	420 and more

The following factors were taken into account in the process of conducting the study:

– change in live weight of heifers (according to data from monthly control individual weighings) and primiparous cows (according to data from weighings and calculation of live weight using measurements). Based on the data obtained, the dynamics of live weight of experimental animals was calculated;

– level of milk productivity of primiparous cows – according to individual data from monthly control milkings with the selection of average milk samples to determine its quality indicators;

– quality indicators of milk (mass fraction of fat and protein) – according to individual data from zootechnical accounting;

– statistical processing of the research results was carried out using biometric methods with determination of the probability level (Ibatullin I.I. et al., 2017).

Multicriteria analysis was performed using the method of evaluating the integral criterion of the distance to the target using the approach of collapsing all criteria to one N using normalization (Piskun, V., 2020). The relative distance N(Ck) will be found for each alternative solution from the expression:

$$N(C_k) = \frac{\sum_{i=1}^{n} u_{ij}^{N} - \sum_{i=1}^{n} u_{i_0}^{N}}{\sum_{i=1}^{n} u_{i_0}^{N}},$$

where $N(C_k)$ – the efficiency of each of the options under study compared to the idealized one;

u^N_{ij} – the normalized j-th indicator of the option under study;

u^N_{io} – the normalized 0-th indicator of the idealized option;

n – the number of evaluated criteria.

Digital material of experimental research was processed by biometric methods using the MS Excel 2003 application package.

Results of research. During the research period, initial data were obtained on establishing patterns and features of the dynamics of live weight indicators, milk productivity of first-born cows for the first 100 days of lactation, 200 days and 305 days of lactation and milk quality indicators (Fig. 1).

It was established that the live weight at fertile insemination was on average in group I – 358.8 ± 1.51 kg, II – 387.7 ± 0.49 kg, III – 406.3 ± 0.65 kg and IV – 445.5 ± 3.66 kg. According to this indicator, it is clear that animals of group IV outweighed animals of other groups by 86.7-39.2 kg or 19.5-8.8% (P>0.999).

The same picture was observed after calving. The live weight of primiparous cows of group I was 573.9 ± 3.56 kg, group II – 583.4 ± 3.58 kg, III – 590.3 ± 6.01 kg and IV – 591.1 ± 5.51 kg. However, it was found that the live weight in the first days had a

tendency to decrease the difference between the groups: animals of group IV outweighed the firstborn from group I by an average of 17.2 kg (or 2.9%), group II - by 7.7 kg (1.3%), group III - by only 0.8 kg (0.1%) (P>0.99 with the first group, with groups II and III there is no significant difference).

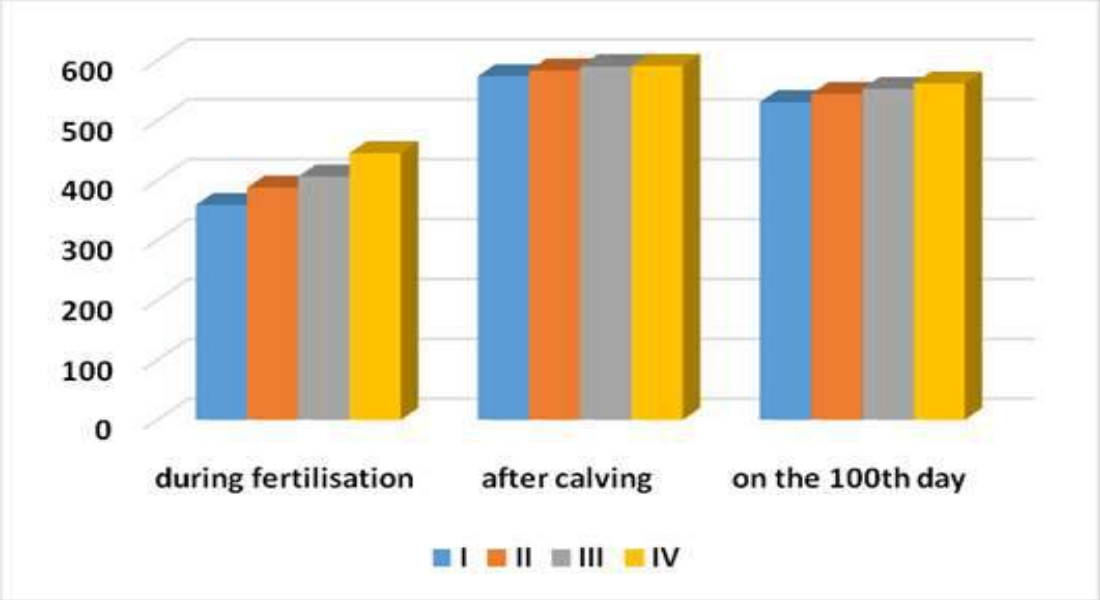

Fig. 1. **Dynamics of live weight of heifers and primiparous cows.**

And according to the results of monitoring live weight on the 100th day after calving, an increase in the difference in live weight of cows of group IV compared to animals of other groups was again noted - 561.7 ± 4.54 kg versus 530.6 ± 3.00 kg (or + 5.5 %) in group I (P>0.999), 544.1 ± 2.95 kg (+ 3.1 %) in group II (P>0.99) and 552.8 ± 4.90 (+ 1.6 %) in group III (P<0.90).

An analysis of milk productivity of primiparous cows during 305 days of lactation was also conducted (Table 2).

Table 2

Indicators of milk productivity and milk quality of primiparous cows per lactation

Indicators	Group			
	I	II	III	IV
Number of heads	149	150	96	52
Milk yield for 1-100 days of lactation, kg	2106,3± 36,29	2462,2± 36,41	2589,4± 45,93	2503,1± 56,22
Milk yield on 101-200 days of lactation, kg	1693,0± 27,43	1952,5± 27,93	2046,8± 33,04	1992,4± 43,07
Milk yield on 201-305 days of lactation, kg	1366,5± 23,19	1605,7± 24,20	1671,4± 28,73	1605,5± 33,59
Milk yield on 305 days of lactation, kg	5165,8± 85,74	6020,3± 87,19	6307,5± 105,53	6101,0± 129,68
Fat content by mass, %	4,07 ±0,31	4,06 ±0,32	4,04 ±0,33	4,00 ±0,33
Milk fat, kg	210,5	244,4	254,7	244,2
Protein content by mass, %	3,26 ±0,23	3,25 ±0,20	3,24 ±0,29	3,16 ±0,24
Milk protein, kg	168,6	195,4	204,6	192,6

According to the results of the assessment, it was found that during the first 100 days of lactation, the largest amount of milk with natural fat content was obtained from cows of group III - 2589.4 ± 45.93 kg, from first-born cows of group IV - less by 86.3 kg (3.3%), group II - less by 127.3 kg (4.9%), and group I - less by 483.1 kg (18.7%) (Fig. 2).

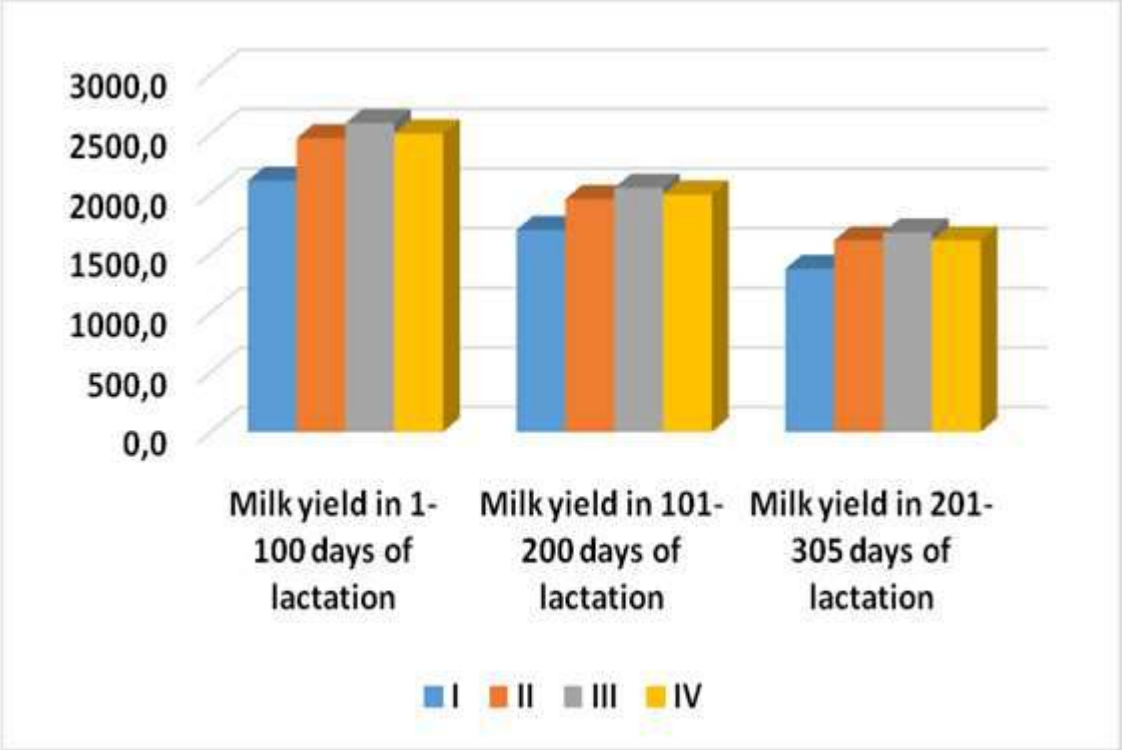

Fig. 2. **Dynamics of milk productivity of primiparous cows depending on live weight.**

In the next 100 days of lactation, this trend was preserved. The productivity of first-born cows of group III was higher than that of yearlings from group IV by 54.3 kg (2.6%) (P<0.90), group II - by 94.2 kg (4.6%) (P>0.95), and group I - by 353.8 kg (17.3%) (P>0.999).

In the third phase of lactation (201-305 days), the dominance of animals of group III over others in terms of milk productivity was also observed. They prevailed in this indicator over cows from group IV by 65.8 kg (3.9 %) (P<0.90), group II by 65.7 kg (3.9 %) (0.90<P<0.95), and group I by 304.8 kg (18.2 %) (P>0.999).

It was established that the highest milk productivity for 305 days of lactation according to the primary accounting data was observed in cows that had a live weight of 400-419 kg (group III) at the time of fertile insemination, - 6307.5± 105.53 kg of milk of natural fat content. This indicator turned out to be greater than that of animals of group I by 1141.7 kg or 18.1% (P>0.999), group II – by 287.2 kg or 4.6% (P>0.95) and group IV – by 206.5 kg or 3.3% (P<0.90).

At the same time, a different pattern is observed with respect to the qualitative indicators of milk (mass fraction of fat and protein) - in cows with lower productivity, these indicators turned out to be higher. Thus, the fat content in milk in group I turned out to be higher than in group II by 0.01% (0.36 abs. %), compared to group III - by 0.04% (0.86 abs. %) and IV - by 0.07% (1.17 abs. %).

The same trend was observed with the protein content. In group I, this indicator was higher compared to other groups by 0.02% (0.53 abs. %), 0.02% (0.62 abs. %) and 0.11% (3.28 abs. %), respectively.

Based on the results of determining the indicators of live weight at fertile insemination, live weight at calving, on the 100th day of lactation, milk productivity and milk quality of first-born cows per lactation, a multi-criteria analysis was performed (Table 3).

Table 3

Multicriteria analysis of the dynamics of live weight and milk productivity of primiparous cows

Indicators	Group			
	I	II	III	IV
Live weight at fertile mating, kg	1,0805	1	1,0478	1,1491
Live weight after calving	1,0166	1	1,0118	1,0132
On the 100th day of lactation	1,0586	1,0323	1,0161	1
Milk yield for 1-100 days of lactation, kg	1,2293	1,0517	1	1,0345
Milk yield on 101-200 days of lactation, kg	1,2089	1,0483	1	1,0273
Milk yield on 201-305 days of lactation, kg	1,2231	1,0409	1	1,0410
Milk yield on 305 days of lactation, kg	1,2210	1,0477	1	1,0338
Mass fraction of fat content %	1	1,0025	1,0074	1,0175
Mass fraction of protein content, %	1	1,0031	1,0062	1,0316
Σ	10,038	9,2265	9,0894	9,3480
Objective function (SC)	0,1153	0,0252	0,0099	0,00387
Difference, times	11,6465	2,5455	-	3,9091

The results of the comparative analysis by the complex efficiency indicator of each of the alternative options N(Ck) in comparison with the idealized one allow us to note the significant advantage of the third group, for which the objective function according to the considered criteria is the smallest and is 0.0099. At the same time, the objective function for the first group turned out to be 11.65 times worse, and the second and fourth groups were 2.55 and 3.91 times worse, respectively. That is, by the complex indicator, the efficiency of animals of group III by economic characteristics turned out to be higher than in other groups.

And to establish the relationship between paratypic factors - milk yield for 305 days of lactation, kg (Y); and live weight at fertilization, kg (X1); live weight after calving, kg (X2); live weight 100 days after calving, kg (X3); average mass fraction of fat in milk, % (X4); average mass fraction of protein in milk, % (X5) mathematical models were developed. The following were developed and analyzed: linear, incomplete quadratic and complete quadratic models.

Linear model:

$Y = 165{,}337 + 16{,}213\ X_1 + 5{,}242X_2 – 7{,}934X_3 – 412{,}412X_4 + 685{,}676X_5$

R-squared = 0.168

Incomplete quadratic model:

$Y = -18534.660 + 109.107\ X1 – 8.407\ X2 + 20.053X3 – 3724.916X4 + 2981.336X5 – 0.118X12 + 0.010X22 – 0.023X32 + 385.264X42 – 337.956X52$

R-squared = 0.220

Full quadratic model:

$Y = 28346.410 + 7.230 X1 – 10.757X2 +33.814X3 – 10976.278X4 – 6632.054X5 – 0.113X12 + 0.024X22 – 0.042X32 +496.708X42 – 336.888X52 + 0.004X1*X2 – 5.666 X1*X4 + 22.482 X1*X5 – 5.141 X2*X5 + 1.826 X3*X4 + 970.384X4*X5$

R-squared = 0.249

Analysis of the obtained models showed that the R-squared value of the full quadratic model is the largest, that is, this model most adequately describes the relationship between paratypical factors.

Discussion. The results of this study show that primiparous heifers that were inseminated at a body weight of 400–419 kg (slightly above optimal) and had an average body weight loss at day 100 of lactation (37.6 ± 11.2 kg) outperformed their peers in terms of milk production.

According to Handcock et al. (2018), the increase in milk yield due to an increase in the percentage of target body weight achieved is consistent with the finding that heavier heifers (especially after puberty and at calving) have more milk solids during the first lactation. Body weight at calving influences the body reserves available to the primiparous heifer to support lactation, the growth requirements during lactation, and the heifer's likely hierarchical position in the herd, so it is not surprising that this would affect lactation.

According to Martín et al. (2018), first-born cows that reached the target live weight (for fertilization) at the age of 15 months produced more milk, protein and total milk solids than their peers that did not reach this at the same age.

At the same time, as noted by V. Liskovich (2023), a different trend was observed in Ukrainian red-and-white cows - the minimum milk yield (4715 kg) was obtained from animals that had the lowest live weight at the first insemination - 374 kg and age 17.5 months, and the maximum milk yield - 5794 kg was obtained from first-born cows that had the maximum indicators of both age and live weight at the first insemination.

And the studies of Shulyar et al. (2020) found that the best milk yields and the amount of milk fat and protein, their total production were noted by first-born cows with a live weight at the time of the first insemination of 391–400 kg. First-born cows, whose live weight at the time of the first calving was within 511–530 kg, were noted for the highest milk yields, the amount of milk fat, protein, their total production. They significantly exceeded cows weighing 471–490 kg in milk yield by 309 kg, but were insignificantly inferior to them in fat and protein milk content. At the same time, they were inferior to cows with a live weight at the time of the first calving of 531 kg and more in milk protein content by 0.04%.

Shevchenko O.B. et al. (2023) found that there is a direct relationship between the live weight of cows and milk productivity indicators in the 1st lactation - with an increase in the live weight of a cow, its milk yield also increases. Thus, if the productivity of cows of the 1st gradation was 7389 kg, then the milk yield of the same-age cows of the 2nd gradation was 156 kg higher (by 2.1%, $P<0.50$), of the 3rd gradation - by 15 kg, of the 4th gradation - by 118 kg (by 1.4%), of the 5th gradation - by 181 kg (by 2.4%, $P>0.95$). The average fat content in milk also tends to increase - the difference between the 1st and 5th gradations was 0.07%, but this difference was not significant. At the same time, it was noted that the average mass fraction of fat in the milk of cows of the 4th gradation is 0.4-0.5% lower than this indicator of peers of adjacent gradations. The amount of milk fat is directly proportional to milk yield, therefore, with an increase in the value of the gradation of the body weight of cows, in accordance with milk yield, the amount of milk fat also increases - when comparing the values of the 1st and 5th gradations, the difference was 22.5 kg at $P>0.999$. A similar pattern was established for the average content and

amount of milk protein - with an increase in the value of the gradation of the live weight of cows, their values also increase: the average mass fraction of protein by 0.08%, and milk protein - by 20.4 kg at P>0.999.

Berry et al. (2007) noted that cows that lost 100 kg of weight from calving to calving weight produced 139 kg more milk in the first 60 days of lactation than cows that lost only 50 kg during the same period.

In their own study, Carvalho et al. (2014) noted that cows that maintained their body weight (BW) or lost up to 10% of their BW during the 21-day postpartum transition period were more productive during early lactation. The authors noted that multiparous cows with extreme BW changes of more than approximately ±10% during the 21-day postpartum period experienced significant declines in their gross milk yield at 90 days. For example, cows that lost approximately 21.4% of their initial BW during the 21-day postpartum period had a 90-day milk yield of 3603 ± 162.0 kg, while cows in the same parity group with a BW gain of 16.7% had an estimated 90-day milk yield of 3037 ± 149.8 kg. When these figures are compared with 4548 ± 52.2 kg in cows of the other group with a 21-day body weight loss of 4.5%, a serious deterioration in the milk production of the cows becomes evident. The maximum estimated milk yield in 90 days for cows of this group was reached when they had lost 7.4% of their initial body weight, and the large body weight loss had no significant effect on milk yield in 90 days. On the other hand, primiparous cows that gained body weight in 21 days showed a significant decrease in milk yield in 3 months. For example, cows with a 21-day body weight gain of 16.8% had an estimated milk yield in 90 days of 1932 ± 134.4 kg, in contrast to 3123 ± 52.6 kg for those who had lost 7.4% of their body weight in the same period. The effect of nutrient allocation on recovery rather than milk production in cows may contribute to this finding and warrants further study. The authors suggest that high-producing cows mobilize large body reserves to meet the demands of producing more milk at the expense of reproductive function.

As Berry et al. (2007) suggest, significant body weight loss early in lactation was associated with increased lactation persistence and higher and earlier peak milk yields.

Therefore, in part, our results are consistent with studies in which cows with early lactation weight loss are those that produce more milk. We believe that primiparous cows with significant post-calving body weight loss may experience more severe negative nutrient balance and potentially health problems, which may also affect dry matter intake, ultimately negatively affecting their performance.

The results of the study by Peiter et al. (2023) show that body weight change during the first 21 days after calving had strong quadratic associations with total milk production over 90 lactations, with differences between groups by insemination. It was found that primiparous cows with the highest productivity lost 7.4% of their body weight during the first 21 days of lactation, while cows with extreme body weight gain had much lower productivity during the first 90 days. In addition, second lactation and older cows with the highest productivity lost an average of about 5% per 21 days. These results demonstrate the usefulness of data from automated systems on the farm to improve the management of dairy cows during the transition period.

This is partially consistent with our data, where primiparous cows with an average post-calving loss of 6.4% (Group III) were the most productive, followed by animals with a loss of 5.0% (Group IV). The lowest productivity was in group I, where live weight decreased by 7.5%.

According to Wathes et al. (2008), heifers that calved with higher fatness (3.8–3.9 points) subsequently mobilize more tissues for milk production and recovery, which also has detrimental consequences for fertility.

Conclusions:

1. It is proven that the highest milk productivity potential for the first 100 days of lactation of 2589.4 kg and more of milk was found in primiparous cows of group III, which exceeded their counterparts from groups I, II and IV by 18.7-3.3%. The same trend was also maintained during the second and third lactation periods.

2. It is noted that the live weight at fertile insemination was on average in group I - 358.8 ± 1.51 kg, II - 387.7 ± 0.49 kg, III - 406.3 ± 0.65 kg and IV - 445.5 ± 3.66 kg. According to this indicator, it is clear that animals of group IV exceeded animals of other groups by 86.7-39.2 kg or 19.5-8.8%. The live weight after calving of the firstborns of group I was 573.9±3.56 kg, of group II – 583.4±3.58 kg, of group III – 590.3±6.01 kg and of group IV – 591.1±5.51 kg. However, it was found that the live weight in the first days had a tendency to decrease the difference between the groups: animals of group IV outweighed the firstborns of group I by an average of 17.2 kg (or 2.9%), of group II – by 7.7 kg (1.3%), of group III – by only 0.8 kg (0.1%).

On the 100th day after calving, an increase in the difference in live weight of cows of group IV compared to animals of other groups was noted - 561.7±4.54 kg versus 530.6 ± 3.00 kg (or + 5.5 %) in group I, 544.1 ± 2.95 kg (+ 3.1 %) in group II and 552.8 ± 4.90 (+ 1.6 %) in group III.

It was found that the loss of live weight of cows from calving to day 100 of lactation was 43.2±8.6 kg (7.5 %) in group I, 39.3±8.3 kg (6.7 %), 37.6±11.2 kg (6.4 %), and 29.3±9.2 kg (5.0 %).

3. As a result of the multi-criteria analysis, it was found that for group III the objective function according to the considered criteria is the smallest and is 0.0099. At the same time, the objective function for the first group turned out to be 11.65 times worse, and for the second and fourth groups it was 2.55 and 3.91 times worse, respectively.

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