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Evaluation of the dynamics of fattening of lactating cows of the newly created Ukrainian red dairy breed

Liliya Roman*
PhD in Veterinary Sciences, Associate Professor
Odesa State Agrarian University
65012, 13 Panteleimonivska Str., Odesa, Ukraine
https://orcid.org/0000-0002-4983-5418
Olena Bezaltychna
PhD in Agricultural Sciences, Associate Professor
Odesa State Agrarian University
65012, 13 Panteleimonivska Str., Odesa, Ukraine
https://orcid.org/0000-0002-4257-0699
Serhiy Vyrvykyshka
Postgraduate Student
Odesa State Agrarian University
65012, 13 Panteleimonivska Str., Odesa, Ukraine
https://orcid.org/0009-0009-1684-4754
Artem Iovenko
PhD in Veterinary Sciences, Associate Professor
Mykolaiv National Agrarian University
54008, 9 Georgiy Gongadze Str., Mykolaiv, Ukraine
https://orcid.org/0000-0001-5675-220X
Tetyana Pushkar
PhD in Agricultural Sciences, Associate Professor
Odesa State Agrarian University
65012, 13 Panteleimonivska Str., Odesa, Ukraine
https://orcid.org/0000-0002-5754-2121

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Abstract. The purpose of this study was to determine the dynamics of fattening of lactating cows of the newly created Ukrainian red dairy breed during the current lactation and at different lactation ages by eye assessment. Based on an industrial dairy complex-reproducer for breeding cattle of the Ukrainian red dairy breed, a scientific and industrial study was conducted to assess the dynamics of fattening of

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*Corresponding author

lactating cows (n = 391) using a modified eye-measured scoring scale and an innovative methodological Model Cow approach to comparing the findings with the visualisation. The study employed structural-comparative, analytical, and statistical methods. The findings of this study revealed that lactating cows of the newly created Ukrainian red dairy breed had a steady downward trend in fertility rates compared to the optimum levels recommended by experts. Thus, the fatness of the first-born cows was on average 35.35-58.25% lower than the recommended level, of the second lactation cows – 18.91–25.67%, and of the third lactation cows – 21.82-28.33% ($P < 0.001$). In cows of the fourth and older lactations (4.43 lactations on average), the dynamics of fattening dynamics was closer to the recommended optimum indicators throughout the current lactation. On average, in the middle of lactation (134.96 days, n = 59), the fattening was 2.39 points, which was 89.91-79.67% of the recommended levels ($P < 0.001$). According to the observations during the current lactation, it was found that the fattening of lactating cows did not have time to reach optimum levels at the end of the lactation period, which indicated significant metabolic disorders in the body of females, especially of young age, which require finding ways to correct the system of feeding the dairy herd of the newly created breed. An innovative approach to assessing the fatness of dairy cows revealed the potential of the methodology to use research findings to regulate herd management and feeding behaviour of cows under intensive milk production technology

Keywords: lactating cows; newly created Ukrainian red dairy breed; feeding behaviour; visualisation; model cow

INTRODUCTION

Over the past decades, in response to an urgent demand from agrobusiness, Ukrainian breeders have carried out large-scale breeding work to create new Ukrainian specialised dairy breeds adapted to operation in large industrial complexes. To fulfil the tasks of forming highly productive dairy herds of animals with unified external parameters according to the conditions of industrial production and quantitative and qualitative indicators of milk that meet the requirements of modern processing enterprises, local populations of dairy cattle were used and large-scale breeding and biotechnology measures were applied, specifically, the frontal use of the method of artificial insemination of cows and heifers with cryopreserved semen of valuable foreign sires, mainly of Holstein breed.

According to J. Bezdicek *et al.* (2020), D.P. Berry and R.D. Evans (2022), depending on the influence of paratypic factors, the findings showed significant variability and depended heavily on the management factors of each particular herd, the qualifications of veterinary medicine specialists, training of service personnel, etc. Considering the latest trends, dairy farms have generally moved away from the previous negative practice of a deficient feed base with uncontrolled ration composition. Modern dairy enterprises mostly use a stable feed base of their production using software to adjust daily rations of the dairy herd according to the requirements of scientifically based zootechnical standards for meeting the physiological needs of lactating and dry cows and sustainable production of the amount of milk required to ensure the cycle of processing raw materials into various dairy and fermented milk products (Ruban *et al.*, 2022).

F. Weik *et al.* (2021) found that the great level of milk yields and their planned growth were influenced by several factors, among which the most influential was the implementation of improved feeding systems for the breeding stock based on the digitalisation of feeding technology, maximum mechanisation of feed preparation processes, and the widespread use of high-tech feed additives. Furthermore, a considerable pressure on the formation of newly created dairy breeds was the introduction of a strict selection system during breeding and the selection and culling of cows that do or do not meet the requirements of dairy breed standards. According to large-scale studies by S.S. Yurochka *et al.* (2023), 15-21% of full-grown cows were culled annually in leading farms, considering milk production, linear classification of exterior type, and live weight. According to experts, it was a balanced, integrated approach to the formation of dairy herds with first-born cows selected for their origin and individual qualities, combined with an improved feeding system, which led to an exponential increase in the milk production of herds of newly created Ukrainian breeds.

There is a consensus among scientists and livestock practitioners on the effectiveness of breeding and selection work with the herd, which is aimed at consolidating animals in the desired type according to the main useful economic traits (Brito *et al.*, 2021; Buonaiuto *et al.*, 2023). A significant factor that characterises compliance with both selection and ration optimisation requirements is the assessment of lactating cows' fatness at different stages of the lactation cycle (considering only sires with a stable feed base, to maximise the exclusion of the influence of breed factors on the implementation of breed factors and reduce the pressure of paratypic factors). According to modern scientific concepts, fatness is an essential indicator that helps to assess the metabolic status of a dairy cow in real time and trends in the dynamics of changes. D. Liu *et al.* (2020) defined fatness as the degree of development of muscle tissue and subcutaneous fat deposits. Thus, in the researchers' opinion, fatness reflects the state of fat reserves in

the animal's body, which increase the level of natural adaptability of the organism and the controllability of industrial dairy production processes.

There is an urgent need to improve the methodology for assessing the fatness of dairy cows, considering the intensity of the key production processes (parturition, peak lactation, end of lactation) to obtain a generalised quantifiable score profile that can be quickly and efficiently compared with the previous or subsequent one to develop operational measures to regulate the feeding system, urgent measures for individual animals or groups, and overall optimisation of herd management. Considering the insufficiency and controversy of data on the factual state of fatness of cows of different breeds in the literature, it is still important to find ways to increase milk production aimed at fulfilling the genetic potential of the population of newly created herds operated in very different regions of Ukraine and requiring the formation of a database for comparison.

The purpose of this study was to determine the dynamics of fattening of lactating cows of the newly created Ukrainian red dairy breed during the current lactation and at different lactation periods by means of eye assessment.

MATERIALS AND METHODS

The experimental part of the study was conducted during 2022-2024 in a breeding reproducer (Odesa region) for the breeding of a new domestic dairy breed of productivity – Ukrainian Red Dairy (URD), which was created based on the genotype of the red steppe breed of the southern fat-milk population, with which, according to the development of specialists of Ukrainian scientific institutions, long-term breeding work was performed to improve productive qualities through Holsteinisation using sperm from outstanding bulls obtained from leading breeding centres in Europe (ABS Genus) and the USA (CRI, CRV).

The farm had a stable feed base of its own production, daily rations were developed using the DairyPlan software with the formation of monofeed composition for each production Group of cows (parturition, peak lactation and mid-lactation, second half of lactation, end of lactation). The balance of diets was corrected by introducing feed additives to the diets to balance the composition of amino acids, macro- and microelements, vitamins, and other ingredients according to the requirements of the physiological state of the animals. Feed was distributed twice a day on feed tables, and specialists ensured that feed was raked in time for each cow to reach the area where it was available. The farm followed the technology of producing complete mono-feed, with the introduction of freshly cut green fodder in the summer (no more than 15% of the total nutritional value of the diet). The conditions of keeping, operation, and care of the animals met modern zoohygienic requirements (untethered housing, individual cow rest boxes, machine milking with individual milk production records). Technological groups of cows were formed according to factual milk yield, time of fertility, and lactation period: Group 1 (104 cows) – 1st lactation, daily milk yield 37.30 ± 2.97 kg, lactation period 123.33 ± 42.06 days; Group 2 (99 cows) – 2nd lactation, daily milk yield 29.29 ± 3.41 kg, lactation period 153.68 ± 55.62 days; Group 3 (107 cows) – 3rd lactation, daily milk yield 36.92 ± 2.65 kg, duration of the lactation period 146.95 ± 53.77 days; Group 4 (81 cows) – 4th lactation, daily milk yield 42.90 ± 3.91 kg, duration of the lactation period 134.96 ± 42.22 days.

All livestock were covered by veterinary support and a programme of infectious disease prevention (vaccinations) according to current guidelines. No harm was done to the health of the animals during the study.

To conduct a visual assessment of lactating cows' fatness, a working scale for comparing fatness indicators in points was developed based on the recommendations of Ukrainian scientists (Vinyukov *et al.,* 2021) and modified to factor in the conditions of intensive production at the study farm. Due to the developed scheme of the experiment, a fixed time for visual inspection of dairy cattle was determined, and the evaluation methodology was established by the commission, considering the exterior type of the newly created URD breed of this population. The animals were not probed due to the lack of separate specialists for such research formats. To increase the standardisation of the results, the experts selected a 'model animal' from the given population for comparison, which met the requirements for the scoring on the working scale. The efficiency of the assessment was organised by inspection at a fixed time of daytime milking in the milking parlour ("Yalynka" type milking machine) with lighting of at least 200 lux. Viewing angles were chosen based on the design features of the viewing platform: from both sides during milking, at the same distance from the animal, examining the general shape of the body, exterior features: the sides of the cow, spinal vertebrae, gluteal tubercles, the presence of a hungry pit, protruding parts of the spine and spinal vertebrae, macules, and overall body roundness. The condition of the skin, limbs, and hoof horn were also considered. The data were recorded in the corresponding format in the report, after which they were subjected to generalisation, structuring, and biometric processing (Table 1). Structural-comparative, analytical, and statistical methods were employed. Zootechnical indicators were selected from the farm's computer database.

The commission data were quickly compared with the visualised example of the 'Model Cow' and the working scale. The research data were generalised, summarised, statistically processed, and presented for analysis in the form of tables with illustrative photographs of the most typical conditions of lactating cows.

The farm has implemented a modern system of feeding the dairy herd with monofeed from juicy forages and concentrates with a moisture content of 50–60% with constant feed quality control.

***Table 1**. Working scale for assessing cow fatness in various periods of lactation*

Production cycle and evaluation period	Terms, days	Fatness score, points		
		minimum	optimum	maximum
Early lactation	8-90	2.75	3.00	3.25
Peak lactation and mid-lactation	91-150	2.50	2.75-3.00	3.25
Late lactation	151 and more	3.00	3.25	3.50

***Source:** developed by the authors of this study*

The analytical part of the study was conducted at the Department of Surgery, Obstetrics and Small Animal Diseases of Odesa State Agrarian University, where structural-comparative and statistical methods were applied using biometric processing of the results (Petrovska *et al.*, 2022). All experimental studies were conducted following modern methodological approaches and according to with relevant requirements and standards, specifically, they met the requirements of DSTU ISO/IEC 17025:2005 (2006). Animals were kept and all manipulations were performed according to the provisions of the Procedure for conducting experiments and experiments on animals by scientific institutions (Law of Ukraine No. 249, 2012), the European Convention for the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purposes (1986).

RESULTS AND DISCUSSION

The summary results of the visual assessment of lactating cows (n = 391) of the newly created URD breed following the objectives of the study scheme are presented in Table 2.

***Table 2**. Dynamics of fattening of lactating cows of the URD breed during lactations, n = 391*

Lactation	n	Fatness, score	Duration of the lactation period, days*	Factual daily milk yield, kg*
1	104	1.94 ± 0.02	123.33 ± 42.06	37.30 ± 2.97
2	99	2.23 ± 0.19	153.68 ± 55.62	29.29 ± 3.41
3	107	2.15 ± 0.19	146.95 ± 53.77	36.92 ± 2.65
4 and older	81	2.39±0.07	134.96 ± 42.22	42.90 ± 3.91
M ± m	391	2.18 ± 0.09	139.73 ± 6.69	36.60 ± 2.79
Biometric indicators				
Q		0.187	13.397	5.589
CV		8.595	9.588	15.270
td		20.533	20.533	12.311
P <		0.001	0.001	0.001

***Note:** * – average for the entire period of observation during lactation; ** – factual milk yield at the time of assessment. td – criterion of reliability of the difference between the mean values of indicators, P < reliability coefficient of fattening indicators, CV – coefficient of variation, Q – Cochran's C test*
***Source:** developed by the authors of this study*

The analysis of the dynamics of growth of indicators prompted the structuring of observation groups by the number of lactations: from the first to the fourth and older. In the older group, there were cows with 6-7 lactations, but the average age was 4.43 lactations and, as the data show, the number of such cows was only 20.72% of the total main dairy herd and indicated a strong level of excessive departure of females in the first or second lactation, as the authors of the present study have shown in previous publications.

Generalised data on the fatness of cows in the first lactation with an average lactation period of 123.33 days revealed a considerable deficit in the fatness of firstborn cows (35.34-58.25% less than the recommended optimum level, P < 0.001). Even the comparison with the minimum acceptable assessment of the fatness of the firstborn cows provided only 71.14% (P < 0.001) of the average score of the fatness of the first-calf heifers, which requires the attention of the company's specialists to adjust the technology of feeding young cows in the early stages of lactation, which, as is well known, substantially affect not only the entire course of the current lactation, but also the entire duration and efficiency of the cow's production operation. The cow feeding management system is presented in Figures 1-3.

***Figures 1-2**. Feeding management system for dairy cows in the studied farm*
***Note:** the feeding management system of dairy cows in the studied farm was distinguished by the optimisation of manual shovelling of monofeed into the feed table area, which is comfortable for animal consumption*
***Source:** compiled by the authors*

After milking, the older cows immediately came to the feed table in the sections, and the first-calf heifers, even if there was a sufficient number of available feed places, stayed behind and did not try to stand next to the older cows. Such a sequence of feed consumption led to technological and then physiological malnutrition of the first-born cows (Figure 4 shows how the first-calf heifers with low live weight approach the feed table and begin to consume the remains of the sorted feed mixture, the nutritional value of which had already been reduced). They gradually lost weight and were even less suitable for typical feeding behaviour, which resulted in reduced milk production, increased vulnerability to diseases, especially of the reproductive system, and premature culling.

***Figure 4**. First-calf heifers in large sections come to the feeding table last*
***Note:** first-calf heifes in large sections come to the feed table last and therefore eat a feed mixture with a lower content of concentrates and bio-additives*
***Source:** developed by the authors of this study*

Observations showed that the average fatness of cows of the second and third lactations was also below the recommended level, namely: the second – by 18.91-25.67%, and the third – by 21.82-28.33% ($P < 0.001$), which was a signal of deep metabolic disorders of

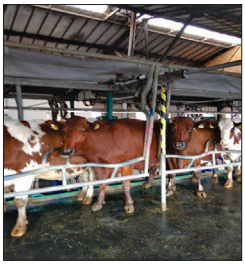

***Figure 3**. At a fixed time during milking in the milking parlour, the cows' fatness can be monitored*
***Note:** under conditions of fixed time during milking in the milking parlour, the cows' fatness can be promptly monitored from both sides of the cows with optimum lighting and the choice of a fixed viewing area from two side angles*
***Source:** developed by the author of this study*

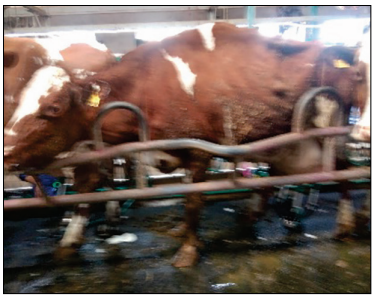

***Figure 5**. Animals with low fatness, extreme deficiencies, and locomotor defects were found among cows during different lactations*
***Source:** developed by the authors of this study*

***Figure 6**. Photo and video materials were entered into the archive of the company's computer programme on a regular basis*
***Note:** the company's computer programme archive was regularly updated with photos and videos describing the desired type of 'Model Cow' of the newly created breed*
***Source:** developed by the authors of this study*

lactating animals. Considering that the average daily milk yield of the first-born cows was greater than that of cows of the 2nd and 3rd lactations, the analysis of fattening revealed the need to correct both the composition of diets and housing conditions. Older cows (fourth

and higher lactations) showed a greater level of milk production among the entire dairy herd with a lower level of fatness loss: the average daily milk yield during 139.94 days of lactation was 2.39 points of fatness, which is 13.09-20.33% lower than the recommended norms ($P < 0.001$). The chosen methodological approach of eye assessment of fatness helped to compare the dynamics of fat reserves recovery in cows during the current second and third lactations (Table 3), which accounted for most of the dairy livestock of the surveyed farm. This production period should potentially characterise the most typical physiological states of lactating cows at Ukrainian industrial enterprises, a clearly visualised signal of which is the assessment of animal fatness.

***Table 3**. Dynamics of fattening of lactating cows during the second and third lactations, n = 196*

Lactation	Assessment of fatness by lactation days:								
	n	LP, days	Score (M ± m)	n	LP, days	Score (M ± m)	n	LP, days	Score (M ± m)
2	14	7-90	1.96 ± 0.14^{a}	29	91-150	2.13 ± 0.14^{b}	46	>150	2.59 ± 0.10^{c}
3	13	7-90	1.86 ± 0.18^{d}	30	91-150	2.07 ± 0.07^{e}	64	>150	2.53 ± 0.08^{j}

***Note:** a-d; d-e ($P < 0.05$); a-b; a-c; d-e ($P < 0.01$); a-j ($P < 0.001$)*
***Source:** developed by the authors of this study*

As the findings of the study indicate, during the transition of cows from the terms of parturition to the peak of lactation and the udder secretory activity reaching the stage of reduced milk secretion, a steady increase in the fattening of females is observed, namely: by 8.67% and 32.14% and by 11.29 and 26.48%, respectively, for the 2nd and 3rd lactations compared to the period of early lactation ($P < 0.05$; $P < 0.01$).

***Figure 7**. Fatness of cows from different angles compared to other animals in the section*
***Note:** During the study, attention was paid to the fatness of cows from different angles compared to other animals in the section*
***Source:** developed by the authors of this study*

***Figure 8**. Visual comparison and correction of the cow fatness score*
***Note:** The feature of the location of cows at a fixed milking time helps to conduct a visual comparison and correction of the fatness assessment scale among the group*
***Source:** developed by the authors of this study*

An illustrative analysis of the data on the factual timing of lactation in the Group of older cows, which biologically have the most stable indicators of adaptation to the technological operations of this environment, where they were formed during both their ontogeny and several generations as the main biological objects of production, is presented in Table 4.

***Table 4**. Fatness of lactating URD cows of older age in different periods of lactation, n = 59*

Number of cows	Lactation period at the time of assessment (M ± m)	Fatness, score (M ± m)	Lim of fatness assessment in points	
			min	max
7	60.67 ± 8.18^{a}	2.29 ± 0.35^{d}	1.50	3.50
21	137.34 ± 5.31^{b}	2.52 ± 0.19^{e}	1.50	2.50
31	206.08 ± 5.31^{c}	2.36 ± 0.19^{j}	2.00	3.50

***Note:** a-b; a-c ($P < 0.001$); d-e ($P < 0.05$); d-j ($P < 0.01$)*
***Source:** developed by the authors of this study*

In the early lactation period, cows had indicators of 75.33% of the optimum, in the most intensive period of milk secretion – 91.63-84.00%, and in the decline of lactation – 72.62% ($P < 0.05$; $P < 0.01$), which reveals contradictory trends during metabolic processes in the body of dairy cows. The boundaries of the established fatness

in older cows also varied considerably even at the beginning of lactation: from 1.50 to 3.50 points (Fig. 8).

K.K. Cevik (2020) and H. Alem (2021) found that the key to fulfilling the high genetic potential of newly created cow breeds, maintaining health and reproductive capacity with minimal feed losses per unit of production is biologically complete energy-saving feeding, which ensures the optimum need of animals for nutrients, biologically active substances and a strong level of their absorption. I.J. Lean and P. DeGaris (2021) and S. Nagy *et al.* (2023) insisted on focusing on the development and study of the fullness of feed mixtures for feeding high-yielding cows, considering regional zones. The current study emphasised the need to create regional dairy cattle populations. The data obtained by I.J. Lean *et al.* (2023) indicated that in the current state, the intensification of the dairy farming industry, as the basis for supplying the internal market with sufficient raw milk and ensuring food security in each country, requires effective methods of managing the physiological state of dairy cows, which is formed by maintaining the animal's normal metabolism under the conditions of technological stress of industrial production.

Ukraine has already built large dairy complexes with intensive technologies that have been put into practice as a result of the Revived Livestock programme, which makes provision for round-the-clock free access to the feed table for each cow, the possibility of automated adjustment of the composition of diets, etc. Analysing the results of the programme implementation, Ukrainian researchers S.S. Yurochka *et al.* (2023) emphasised the necessity of considering the physiological characteristics of dairy animals, a characteristic feature of which is the ability to produce milk during certain periods of physiological activity at the expense of their body reserves, which leads to substantial changes in the condition of cows in various technological periods: with an increase in lactation and its decline, dry period. Particularly significant changes in fatness are typical for specialised dairy breeds with a prominent level of Holsteinisation, which was noted by W. Shi *et al.* (2023) as significant changes in animal condition. Considering the unresolved problems in advanced technologies for the rapid and stress-free reformation of similar groups of animals (by age, productivity, live weight, physiological condition, etc.), monitoring of fertility indicators of dairy cows stays a vital tool for managing herd productivity. Modern scientific research requires a deeper understanding of the conversion of feed into milk and the development of guidelines and manuals that will help implement this knowledge in cow feeding practices to improve the efficiency and sustainability of milk production. Therefore, the need to develop operational methods for assessing the real and dynamic fatness of dairy cattle in highly productive herds with the ability to individually adjust the diet for nutrient content, using additional feed to each cow's diet according to the need by various means of mechanisation and automation, which increases the role of fatness assessment in the organisation of real production, is becoming increasingly significant (Dallago *et al.,* 2021; Marquez-Acevedo *et al.,* 2023).

Studies conducted by leading research institutions in Ukraine have provided detailed scientifically based recommendations on the methodology for assessing the fatness of cows operated in industrial enterprises to improve the skills of producers (Vinyukov *et al.*, 2021). The proposed methods are based on conventional approaches to animal grading using eyeball assessment of body shapes, individual articles, and methods of probing control anatomical points on the animal's body surface. For instance, muscle development is determined by the overall roundness of the body, the fullness of the hips, the density of muscle tissue when palpated, and how much the skeletal bones protrude. A well-fed animal has a rounded body with no protruding ilium, ischial tubercles, sacrum, and especially the spinal vertebrae. Animals with underdeveloped muscles have a less rounded body shape. Poorly fed cattle have an angular body shape, the lumbar region is flat, the hips are tight and almost not full, and the skeletal bones protrude quite strongly. The degree of development of fat deposits is determined by palpation of the animal's body in the places most characteristic of fat deposition.

Based on this methodology, J. Schillings *et al.* (2023) developed a series of recommendations for the boning process, organisation of the evaluation process (lighting of the visual inspection site, rules for choosing anatomical points – probes, etc.), which considerably increase the level of unification of indicators in points, measurability of qualitative characteristics. However, optimising the fatness assessment process by detailing indicators, especially those related to fat palpation, considerably slows down the procedure, which is technically inconsistent with the high pace of production processes in intensive enterprises. Furthermore, a substantial time lag in obtaining the analysis results from the factual physiological state of a particular cow or technological Group of livestock cancels out most of the positive developments of existing methods. The recommended methodological approaches require separate organisational and financial support, which in the current conditions of the Ukrainian agricultural sector does not have a basis for implementation.

Considering that, according to the observations and data of S. Nazhat *et al.* (2021), each farm may have cows that are very thin or overfed, the present study was characterised by a substantial decrease in fat resources in most of the lactating cows, subject to a stable feed base and stable filling of feed tables. The analysis of the production conditions of the studied enterprise revealed one of the crucial factors of significant loss of fatness of the first-born cows, namely: the technology of the farm was based on the principle of general

maintenance of dairy cows of all age groups in large sections (90-110 heads), where a negative trend in access to the feed table was observed according to the hierarchical structure of the herd, which was preserved in this population of the newly created breed. Thus, the animals gradually lost weight and were even less suitable for typical feeding behaviour, which resulted in impaired milk production, reduced immunity, and premature culling, which is consistent with the studies of a series of researchers (Poczta *et al.,* 2020; Newton *et al.,* 2021).

After and during the period of weight loss, cows need to receive more feed than their normal requirement to restore normal fatness. Each farm may have animals that are very fat or very thin for their period of lactation. An example of this is comparing the factual fatness of cows with a 'model cow' in real time or retrospectively. If such animals are not identified in time, conditions are created that negatively affect the rotation of the herd and the operational life of the dairy cattle. Specifically, the lack of attention to regulating the fatness of first-calf heifers has a substantial negative influence on the breeding progress in creating new Ukrainian breeds adapted to industrial technologies. Probably, the established signal of a significant decrease in the fatness of the first-calf heifers for this population should highlight the way to optimise the feeding system on the farm, considering the efficiency and availability of the selected innovative method of visual assessment with the comparison of a 'model cow'. L. Brito *et al.* (2021) showed the effectiveness of this methodological approach in intensive livestock production technologies.

According to the findings of the study, during the transition of cows from the terms of beginning lactation to its peak and to a decrease in the secretory activity of the udder, was observed a steady increase in the fatness indicators of females, namely: by 8.67% and 32.14% and by 11.29 and 26.48%, respectively, for the 2nd and 3rd lactations compared to the period of early lactation ($P < 0.05$; $P < 0.01$). The data obtained are in line with the findings of studies by many researchers, which indicated that the body of dairy cows tries to restore metabolic balance during the completion of lactation activity (Shi *et al.,* 2023*;* Marquez-Acevedo *et al.,* 2023). However, as the analysis revealed, the studied livestock does not restore fatness to the recommended levels, which proves the need for a more systematic consideration of the results to correct the methods of herd management, because the loss of the necessary resources of the cow's body contributes to vulnerability to diseases in the herd, which can result in large financial losses caused by treatment costs, reduced animal productivity and reproductive characteristics.

Research on feeding high-yield cows requires improving energy, protein-amino acid, carbohydrate, lipid, mineral, and vitamin nutrition, and developing measures to ensure them, and controlling the effectiveness of organisational approaches is created by continuously monitoring the profile of fattening indicators of each herd. The methodological approach in the research and production study revealed that the task of training young specialists according to the dual principle of education is becoming a real production practice. The innovative methodological approach in the study allowed for parallel work in the demonstration and training module, which helped to implement the dual principle in the agricultural education curriculum. The training of higher education students in veterinary medicine showed young specialists the examples of positive practices in industrial livestock production, allowed them to learn about the complexities of the modern dairy industry and consolidate their practical skills. The use of modern office equipment helped to accumulate a list of examples of the 'Model Cow' of the desired exterior type in the farm's computer archive and to visualise the dynamics of changes in the recorded examples and live animals during production processes over several years.

CONCLUSIONS

It was experimentally established by eye (according to a modified method) assessment of the dairy herd ($n = 391$) at a fixed time that the fattening indices of cows of the newly created Ukrainian red dairy breed are significantly lower than the recommended optimum levels, namely in first-born cows, fatness is lower by 35.34-58.25% ($P < 0.001$); in cows of the 2nd lactation – by 18.91-25.67%, and in the 3rd lactation – by 21.82-28.33% ($P < 0.001$), respectively, which was a signal of deep metabolic disorders in females at the beginning of lactation, especially at a young age. In cows of the older Group (average age 4.43 lactations, $n = 59$), the smallest deviation of fattening indices from optimum levels was observed, namely: in the middle of the current lactation (134.96 days), the fattening was 2.39 points, which was 86.91-79.67% of the recommended optimum values ($P < 0.001$), indicating greater adaptability of animals that retain endurance for industrial operation for several lactations.

Changes in the fattening indices of cows of different age groups were marked by contradictory dynamics between the level of daily milk yield, the period of milk secretion and condition, which indicated the continuation of the processes of genotype transformation of the newly created population and, accordingly, the need for strict attention to the selection of the most desirable types of animals. An innovative methodological approach to the visual assessment of lactating cows' fatness as a signal for optimising industrial milk production technology helped to identify problems in the system of feeding of first-calf heifers during the beginning and peak of lactation, which contributed to optimising herd management. The methodology of eyeball

assessment of cow fatness at a fixed time using visualisation of the 'model cow' of a given herd will facilitate the introduction of practical skills for specialists and students of animal and veterinary engineering on the principles of dual education. The prospect of further research will be to improve the innovative methodological approach to assessing the fatness of cows at the end of lactation and during the dry period for the purpose of selecting the most desirable types of cows of the newly created Ukrainian red dairy breed.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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Оцінка динаміки вгодованості лактуючих корів новоствореної української червоної молочної породи

Лілія Роман
Кандидат ветеринарних наук, доцент
Одеській державний аграрний університет
65012, вул. Пантелеймонівська, 13, м. Одеса, Україна
https://orcid.org/0000-0002-4983-5418
Олена Безалтична
Кандидат сільськогосподарських наук, доцент
Одеській державний аграрний університет
65012, вул. Пантелеймонівська, 13, м. Одеса, Україна
https://orcid.org/0000-0002-4257-0699
Сергій Вирвикишка
Аспірант
Одеській державний аграрний університет
65012, вул. Пантелеймонівська, 13, м. Одеса, Україна
https://orcid.org/0009-0009-1684-4754
Артем Іовенко
Кандидат ветеринарних наук, доцент
Миколаївський національний аграрний університет
54008, вул. Г. Гонгадзе, 9, м. Миколаїв, Україна
https://orcid.org/0000-0001-5675-220X
Тетяна Пушкар
Кандидат сільськогосподарських наук, доцент
Одеській державний аграрний університет
65012, вул. Пантелеймонівська, 13, м. Одеса, Україна
https://orcid.org/0000-0002-5754-2121

Анотація. Метою дослідження було визначення динаміки вгодованості лактуючих корів новоствореної української червоної молочної породи впродовж перебігу поточної лактації та за різного лактаційного віку шляхом окомірної оцінки. На базі промислового молочного комплексу-репродуктора із розведення худоби української чеврвоної молочної породи було проведено науково-виробниче дослідження з оцінки динаміки вгодованості лактуючих корів (n = 391) за використання модифікованої окомірної бальної шкали та з інноваційним методологічним підходом порівняння результатів із візуалізацією «Модельної корови». Було застосовано структурно-порівняльний, аналітичний і статистичний методи. Результати дослідження показали, що лактуючі корови новоствореної української червоної молочної породи відрізнялись сталою тенденцією до зниження показників вгодованості у порівнянні з рекомендованими фахівцями оптимальними рівнями. Так, вгодованість первісток в середньому була нижче рекомендованої на 35,35-58,25 %, корів другої лактації – на 18,91-25,67 %; третьої – на 21,82-28,33 % ($P < 0,001$). У корів четвертої і старше лактацій (в середньому 4,43 лактацій) було відмічено більш наближену до рекомендованих оптимальних показників динаміку вгодованості впродовж всієї поточної лактації. В середньому у термін середини лактації (134,96 днів, n = 59) вгодованість становила 2,39 балів, що складало 89,91-79,67 % від рекомендованих рівнів ($P < 0,001$). За даними спостережень впродовж поточної лактації встановлено, що вгодованість лактуючих корів не встигла досягти оптимальних показників наприкінці лактаційного періоду, що свідчило за значні метаболічні негаразди у організмі самиць, особливо молодого віку, які потребують пошуку шляхів корекції у системі організації годівлі дійного стада новоствореної породи. Інноваційний підхід до оцінки вгодованості молочних корів засвідчив потенціал методики для використання результатів досліджень з метою регуляції менеджменту стада та кормової поведінки корів в умовах інтенсивної технології виробництва молока

Ключові слова: лактуючі корови; новостворена українська червона молочна порода; кормова поведінка; візуалізація; модельна корова