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USE OF MATHEMATICAL MODELS FOR EVALUATION OF LACTATION CURVES OF DIFFERENT BREEDS AND TYPES OF COWS

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Abstract. The paper highlights the results of the evaluation of lactation curves of dairy cattle of the productivity sector for different types of intensity of body formation based on D. McNally's model. The latter, thanks to the obtained indicators of relative variability, makes it possible to describe the type of lactation curve and its dynamics quite clearly and accurately.

Keywords: lactation curve, intensity of organism formation, modeling of lactation curves, D. McNally model.

In recent years, researchers in various fields of science often turn to modernized assessment techniques and methods. Dairy farming is no exception, in which modern achievements of bioengineering and biocybernetics are increasingly used, in particular, mathematical forecasting and modeling of cow productivity using various genetic and mathematical models [2].

The existing estimates of lactation curves are quite subjective and uninformative, which significantly inhibits the improvement of the accuracy of genotype estimation [1, 3, 6]. Therefore, more and more scientists are turning to new genetic-mathematical methods that allow analyzing the ontogeny of the lactation activity of cows, both in terms of genetics and their own specific lactation [8, 9]. And the genetic-mathematical models themselves make it possible to mathematically express the theoretical curves of lactations, their rate of increase and decline at different periods of the cow's lactation activity [1, 3, 7].

Therefore, based on the above, we evaluated the features of milk production during separate lactations of cows of different breeds and types of body formation using the most adequate mathematical models.

The work was carried out under the conditions of: SE «Plemreproduktor «Stepovy» and PSGP «Kozyrske» of the Mykolaiv region. The study included interpolated milk yield indicators of 189 breeding animals of the Red Steppe (ChS), Ukrainian Black and Spotted Dairy (UCHRM) and Ukrainian Red Dairy (UCM) breeds calculated for 305 days. lactation (first, second, third and higher) according to S.S. By Kramarenko [5], as well as by monthly milk yields. Groups of animals within each breed were divided according to the method of V.P. Kovalenko on two types of intensity of organism formation [4]. The average data by breed was taken as the control group.

The characteristics of the dynamics of monthly milk yield of cows of different distribution groups and the construction of theoretical lactation curves were carried out using the D. McNally model [1]. Correlation analysis was used and approximation was

carried out with the determination of the coefficient of phenotypic correlation (rr±Srr) and determination (R2) with the involvement of MathCad and MS Excel application programs.

It was established that the lower rate of milk yield (ε) according to D. McNally's model is characteristic for representatives of slow growth intensity in the first, second, third and higher lactation (CS) and the second, third, higher lactation (UCRM) and for females of the same age of the slow type the formation of the organism of the UCM of cattle in the first and second lactation. And the lowest kinetic constant (ε) is noted in almost all breeds and types of body formation during higher lactation. This model shows that the exponential constant (λ) of monthly milk yield is more pronounced in representatives of the CH of cattle with a rapid growth intensity, while it decreases with age. A higher hope for 305 days of lactation in cows of the UCM breed in females of the same age with a fast development type only in the first lactation. According to the group of cows of the UCM cattle, the exponential constant in cattle with a fast growth rate, on the contrary, is inferior only in the first lactation to peers with a slow body formation, and then - with age - it exceeds in animals with an accelerated growth rate.

It should be noted that using this model, the lowest ε/λ ratios were obtained mainly due to low values of both ε and λ and mostly in representatives of slow growth rate - from 1.550 to 6.291 (CHS), from 0.494 to 8.055 (UCM) and from 2.931 to 4.935 (UCRM). Therefore, the comparison of kinetic and exponential constants in most cases are identical in terms of maximum and minimum levels in relation to the order of lactation and types of organism formation for all genotypes of animals.

The estimation of the deviation (Sr) of the theoretical and actual curves indicates that the application of the model of D. McNally provides for all genotypes a level from 1.74% (ChS, slow type, II lactation) to 6.91% (UCRM, fast type, I lactation). Moreover, the higher values of the deviation of the theoretical and actual curves are observed among the cows of the UCHRM breed, although with age there is a tendency to decrease, but it still remains quite high - 4.47% (III lactation). Also, fairly high values of these indicators are noted among cows of other new Ukrainian livestock, which, in our opinion, is explained by the deep potential of the last two breeds in terms of increasing and realizing their genetic resources.

According to D. McNally's model, the correlations of model parameters with milk yield for 305 days of lactation were studied. A high positive relative variability of the sign and the kinetic constant (0.887-1.0; R2 =1), the exponential constant (0.829-0.999; R2 =1) and the ε/λ ratio (0.933-0.999; R2 =1) with taking into account the phenotypes and age of the animals, but without taking into account the type of intensity of organism formation, which allows us to judge the specificity of the dependence on the constants and the mathematical model itself, as well as the serial number of animal lactation (this is especially evident in representatives of the UCM breed).

Our calculations show that D. McNally's mathematical model (its kinetic and exponential constants and their ratio) allows us to reliably describe the nature of lactation curves in red and black-and-white breeds of different intensity of body formation during separate lactations.

At the same time, this model highly adequately describes the actual curve, especially the periods of the beginning of the increase of lactation and its decline. And

the shape of the lactation curves according to D. McNally's model is typical for all studied breeds of dairy productivity regardless of the characteristics of their growth processes during cultivation.

A high positive correlation was found between the main parameters of the model and milk yield, which indicates the specificity of the dependence of the characteristic on the constants and the model itself and the age of the animals. This gives reason to assert the possibility of using this model for predicting milk productivity of cows.

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Анотація. У статті висвітлено результати оцінки лактаційних кривих молочної худоби продуктивного сектора за різними типами інтенсивності формування тіла на основі моделі Д. Макнеллі. Останнє, завдяки отриманим показникам відносної мінливості, дає змогу досить чітко і точно описати тип лактаційної кривої та її динаміку.

Ключові слова: лактаційна крива, інтенсивність формування організму, моделювання лактаційних кривих, модель Д. Макнеллі.