

# Diet energy intake and use patterns

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**Abstract.** The purpose of the work is to evaluate the effect of the feed premix "Megamix-Optilak" on the milk productivity of cattle. During research in 2022-2023 in the farms of the Chekmagushevsky district of the Republic of Bashkortostan, the consumption and digestibility of energy of nutrients in diets, energy digestibility coefficients, energy use by dairy cows of the type being created were determined "Bashkir" black-and-white breed, depending on the dose of feeding the feed premix. The object of the research was 80 cows, formed from analogues into 4 groups of 20 heads: control group and I, II, III - experimental. Experimental animals were kept in identical conditions. The difference between the groups was in feeding: animals of groups I – III, in addition to the main diet, received the Megamix-Optilak premix with the diet in doses of 100-200 g/animal per day, the control group was not fed the studied premix. The results of the studies indicate a positive effect feed premix "Megamix-Optilak" on the palatability of ration feed by cows of the experimental groups. Adding the studied premix to the feed mixture at a dosage of 200 g/head. per day contributed to more intensive feed consumption by dairy cows. In addition, the animals absorbed more energy from the main nutrients, including protein - by 10.66%, fat - by 14.14%, fiber - 10.63% ( $P < 0.05$ ).

## 1 Introduction

Feeding cows, like other farm animals, should be based, first of all, on knowledge of their needs for energy, nutrients, biologically active substances, as well as an objective assessment of feed products in terms of the effectiveness of their use and the specific effect on the cow's body, level and quality the resulting products. In turn, the need for feed nutrients and their use vary widely depending on the age of the animal, its physiological state, the level of milk production, as well as the feeding regime and characteristics [1-4].

All livestock feeding systems are based on the principle of energy balance. It consists in creating a balance between the energy supplied with feed and the energy consumed during life [5-8].

The energy of feed is used by animals, first of all, to maintain life processes and for the formation of products. Cows use the metabolic energy of feed more efficiently to maintain body weight (69-75%). Next in terms of efficiency of productive use is the formation of milk directly due to energy (46-68%). If the diets of highly productive cows do not provide

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the complete process of milk formation, then milk can be formed due to weight loss (milking) of the cow [9-12].

The efficiency of energy use in animals is determined by two main factors, namely the nature of the chemical compounds that contain metabolic energy and how these compounds are used in the body.

## 2 Materials and methods

Object of study: dairy cows of the created type “Bashkir” of the black and white breed.

Animal care and experimental studies were carried out in accordance with the instructions and recommendations of Russian regulations (Order of the USSR Ministry of Health No. 755 of 08/12/1977 “On measures to further improve organizational forms of work using experimental animals”) and “Guide for the Care and Use of Laboratory Animals” (National Academy Press, Washington, D.C., 1996). During the research, measures were taken to ensure a minimum of animal suffering and an optimal reduction in the number of test samples.

Experimental design. To solve the set tasks in 2022-2023. Scientific, economic and physiological experiments were carried out on the basis of the enterprise SPK-collective farm “Geroy” in the Chekmagushevsky district of the Republic of Bashkortostan. According to the principle of analogues, taking into account origin, live weight, milk production, age in lactation, physiological state, 80 analogue dairy cows were selected to participate in the experiment, divided into 4 groups of 20 heads each. The experimental animals were kept in identical conditions and received equal feeding. A mixture of concentrated feed for cows of the control group was prepared by receiving, cleaning, dosing and mixing components in the following proportions: rye - 80%, soybean meal - 13%, sunflower meal - 2%, dry beet pulp - 1%, table salt - 1 %, feed phosphate – 4%. For cows of the first experimental group, an additional 1% Megamix-Optilak premix was introduced at the rate of 100 g/head. per day, experimental II – 1.5% at the rate of 150 g/animal. per day and III experimental – 2% at the rate of 200 g/head. per day. The experimental groups were fed the feed premix from day 1 of lactation until launch. Cows in the control group did not receive the studied premix. The study design is presented in Table 1.

**Table 1.** Experimental design.

| Group   | Feeding features       | Number of animals in the group, head |
|---------|------------------------|--------------------------------------|
| control | Basic diet (BD)        | 20                                   |
| I       | BD+100 g/head. per day | 20                                   |
| II      | BD+150 g/head. per day | 20                                   |
| III     | BD+200 g/head. per day | 20                                   |

Every month, for two adjacent days, the actual feed consumption was determined by weighing the given feed and its residues. The nutritional value of the studied feeds and diets was determined based on their chemical analysis by calculation.

In the testing complex analytical laboratory of the Bashkir Research Institute of Agriculture, the chemical composition and nutritional value of feed and their residues were determined using methods of zootechnical analysis. During the balance experiment, feces and urine were analyzed from three animals from each group.

The samples were to be examined in accordance with GOST 13496.4-93 for dry matter and crude protein content; crude fat and fiber GOST 13496.15-97 and GOST 31675-2012, ash GOST 26226-95. Based on the data obtained, the coefficients of digestibility of diet nutrients and energy metabolism were calculated. The energy content of the diets was calculated using a regression equation.

Statistical processing. Analysis of the data obtained during the experiment was carried out using the Statistica 10 software package (Stat Soft Inc., USA). Results are presented as mean (M) and standard error of the mean (m). The significance of the differences in the compared indicators was determined by Student's t-test. Values at  $P \leq 0.05$  were considered significant.

3 Results

Our studies have shown that the highest consumption of dietary nutrients by cows in the experimental groups directly affected their consumption and use of gross energy (Figure 1).

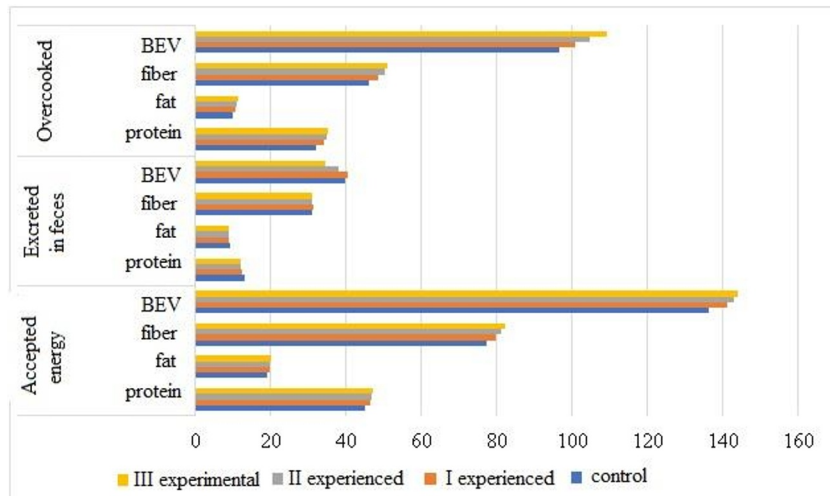


Fig. 1. Energy consumption and digestibility of diet nutrients by experimental cows.

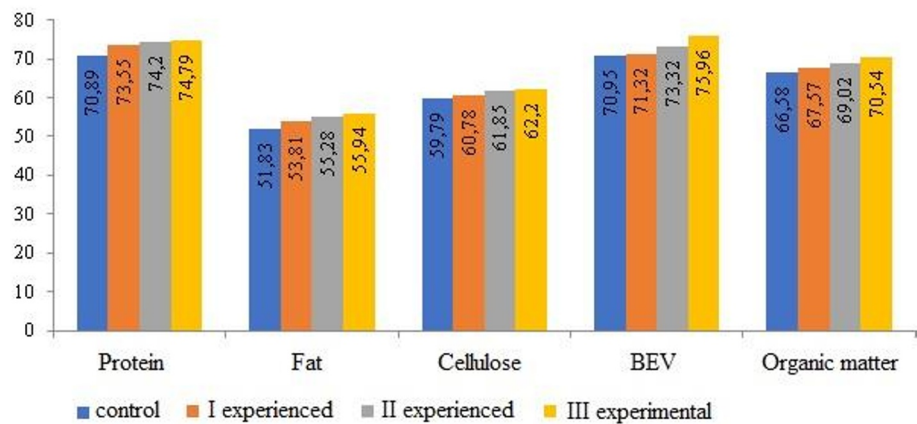
The cows of the experimental groups that received the premix as part of the Megamix-Optilak diet consumed more protein energy by 1.50-2.20 MJ (3.33-4.99%), fat - by 0.60-1.10 MJ (3.14-5.76%), fiber - by 1.70-4.90 MJ (3.50-6.36%), nitrogen-free extractives - by 4.90-7.60 MJ (3.60 -5.58%) compared to their peers from the control group.

Among the experimental groups, animals that received the studied premix at a dose of 200 g/head per day (Experimental Group III) consumed more protein energy by 0.70 and 0.30 MJ (1.51 and 0.64%), fat - by 0 .50 and 0.30 MJ (2.54 and 1.51%), fiber - by 1.20 and 1.00 MJ (2.76 and 1.23%) and nitrogen-free extractives - by 2.70 and 1 .10 MJ (1.91 and 0.77%) in comparison with their counterparts from experimental groups I and II.

Animals of the basic variant were inferior to cows of the experimental groups in digesting protein energy by 2.30-3.40 MJ (7.21-10.66%), fat - by 0.70-1.40 MJ (7.07-14.14 %), fiber - by 2.40-4.90 MJ (5.21-10.63%) and BEV - by 4.00-12.60 MJ (4.14-13.03%).

Analysis of the absolute values of energy consumption and digestion of nutrients in diets showed that the advantage of animals in the experimental groups was also observed in relative terms (Figure 2).

The cows of the experimental groups had an advantage over their peers in the control group in the digestibility of protein energy by 2.66-3.90%, fat - 1.98-4.11%, fiber - 0.99-2.41%, nitrogen-free extractives - 0 .37-5.01% and organic matter – 0.99-3.96%.



**Fig. 2.** Digestibility coefficients of energy nutrients in diets, %.

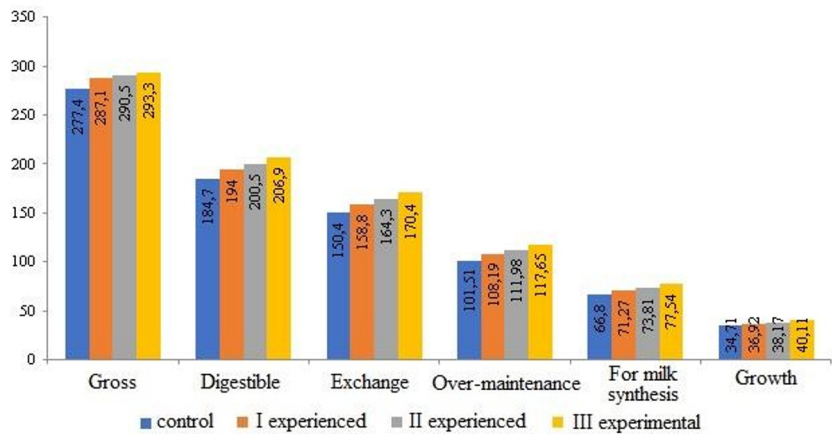
The degree of energy use in the body of cows when the Megamix-Optilak premix is included in the mixed feed rations is shown in Figure 3.

Studies have shown that the use of feed and the energy contained in it to a certain extent depends on the intake of nutrients into the body and the efficiency of their absorption by animals. The largest amount of gross energy, or 3.50%, 4.72 and 5.73% more compared to peers in the control group, was consumed by the cows of the experimental groups, which, in turn, consumed almost the same amount of gross energy.

The experimental groups consumed more digestible energy than the control group by 5.03-12.02%, and metabolic energy by 5.59-13.30%, respectively.

The available information on the consumption of metabolic energy in the body of experimental animals indicates that the energy and nutrients of the feed are used to ensure physiological functions, maintain the vital activity of biosynthesis processes and directly for the formation of products.

There were no significant differences in the use of metabolic energy to maintain life. Its share was 17.62-18.01% of the gross, but differences were noted in the metabolic energy for the synthesis of products (over-maintenance). The highest indicator was in cows of the III experimental group, which exceeded the control animals by 15.90% ( $P>0.05$ ), I - by 8.74 ( $P>0.05$ ) and II experimental group - by 5.06% ( $P>0.05$ ).



**Fig. 3.** Energy use of diets by experimental cows, MJ.

It should be especially noted that the inclusion of the studied premix in the composition of mixed feeds significantly influenced the use of energy from nutrients in diets for milk synthesis. Animals from the experimental groups outperformed the control group cows by 6.69-16.08% ( $P>0.05$ ) in this indicator.

In terms of energy gain, superiority was also on the side of the experienced groups. They were ahead of the animals in the control group by 6.37-15.56% ( $P>0.05$ ) in this indicator.

The energy metabolism coefficient in cows of the control group was 54.22%, which is 1.09-3.88% lower than that of their peers from the experimental groups.

## 4 Discussion

In general, animals in the experimental groups consumed gross energy by 9.70 MJ (3.50%), 13.10 (4.72%) and 15.90 MJ (5.73%) more, respectively, compared to their peers from the control group. Cows from experimental group III were superior to their counterparts from experimental group I by 6.20 MJ (2.16%), and those from experimental group II by 2.80 MJ (0.96%).

It should be noted that the animals of the experimental groups, compared to their counterparts in the control group, released less energy in their feces, which affected the ability of cows to better digest energy from diets when the test premix was included in the feed.

Cows that received the Megamix-Optilak premix in various doses as part of their feed had higher energy digestibility coefficients. At the same time, animals of experimental group III had superiority over their peers of experimental groups I and II in terms of the studied indicators.

At the same time, the digestibility of nutrients was also higher in the experimental groups that received more biologically complete feeding.

The animals of experimental group III used metabolic energy most productively. Their advantage over their peers in the basic variant and cows of experimental groups I and II in the use of metabolic energy for milk synthesis was 1.09, respectively; 0.62 and 0.58%.

## 5 Conclusion

Thus, the results obtained allow us to conclude that increasing the productivity of lactating cows, as well as more efficient use of feed energy for the formation of products, is closely related to the use of the tested Megamix Optilak premix as part of mixed feed rations.

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