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# Organization of feeding dairy cows for preventing metabolic disorders

**Alexander Nikolayevich Ratoshny**
**Anatoliy Alekseevich Soldatov**
**Sergey Ivanovich Kononenko**
**Ivan Nikiforovich Tuzov**
**Andrey Georgievich Koshchaev**
*Kuban State Agrarian University*
*13 Kalinina Street, Krasnodar, 350044, Russia*

**Abstract**.

Prolonged feeding silage or silage-concentrate types of fodder with lack of hay and carbohydrates to cows may result in disruptions of the protein, carbohydrate, mineral and vitamin metabolism with the accumulation of excess acidic products of ruminal content fermentation in the body.

For preventing metabolic disorders, combination fodders have been developed and tested for feeding cows before and immediately after calving. Their influence on milk production and health status has been studied.

Studying these combination fodders on animals has shown that the gross milk yield in the experimental group was by 9.9% higher than in the reference group against the background of high average daily yields of 22.8 kg of milk in the experimental group and 20.7 kg in the reference. Along with increasing the gross yield of natural milk from cows in the experimental group, compared to the reference, a tendency to improving milk quality has been observed. The yield of milk fat over the 60 days of the experiment in cows that received the Genetic Plus feed additive was higher than that in the reference group by 5.3 kg, or by 11.7%. The overall yield of 4% fat milk was higher in the animals in the experimental group (compared to the reference, the difference was 132 kg), which was higher than the reference by 11.7%. The yield of milk protein over the 60 days in the experimental group was higher than that in the reference group by 4.2 kg, or by 10.9%.

**Keywords**: metabolism preventive care, ketosis, acidosis, forestomachs, ruminitis, combination fodder, hypocalcemia, anion and cation balance, efficiency of use.

## INTRODUCTION

The most common diseases of lactating cows are manifested in the first two months of lactation, i.e. during the period of reaching peak of productivity. They are determined by changes in the metabolism during the transition period, which are not enforced by adequate changes in organization of feeding, or rather sufficient supply of nutrients to cows, which causes several closely related diseases. Outlining any of them does not seem possible, since their manifestations depend on a number of reasons, and depending on the situation, one or another may prevail.

The most common diseases include ketosis, milk fever (labor paresis), rennet dysplasia, acidosis, mastitis, endometritis, laminitis and leucosis. These diseases cause the most significant problems in herds with high productivity, and are caused by changes in metabolism of cows during the transition period and the failure to properly feed animals during this period. To identify the reasons of these diseases, there is no need to study each of them individually - it is sufficient to understand peculiarities of their metabolism. This period includes the month before calving and the first and second months of lactation. However, the 3 weeks before calving and 3 weeks after it are the most important periods.

Despite the fact that it was possible to identify a number of biological patterns of this difficult period, during the last 10-20 years, scientists have continued to pay special attention to studying adaptation to the beginning of lactation and creating a feeding strategy during the transitional period. This short period includes the majority of problems that determine subsequent health and productivity of cows.

During the transfer from pregnancy to lactation, dramatic changes in metabolism occur in the organism over several days. This implies the need for appropriate changes in feeding animals. Given the specificity of the ruminants' digestion, the proposed activities are to be planned and carried out in advance, anticipating them, since the microflora in the rumen takes a few days to adapt to the new type of feeding.

Three weeks before calving are a short but the most important period in the life of a cow, which determines health and productivity during subsequent lactation, and preservation of the herd as a whole. During this time, a cow is to be prepared for abrupt changes in the organism that occur immediately before calving and at the beginning of lactation.

These contradictions result in metabolic disorders during the transition period and subsequent reduction of natural resistance that creates the conditions for manifestation of mastitis, endometritis and other infectious diseases, which literally overwhelm the cow in the first days of lactation (Golovan V. T., et al., 2014; Koshchaev A. G. et al., 2016).

With the approach of calving, concentration of progesterone in the blood decreases, whereas estrogen content remains high, or even increases. High estrogen content in the blood is the main regulator of appetite. At the same time, during the last 3 weeks of pregnancy, the need for nutrient for the growth of the fetus and increasing the placenta and the breast is the maximum, although their consumption during this period reduces by 10-30%, compared to the previous period.

Thus, energy deficiency in cows is determined by physiological reduction of appetite, especially in the last week before calving; this reduction is more pronounced in cows with large fat reserves in the body. Therefore, the main task of the transitional period is creating the conditions for fast and smooth increasing fodder consumption after calving. The main changes in the diets during the transitional period are in increasing the overall nutritional value starting with the second week of the period before calving until the moment of calving (Fisinin V. I., 2012; Zykova S. S. et al., 2018; Shcherbatov V. I. et al., 2018).

Another problem in feeding cows is the use of preserved feed, primarily silage, prepared in both natural way, and with the use of various starter cultures.

The mechanism of negative influence of acid fodder on the organism of ruminants is as follows. When animals are fed with these fodders, many free organic acids, of which the main share is taken by lactic acid (up to 70-80%), enter their forestomachs. When a cow receives daily 20 kg of silage of normal acidity, 340-440 g of the mixture of organic acids enters its rumen. As a result, pH of the rumen shifts towards acidic value (to 5.2-5.6), which results in inhibiting activity of the

physiologically beneficial rumen microflora, for which pH of 6.8 to 7.2 is optimal. This disrupts the processes of rumen digestion, and free acids that have no time to decompose in the rumen are absorbed into the blood, and have slow toxic action on the entire organism. The content of butanoic acid in the silage is above 0.3% (relative to total acids); feeding such silage to lactating cows at the rate of 20 to 25 kg per day without easily accessible sugars for 2 to 6 months causes latent ketosis. In pregnant cows, this results in intrauterine intoxication of the embryo with oxidized products and ketone bodies, causes indigestion in young cattle, and in case of severe intoxication this causes abortions and stillbirth (Ryadchikov V. G., 2013; Soldatov A. A. et al., 2006; Turlyun V. I., Yakovenko P. P., 2013; Koshchaev A. G. et al., 2017).

If concentrates rich in protein are introduced into the diet of cows, the overall level of volatile fatty acids (propionic, acetic, butyric) in the rumen increases, and the milk yield increases at first, but after 2-3 weeks it reduces again, since the ratio of volatile fatty acids in rumen fluid changes due to an increased content of oil and lactic acid. Therefore, concentrated fodders such as wheat and barley groats should be considered physiologically acidic.

Concentrated fodders that contain a lot of starch, especially maize, have a completely different effect on the organism. In the rumen, their intensive fermentation occurs, accompanied by the formation of a lot of propionic acid, which causes an increase in the content of sugar in the blood. Therefore, such a diet promotes reduction of ketone bodies' content in the body (antiketogenic action). This normalizes ruminal digestion and improves productivity of animals (Radchikov V. G., 2013; Chikov A. E., Kononenko S. I., 2009; Chasovshchikova M. A. et al., 2017).

Prolonged feeding silage or silage-concentrate types of fodder with lack of hay and carbohydrates to cows may result in metabolism disruptions: protein, carbohydrate, mineral and vitamin with accumulation of excess acidic products of ruminal content fermentation in the body. In fact, slow intoxication with lactic acid occurs in the organism, otherwise called chronic lactic acid toxicosis. Acute lactic acid toxicosis occurs in cows in case of one-time single feeding to them a large amount of fodder rich in carbohydrates: sugar beet, molasses, green corn, grain, etc. The disease is called rumen acidosis, ruminitis, lactic acidosis (Ryadchikov V. G., 2013; Koba I. S. et al., 2017).

## METHODS

In order to exclude the possibility of metabolic disorders in cows during preparation for calving and the first week of lactation, employees of the Department of Agricultural Animals of the Kuban State Agrarian University developed special concentrated combination fodders intended for feeding high-yielding cows in the period before calving (within the last 20-25 days before calving) and the first 30-60 days of lactation. The biologically active substances in their composition are aimed at removing specific metabolic problems during these periods. Production of these fodders has been established at CJSC Premix in the town of Timashevsk (Ratoshny A. N., Soldatov A. A., Bogdanov V. K., 2013; Radchenko V. V. et al., 2016; Serdyuchenko I. V. et al., 2018).

In case of less pronounced symptoms of the diseases associated with metabolic disorders in animals, the use of combination fodders KK-60-1/S, KK-6-2/D is recommended. Combination fodder KK-60-1/S is fed only during the last days of the period before calving, 20-25 days before the expected date of calving, and KK-60-2/D - during the first 30-60 days after calving. Combination fodders are fed twice a day, 0.5 kg in the morning and 0.5 kg in the evening, along with other concentrated fodders.

In case of more severe symptoms of diseases, combination fodders KK-60-1/SS, KK-60-2/DD are recommended for animals to be fed before calving and after it, respectively, also at the dosage of 0.5 kg in the morning and in the evening during the same periods.

On the day of calving, combination fodders KK-60-1/or KK-60-1/SS are excluded from the diet. All combination fodders have ingredients that inhibit development of leucosis in animals, and components that regulate the anion and cation balance in the diet of animals during the period before calving.

Feeding combination fodders KK-60-1/S, KK-60-1/SS, KK-60-2/D and KK-60-2/DD to cows is an inhibiting factor in development of ketosis, labor paresis, rennet dysplasia, acidosis, mastitis, foot rot and leucosis.

## DISCUSSION

Quality of feeding cows before calving is monitored by determining urine acidity once in 3-5 days at the same time of day. It is recommended to perform monitoring 2-4 hours after feeding. In herbivorous animals, urine pH is 8.2, but before calving, for preventing hypocalcemia and, accordingly, labor paresis, urine pH should be about 6.2-6.8. These indicators are aligned by introducing the above combination fodders into the daily diets of cows.

In addition, quality of feeding should be monitored according to biochemical parameters of blood, which is important for early detection of metabolic disorders. For example, the level of urea in combination with the data about the concentration of albumin and glucose in blood plasma can be used to accurately assess the balance of the diet at all stages of lactation of cows in terms of energy-to-protein ratio, and establishing the deficiency or excess of crude protein in the dry matter of the ration. However, it is necessary to exclude functional disorders of the liver, and to consider the extent of protein decomposition in fodders. Decreased to 2.7-3.0 mmol/l level of urea indicates deficiency of crude protein in the diet of cows. Increased above 6.3 mmol/l urea level with reduced to 19.0-24.0 g/l level of albumin and reduced to 1.94 mmol/l level of glucose should be regarded as imbalance of the diet in terms of the energy-to-protein ratio. High (5.83-7.49 mmol/l) urea concentration with normal values of other blood biochemical parameters indicates high degree of protein decomposition.

In case of insufficient glucose, especially during the period before calving and in phase 1 of lactation, the body tends to compensate for the energy deficiency by burning its own fat, which results in an increased concentration of cholesterol in the blood to 6.95-9.45 mmol/l, and formation of ketone bodies, which leads to liver regeneration, decreased productivity of cows, infertility, and birth of calves with low viability. The content of cholesterol in the blood of healthy cows is in direct correlation with milk productivity.

Variety of feeds in the rations and their quality are the key conditions to the usefulness of feeding dairy cows and high efficiency of using nutrients.

Insufficient amount of rough and juicy fodders and their poor quality result in significant waste of concentrates in feeding of animals. For example, obtaining the milk yield of 20 kg when cows are fed with class I, II and III hay required consumption of 270g, 365g and 500 g of concentrated fodder per 1 kg milk, respectively. This implies that when hay or other main class III fodder is used, consumption of concentrates per unit of product increases almost twice.

Increasing energy concentration in the ration by increasing feeding of specialized combination fodders during the first 100 days of lactation at the rate of 350-400 g/l and reducing their level in subsequent periods (in the final period– 180-220 g/l) are justified in feeding cows. This provides an opportunity to save

12-16% of concentrated fodders' consumption during lactation per each animal without reducing productivity of cows.

## RESULTS

Another way of reducing metabolic complications in newly calved cows is the use of the multicomponent feed additive BVMK P-60-SD (Genetic Plus) during the last days of the period before calving, and in the days in milk. Feeding this additive showed significant effect on cows' milk productivity (Ratoshny A. N., 2013; Donnik I. M. et al., 2017).

This additive was tested on two groups of cows, 58 animals each, cows in one group received the additive (the experimental group), cows in the reference group received the fodder that was balanced for the main nutrients with standard premix P-60-3.

The tested additive was fed to cows in the last 20 days of the period before calving and 20 days after calving. The consumption norm was 200 g/animal per day along with the main diet. Genetic Plus includes a number of protected and unprotected amino acids, vitamins, chelated mineral salts, pre- and probiotics, deoxidizers, adsorbents, and aromatic substances. The synergistic effect of the components contributes to addressing deficiency of energy and glucose, and to preventing fatty infiltration of the liver due to regulation of gluconeogenesis, as well as to treatment and prevention of acidoses, ketoses, and hepatoses.

During this period, fodder palatability, milk yield and economic practicability of using the additive were determined.

Concentrated fodder was fed to animals in the reference and the experimental groups at the rate of 400 g per kg of milk. In the structure of diets, in terms of actual consumption, the share of the concentrated fodder in the reference group was 38.8%, in the experimental group - 39.4%.

The research was performed in the summer: the share of green mass of various crops was 35.5%. In terms of dry matter, the average share of hay and silage in the diet was 23.1% of dry matter, of which that of hay was 14.9%.

Fodder palatability in the reference group over the entire experimental period was 92%; in the experimental group that received BVMK palatability was slightly higher and reached 96.5%. Fodder residues mainly consisted of corn silage and hay. The green mass and combination fodder were almost completely eaten.

Milk production was studied by the method of check-out milking operations every 10 days in accordance with the recommended methods (V. T. Golovan, et al., 2013). On the average, over the experiment period (60 days), milk yield was higher in cows in the experimental group (1,365 kg), while in the reference group it was 1,242 kg. During the experiment, the gross milk yield in the experimental group was higher by 9.9% than that in the reference group.

The daily milk yield in the experimental group was 22.8 kg, in the reference group - 20.7 kg. Along with increasing the yield of natural milk from cows in the experimental group, compared to the reference, a tendency to improving milk quality has been observed. The yield of milk fat over the 60 days of the experiment in cows that received Genetic Plus was higher than that in the reference group by 5.3 kg, or by 11.7%. The overall yield of 4% fat milk was higher in the animals in the experimental group (compared to the reference, the difference was 132 kg), which was higher than that in the reference group by 11.7%. The yield of milk protein over the 60 days in the experimental group was higher than that in the reference group by 4.2 kg, or by 10.9%.

Feeding the P-60-SD Genetic Plus feed additive to cows along with fodder proved to be economically substantiated, since it helped increase profitability of milk production from 36.5% to 51.2%.

## CONCLUSION

The best practice has sufficiently proven that feeding highly productive cows requires new approaches with the use of all latest scientific achievements that make it possible not only to obtain record yields, but to preserve health of the animals as well (Kuznetsov V. V. et al., 2010).

Without using the combination fodder, pregnant and newly-calved high yielding cows already have metabolic disorders, though the diseases are not visible to the eye.

Feeding the combination fodders KK-60-1/S and KK-60-2/D to nonmilking cows is required for getting the maximum milk after calving.

Feeding the combination fodders KK-60-1/S, KK-60-1/SS, KK-60-2/D and KK-60-2/DD to cows is an inhibiting factor in development of ketosis, labor paresis, rennet dysplasia, acidosis, mastitis, foot rot and leucosis.

The use of the P-60-SD Genetic Plus feed additive in the diet also contributes to preventing metabolic disorders in highly productive cows.

Holstein Frisian cows are monitored before calving by determining urine acidity once in 3-5 days at the same time of day (Buryakov N. P., 2009; Viktorov, P. I., Soldatov A. A., 2002). It is recommended to perform monitoring 2-4 hours after feeding. In herbivorous animals, urine pH is above 8.2, but before calving, for preventing hypocalcemia and, accordingly, labor paresis, urine pH should be about 6.2-6.8. In Jersey cows, urine pH is 5.0-5.5.

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