Studying the Feeding of a Buffer Multicomplex in the Diet of Newly Calved Highly Productive Cows

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Abstract. The research has been carried out to study the feeding of the buffer multicomplex in the diet of newly calved highly productive cows. The studied feed additive includes sodium bicarbonate, magnesium oxide, vitamin-mineral premix, probiotic complex, yeast complex, chalk, monocalcium phosphate, phosphate salt, organic chromium, essential oil extracts. In animals of the group where 0.5 kg of compound feed was replaced with 0.5 kg of a buffered probiotic multicomplex, the daily milk yield was significantly higher by 10.9% than in the control. The cost of dry matter for the production of 1 kg of milk decreased in the experimental group relative to the control by 8.6%, the cost of crude protein – by 5.8%. Biochemical parameters of blood serum of all cows corresponded to the norm. In the control, the level of glucose in the blood serum of cows was 3.1 ± 0.20 mole / l; in the experimental group, there was a significant increase in this level by 12.9% within the normal range, which indicates an improvement in carbohydrate metabolism in the body of cows in the new calving period in the experimental group. The level of alkaline phosphatase significantly increased in the second group by 53.4. This indicates an improvement in mineral metabolism in the body of the cows in the experimental group. The microbiological indicators of the ruminal fluid of cows were within the normal range. The results of washing feces on the analyzer showed that the best digestibility of fiber was observed in the experimental group.

1. Introduction
Due to their high energy requirements, highly productive dairy cows consume diets high in concentrated feed. This usually leads to disruption of the gastrointestinal tract, causing subacute rumen acidosis. These disorders can disrupt the absorption of nutrients, the function of the microbiota of the gastrointestinal tract, reduce the absorption and barrier capacity of the intestinal epithelium, and can cause inflammatory reactions. Symptoms are also due to the lowered pH of the rumen [1–3].

Strategies for preventing acidosis include adjusting diets for physically effective fiber, non-fibrous carbohydrates and starch, and adding “protected” protein [4–6]. Disorders from the gastrointestinal tract caused with feeding diets high in concentrated feed can be reduced with using various feed additives and additives, including buffers, mineral complexes, probiotics, prebiotics, and others [7–9].
A rational approach to the use of such feed additives requires an understanding of the mechanisms of their action, both individually and in combinations, with the help of which they affect the functionality of the microbiota and epithelium of the gastrointestinal tract, as well as the immunity, productivity and longevity of cows [10–12].

2. Material and methods
The purpose of the research: to study the feeding of the buffer multicomplex in the diet of newly calved highly productive cows.

As part of achieving this goal, the following tasks were solved:
1) to determine the effect of feeding the studied multicomplex on the feed intake by cows, their milk productivity, the content of fat, protein in milk and the consumption of nutrients per 1 kg of milk;
2) to study the effect of feeding the studied feed additives on the loss of live weight in the first phase of lactation;
3) to analyze the influence of the fed feed products on the biochemical parameters of the blood serum of cows;
4) to determine the effect of the studied feed ingredients on ruminal metabolism and microbiological composition of ruminal fluid;
5) to study the disintegration of crude protein on an artificial rumen and to determine the degree of digestion of particles of the feed mixture when using the studied feed additives;
6) to analyze the economic efficiency of using the studied feed additives in diets for cows in the first phase of lactation.

The experiment was carried out in the conditions of the enterprise LLC Breeding Plant “Nasha Rodina” village Sokolovskoe, Gulkevichsky District, Krasnodar Territory.

Laboratory studies were carried out in laboratories at the IC “Argus” of the Krasnodar Scientific Center for Animal Science and Veterinary Medicine, the Department of Biotechnology, Biochemistry, Biophysics, Kuban State Agrarian University named after V.I. I.T. Trubilina”, LLC “Protectfeed”, CJSC “Premix”.

Four groups of black-and-white cows were formed, selected according to the principle of pairs-analogues of 8 heads in each: by age at calving, calving date, live weight, productivity for the last lactation, fat and protein content in milk.

The cows were fed according to diets, the composition of which is presented in table 1.

| Component                | Feed cost | Group 1 | Group 2 |
|--------------------------|-----------|---------|---------|
| Corn silage              | 1.25      | 18.0    | 18.0    |
| Alfalfa haylage          | 1.25      | 5.0     | 5.0     |
| Green mass of alfalfa    | 0.55      | 22.0    | 22.0    |
| Alfalfa hay              | 3.00      | 1.5     | 1.5     |
| Brewer’s grains          | 1.00      | 8.0     | 8.0     |
| Molasses                 | 3.24      | 1.5     | 1.5     |
| Compound feed            | 7.72      | 9.0     | 8.5     |
| Buffer multicomplex      | 69.00     | -       | 0.5     |

The ration of the first control group was the ration adopted on the farm for newly calved cows. The diet of the second experimental group included the same set of ingredients, only 0.5 kg of compound
feed was replaced by 0.5 kg of VetPro Ruminator – a product produced by LLC “Protectfeed” (Novotitarovskaya station, Dinsky district, Krasnodar region).

The feed additive includes sodium bicarbonate, magnesium oxide, vitamin and mineral premix, probiotic complex, yeast complex, chalk, monocalcium phosphate, phosphate salt, organic chromium, essential oil extracts. Absolutely dry matter contains 25.78% crude protein, 6.50% moisture, 2.20% crude fat, 29.76% crude ash, 3.63% crude fiber, 10.30% sugar, 15.08 MJ metabolizable energy, 10 mg chromium, 8.13 g calcium, 63.43 g magnesium.

Animal diets have been developed in accordance with the requirements of modern detailed feeding norms for lactating cows, taking into account the actual productivity and physiological condition. The dry matter content was in the range of 27923.00–27997.00. The content of net energy of lactation (NEL) varied between groups in the range of 185.10–185.97 MJ.

The level of crude protein in the diet was in the range 4207.57–4667.24 g. The level of digestible protein (nXp) was 3918.47–4334.95 g. Crude fiber levels ranged from 5144.99 to 5159.24 g; crude fat – from 1116.74 to 1135.48 g; starch – from 5796.13 to 6553.01 g; sugar – from 1451.09 to 1546.71 g. The content of structural fiber in both groups of the experiment was 3145.00 g. The nitrogen balance was in the range of 20.44–45.27 g. The content of stable starch in the diet was kept at the level of 1204.02–1370.90 g.

The percentage of non-cleavable protein in the diet of cows was in the range of 25.63–33.00%; non-degradable starch – 20.77–20.92%.

NEL milk was at the level of 45.55–45.81 L; protein milk – 43.91–49.32 l; milk according to nXp – 41.04–45.94 l.

The calcium content in the diets of cows was in the range of 212.52–215.40 g. The percentage of phosphorus in the diet varied in the range 102.48–107.39%; sodium – 64.46–84.59%; magnesium – 56.30–88.28%. The ratio of calcium to phosphorus in the diet of cows of all groups of the experiment was 2.00:1–2.08:1.

In the second group, the cows consumed feed mixtures on average per day by 1.2% more than in the control during the entire experimental period. The consumption of crude protein by animals in the experimental group increased by 4.6% in comparison with the control value.

3. Results and discussion

During the period of milking, the daily milk yield of cows in the control group was 30.80 ± 1.07 kg (table 2). This parameter in animals of the second group, where 0.5 kg of compound feed was replaced by 0.5 kg of a buffered probiotic multicomplex, was significantly higher by 10.9% (p <0.05).

**Table 2. Milk productivity of experimental cows.**

| Indicators                      | Group 1     | Group 2     |
|--------------------------------|-------------|-------------|
| Daily milk yield for the period of milk yield, kg | 30.80±1.07  | 34.17±1.02a |
| % To control                   | 100.0       | 110.9       |
| Milk yield for the period of Days In Milk, kg | 2772.0      | 3075.3      |
| Milk fat, kg                   | 112.42±3.35 | 126.43±3.44b |
| % To control                   | 100.0       | 112.5       |
| Milk protein, kg               | 95.48±3.28  | 110.37±2.94b |
| % To control                   | 100.0       | 115.6       |

*a p<0.05;  
*b p<0.01

Milk yield for the period of Days In Milk increased in the second group by 10.9%. Due to the increase in gross milk yield, the amount of milk fat in the milk of a cow of the second group increased by 12.5% (p <0.01), milk protein – by 15.6% (p <0.01).
When the milk yield was adjusted for 4% milk, the milk yield in the second group of animals increased relative to the control by 11.8%.

Based on the actual feed intake by cows, the cost of dry matter for the production of 1 kg of milk decreased in the experimental group relative to the control by 8.6%, the cost of crude protein – by 5.8%.

The live weight of cows before calving was 575.4 ± 5.1 kg in the control group, after the third month of lactation – 480.6 ± 6.6 kg, in the second group – before calving – 573.1 ± 7.1 kg, after the third month of lactation – 499.8 ± 5.6, or 4.0% higher (p <0.01).

The assessment of biochemical parameters of blood serum plays an important role in assessing the health status of animals (table 3).

**Table 3.** Biochemical parameters of blood serum of cows at the end of the 3rd month of lactation (n=6).

| Indicators               | Group 1 | Group 2 | Norm   |
|-------------------------|---------|---------|--------|
| Protein g/l             | 83.7±0.55 | 87.1±0.23 b | 79-89  |
| Albumin,%               | 42.1±0.70 | 42.3±0.70  | 40-52  |
| Globulins,%             | α       | 13.0±0.44 | 13.1±0.42 | 12.8-17|
|                         | β       | 11.9±0.17 | 11.2±0.51 | 10-17  |
|                         | γ       | 33.0±0.46 | 33.4±0.40 | 25-40  |
| Glucose, mole/l         | 3.1±0.20 | 3.5±0.06 b | 2.2-3.9 |
| Urea, mole/l            | 7.5±0.40 | 7.2±0.23  | 3.3-8.8 |
| Cholesterol, mole/l     | 5.4±0.09 | 4.8±0.40  | 4.7-6.2 |
| Thymol test             | 12.5±2.91 | 11.0±1.15 | till 20 |
| AST, U/l                | 87.5±2.00 | 77.0±2.04 a | 45-110 |
| ALT, U/l                | 30.3±0.57 | 28.2±0.50 a | 6.9-35 |
| Ca, mole/l              | 2.5±0.02 | 2.5±0.36  | 2.48-3.8|
| P, mole/l               | 1.7±0.09 | 1.9±0.09  | 1.4-2.3 |
| Ca/P                    | 1.47±0.08 | 1.32±0.03 | -      |
| Triglycerides, mole/l   | 0.3±0.03 | 0.2±0.03 a | 0.33-0.79|
| Alkaline phosphatase, U/l | 88.0±6.93 | 135.0±0.58 b | 17.5-152|
| Carotene, mg %          | 0.3±0.02 | 0.3±0.06  | 0.9-2.0 |

*a p<0.05;  
b p<0.01;  
c p<0.001

The level of total protein in blood serum was significantly higher when feeding the studied food product by 4.1% in the second group (p <0.01).

The percentage of albumin in the blood of cows in the experimental and control groups did not practically differ, varied from 41.8 to 42.3% and did not exceed the level of the physiological norm; the content of α-, β-, γ-globulins in the blood serum was within the normal range and practically did not differ in the experimental groups from the indicators of the control group.

In the control, the level of glucose in the blood serum of cows was 3.1 ± 0.20 mole / l; in the experimental group, there was a significant increase in this level by 12.9% (p <0.01) within the normal range, which indicates an improvement in carbohydrate metabolism in the body of cows in the new calving period in the experimental group.

The concentration of urea in the blood serum of cows in the control and experimental groups was at the level of 7.2–7.5 mole / l (within the normal range).

In the experimental group, there was an unreliable dynamics towards a decrease in the level of cholesterol in the blood serum of cows by 11.1% in the second group.
A thymol test can determine the level of blood proteins that appear in abnormally high concentrations when the liver is damaged. In the blood serum of cows in the control group, this indicator was within the normal range, however, it was higher and amounted to 12.5 ± 2.91 units, while in the second group there was a dynamics towards a decrease in this indicator by 12.0%.

Serum levels of alanine transaminase (ALT) and aspartate aminotransferase (AST) are considered the two most important indicators of liver damage.

With regard to the level of aspartate aminotransferase (AST) in the blood serum of cows in the experimental group, there was a tendency to decrease relative to control by 12.0%.

According to the level of alanine aminotransferase (ALT) in the blood serum of the cows of the second group of the experiment, there was a dynamics towards a decrease by 4.4% relative to the control.

The above indicates a decrease in the load on the liver of new-calving cows with the combined use of the PassPro Soy feed product, consisting of protected soy protein, and the buffer multicomplex with probiotics VetPro Ruminator (VP Ruminator).

The level of calcium and phosphorus in the blood serum of the experimental cows was within physiological norms. The ratio of calcium and phosphorus in the blood of cows in the control group was 1.5, in the experimental one – 1.3.

Triglycerides in the blood of cows of all groups were slightly below the norm, which can be explained by the postpartum period.

The level of alkaline phosphatase significantly increased in the second group by 53.4 (p <0.01). This indicates an improvement in mineral metabolism in the body of the cows in the experimental group.

Carotene was below the physiological norm in all groups of the experiment, this is most likely due to the lack of this provitamin due to the year-round feeding of the same type in the diet, which should be taken into account in the farm during further feeding of the cows.

Microbiological indicators of the rumen fluid indicate that the number of enterobacteria – representatives of the normal microflora of the rumen – did not differ from the control value in the experimental group and amounted to 1×10^2 CFU in 1 ml (table 4).

| Microbiological indicators, CFU in 1 ml | Group |
|--------------------------------------|-------|
|                                      | 1     | 2     |
| Enterobacteria                       | 1×10^2| 1×10^2|
| Staphylococcus                       | 3×10^5| 6×10^4|
| Sulfiding Clostridia                 | 1,0   | abs   |
| Lactic acid bacteria                 | 5×10^4| 3×10^6|
| Yeast                                | 3×10^6| 3×10^7|

The highest content of colony-forming units of staphylococcus was detected in the rumen fluid of cows of the control group – 3×10^5 CFU in 1 ml. In the experimental group, this indicator was 6×10^3 CFU in 1 ml.

Sulfiding clostridia were found in a small amount of the rumen fluid sample from the control group, namely in the form of one colony. Colonies of sulfiding clostridia were not found in the samples of the rumen fluid of the cows of the experimental group.

The content of lactic acid microorganisms in the control was 5×10^4 CFU in 1 ml. In the experimental group, this indicator was slightly lower than the control value and amounted to 3×10^6.

The number of yeast in the rumen of the first group was 3×10^6 CFU in 1 ml. In the second group, this indicator was 3×10^7 CFU in 1 ml.
Table 5 provides data on the study and disintegration of crude protein feed mixture on artificial rumen.

**Table 5. Decomposition of crude protein feed mixture.**

| Indicator                  | Group | 1         | 2         |
|----------------------------|-------|-----------|-----------|
| Protein breakdown,%        | 1     | 44.20±0.64| 52.90±0.67*|
| % To control               | 2     | 100.0     | 135.5     |

* p<0.001

Protein degradability increased in the experimental group by 35.5% (p <0.001).

The results of washing feces on the analyzer showed that the best digestibility of fiber was observed in the experimental group (table 6).

The number of undigested parts of grain in the second group of the experiment using the multicomplex significantly decreased by 0.26% (p <0.05).

**Table 6. Results of washing feces on the analyzer Nasco Pigestion Analyzer, %**

| Group        | Sieve type | The amount of undigested parts of grain,% by weight |
|--------------|------------|---------------------------------------------------|
|              | top        | average | bottom |                                     |
| 1 (control)  | 38.5       | 36.0    | 25.5   | 1.33±0.07                             |
| 2 (experience)| 29.4       | 20.6    | 50.0   | 1.04±0.07*                            |
| B %          | -          | -       | -      | -0.26                                 |

* p<0.05

4. Conclusion

In animals of the group, where 0.5 kg of compound feed was replaced by 0.5 kg of a buffered probiotic multicomplex, the daily milk yield was significantly higher by 10.9% than in the control (p <0.05).

Based on the actual feed intake by cows, the cost of dry matter for the production of 1 kg of milk decreased in the experimental group relative to the control by 8.6%, the cost of crude protein – by 5.8%.

Biochemical parameters of blood serum of all cows corresponded to the norm.

In the control, the level of glucose in the blood serum of cows was 3.1 ± 0.20 mole / l; in the experimental group, there was a significant increase in this level by 12.9% (p <0.01) within the normal range, which indicates an improvement in carbohydrate metabolism in the body of cows in the new calving period in the experimental group.

The level of alkaline phosphatase significantly increased in the second group by 53.4 (p <0.01). This indicates an improvement in mineral metabolism in the body of the cows in the experimental group.

The microbiologic indicators of the rumen fluid of the cows were within the normal range.

The results of washing feces on the analyzer showed that the best digestibility of fiber was observed in the experimental group.

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