Use of feed additives “Valopro” and “Ruprokol” to increase the energy of growth and meat productivity of simmental steers

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Abstract. The article assesses the growth, development and meat productivity of Simmental bulls during the growing period when the feed additives “Valopro” and “Ruprokol” are included in the ration. For experience in intensive growing conditions on the basis of the industrial complex LLC Agropark-Razvilnoye, Rostov Region, in September 2019, two groups of 10-month-old calves of Simmental breed were formed. In the experimental group, the calves were fed in feed compound “Valopro” at the rate of 20 grams and “Ruprokol” - 50 grams per head per day. Gobies of control feed additives were not received. In the experimental group, over 80 days of growing, an average of 9.15 kg was consumed, and in the control group, 8.9 kg of dry matter per head per day. The absolute growth of young animals fed a diet with feed additives was 26 kg higher during the accounting period. The use of fodder additives in the feeding of bull calves made it possible at the age of 13 months to obtain a live weight of 439 kg, one kilogram of which contains 403 g of muscle tissue and 429 g of edible carcass elements. The introduction of feed additives helped to reduce feed costs per 1 kg of gain in live weight by 18%, to obtain 1600-1700 g of daily gain and provide additional profit.

1. Introduction
The leading role in solving the problems of food security of the population is given to livestock. In this regard, one of the main tasks of the livestock industry is the production of high-quality beef by intensive rearing of young animals [1, 2]. It has been proved that it is advisable for meat cattle breeding to focus on the use of intensive breeds and technologies that ensure the achievement of a live weight of at least 500 kg at 14-16 months of age, which is important, including from an economic point of view [3, 4, 6].

To ensure the maximum level of meat productivity when growing and fattening young cattle and to obtain high-quality products, according to [6], it is necessary to use the age-related patterns of muscle, fat and bone tissue formation. During the period of maximum growth rate, young growth uses feed nitrogen most efficiently, which contributes to intensive protein synthesis in the body [7, 8, 9].

The presence of a high level of concentrates in the diet of young cattle during the cultivation of high levels provokes active fermentation processes in the rumen in the first hours after eating, causing cleavage and excessive fermentation of starch, reducing its transit ability to the intestines. This provokes the production of an excessive amount of lactic acid (lactate), which under optimal conditions of the intracerebral environment is almost completely processed into propionic acid and which is the main...
precursor of glucose obtained in the process of gluconeogenesis in the liver. Due to the rapid accumulation of lactic acid, the pH in the rumen decreases and the activity of cellulose-lytic (fiber-breaking) bacteria decreases [2]. Such a course of digestion reduces the efficiency of splitting and the involvement of fiber in the metabolic processes. By introducing feed additives created on the basis of the “transit phytogenic nutrients” principle, the negative factors of the unbalanced dietary structure in cicatrical digestion are eliminated and the quality of the intestinal stage of digestion is improved. These measures allow you to influence the growth energy and composition of the tissues of the animal in different age periods.

The inclusion in the diet of ruminants of the feed additive “Valopro”, consisting of a mixture of tannins, essential oils, mineral salts (zinc sulfates, manganese, cobalt, sodium and calcium carbonate), slows down the degradation of starch, improves the breakdown of fiber, stabilizes the pH of the scar. At the same time, the amount of cellulolytic cicatrical microflora in the chyme of the scar increases and the rate of protein breakdown decreases, which, in turn, contributes to their more efficient absorption in the intestine [10, 11].

To meet the needs of the body of ruminants in choline chloride, the feed additive Ruprocol is used. As part of the additive, the microcapsulated choline chloride is located in the lipid matrix, which passes the scar without undergoing cleavage. In the small intestine, choline chloride becomes active and, being a source of free methyl groups and possessing lipotropic properties, is involved in the exchange of phospholipids. The presence of a sufficient amount of choline chloride helps to reduce the formation of ammonia in the rumen and urea in the liver, as well as improve energy synthesis, which, ultimately, has a positive effect on increasing productivity [8, 12, 13].

The purpose of the study was to assess the growth, development and meat productivity of Simmental calves during the growing season when the feed additives Valopro and Ruprocol were included in the diet.

2. Material and research methods
For experience in intensive growing conditions on the basis of the industrial complex LLC Agropark-Razvilnoye, Rostov Region, in September 2019 two groups of 10-month-old gobies of Simmental breed were formed. In an experimental group of 18 calves with an average live weight of 311 kg, feed additives “Valopro” were added to the feed at the rate of 20 grams and “Ruprokol” – 50 grams per head per day. Gobies of the control group (19 goals with an average live weight of 314 kg) did not receive feed additives. The animals of the experimental groups were kept separately loose in light-type rooms with free access to the live-feed area. On the site under a canopy, automatic drinking bowls and self-feeders for coarse (barley and pea straw, mixed grass and alfalfa hay) and concentrated feeds were located. Feeds were consumed by experimental animals ad libitum. The amount of feed consumed depended on age and live weight and varied from 7.5 to 10 kg of dry matter per head per day (table 1). According to the results of taking into account specified feeds and their residues, it was found that in the experimental group for 80 days of growing, an average of 9.15 kg was consumed, and in the control group, 8.9 kg of dry matter per head per day.

In addition, due to the introduction of feed additives, experimental bulls consumed an additional 24 hours: zinc sulfate 371 mg, manganese sulfate 372 mg, cobalt acetate 2 mg, sodium sulfate 3.1 g, calcium carbonate 1.6 g and fineness – 764 mg.

The account of the eatability and feed costs per 1 kg of live weight gain was determined by the generally accepted method by the group method. To study the growth energy of the experimental animals, weighed when setting up the experiment, on day 40 and at its end. Based on the data obtained, the absolute and average daily gains for the full cycle of growing were calculated.

At the end of the experiment, 5 bulls of each group from the jugular vein were taken blood samples for biochemical studies. For the control slaughter, 3 heads were selected from each group, reflecting the average values of live weight in their groups. Slaughter qualities were determined by the pre-slaughter live weight, the mass of fresh carcass, the mass of internal raw fat, the slaughter weight, the slaughter yield and the morphological composition of the carcass.
The cost recovery for rearing animals using feed additives was determined according to accounting data on the cost of feed, labor, energy and other costs by comparing them with the proceeds from the sale of animals for slaughter. Digital experimental data were mathematically processed.

### Table 1. Used rations on average per bull.

| Feeds             | Group and live weight, kg |
|-------------------|---------------------------|
|                   | Experienced | Control |
|                   | 310         | 420      | 310   | 420      |
| Mixed grass, kg   | 2.0         | 3.5      | 2.0   | 3.5      |
| Hay bean, kg      | 1.0         | 1.5      | 1.0   | 1.5      |
| Barley straw, kg  | 1.0         | 0.5      | 1.0   | 0.5      |
| Bean straw, kg    | 1.0         | 1.0      | 1.0   | 1.0      |
| Compound feed, kg | 4.75        | 7.25     | 4.5   | 7.0      |
| Feed additives, g | 70          | 70       | 0     | 0        |
| Salt, g           | 45          | 55       | 45    | 55       |
| Total: Dry substance, kg | 7.8   | 10.6     | 7.6   | 10.2     |
| Exchange energy   | 91          | 118      | 87    | 112      |
| Cellulose, kg     | 1902        | 1938     | 1902  | 1938     |
| Calcium, g        | 81          | 84       | 79    | 82       |
| Phosphorus, g     | 32          | 38       | 32    | 38       |
| Sulfur, g         | 24          | 27       | 24    | 27       |
| Iron, mg          | 913         | 917      | 913   | 917      |
| Copper, mg        | 63          | 73       | 63    | 73       |
| Zinc, mg          | 1479        | 1490     | 217   | 228      |
| Manganese, mg     | 1650        | 1657     | 385   | 392      |
| Cobalt, mg        | 8.1         | 8.5      | 7.3   | 7.5      |
| Carotene, mg      | 170         | 178      | 170   | 178      |
| Vitamin D, thousands. ME | 6.1 | 6.4      | 6.1   | 6.4      |
| Vitamin E, mg     | 380         | 391      | 380   | 391      |

### 3. Results and discussion

Gobies of the Simmental breed of the experimental groups arrived at the feeding complex at 8 months of age and underwent adaptation in the quarantine case within 30 days. Then the animals were transferred to the housing for rearing with the same conditions, which met the requirements of pet hygiene in terms of distribution density and the front of feeding and watering. Despite eating experimentally coarse and concentrated feed in plenty, the calves of the experimental group noted a higher activity of eating coarse and concentrated feed.

As a result, the growth energy in the first month of growing increased by almost 2 times compared with the pre-experimental period and amounted to 1675 grams (table 2). The peers of the control group in terms of growth rate were 375 grams inferior to the young man of the experimental group. Subsequently, the average daily increase in gobies of both groups decreased slightly, but the superiority of the bulls of the experimental group remained. As a result, the absolute growth of the young man receiving the diet with feed additives was 26 kg higher during the reporting period. The difference in live weight between the experimental groups at all stages of the research was highly significant.

### Table 2. Productivity of Simmental calves.

| Age, days | Live mass, kg | Cv, % | Absolute increase, kg | Daily average increase, g | Live mass, kg | Cv, % | Absolute increase, kg | Daily average increase, g |
|-----------|---------------|-------|------------------------|---------------------------|---------------|-------|------------------------|---------------------------|
|           | experienced   | groups | control                |                           |               |       |                        |                           |
|           |               |        |                        |                           |               |       |                        |                           |
It should also be noted that in the gobies of the experimental group, unlike the control, there were no diseases of the upper respiratory tract, eye diseases, etc. Analysis of blood samples revealed that all the evaluated parameters in the animals of the experimental groups were within, or slightly higher than the physiological norm. Thus, a higher total protein content in the blood of the experimental group, similar to the control, was increased and the energy supply of the body of young experimental group was improved.

The high content of alkaline phosphatase in the blood of gobies of the control group is probably due to the feed additive “Ruprocol”, choline chloride entered the liver, which normalized phospholipid metabolism and prevented hepatosis. Therefore, the content of alkaline phosphatase and prevented hepatosis. Therefore, the content of alkaline phosphatase

| Indicator          | Unit of measurement | Norm | Experienced group | Control group |
|--------------------|---------------------|------|-------------------|---------------|
| Total protein      | g/l                 | 62-82| 89.62 ± 3.91.6    | 85.58 ± 79.9-90.1 |
| Albumen            | g/l                 | 28-39| 31.66 ± 3.2-39.6  | 38.46 ± 31.9-44.7 |
| Glucose            | mmol/l              | 2.3-4.1| 3.00 ± 2.45-3.51 | 3.01 ± 2.37-3.40 |
| Amylase            | u/l                 | 41-98| 109 ± 88-124      | 111 ± 80-140   |
| Bilirubin          | mkmol/l             | 0.7-14| 2.14 ± 1.8-2.6   | 2.53 ± 1.3-3.5 |
| Alkaline phosphatase| mkmol/l            | 18-153| 156.2 ± 106-209  | 186.6 ± 156-214 |
| AlAt               | u/l                 | 6.9-35| 28.38 ± 19.9-31.2 | 30.72 ± 26.3-36.2 |
| AsAt               | u/l                 | 45-110| 45.9 ± 34.7-57.7  | 43.9 ± 21.3-52.6 |
| GGT                | u/l                 | 4.9-26| 26.4 ± 21-36     | 20.2 ± 13-27 |
| LDG                | u/l                 | 309-938| 726.4 ± 612-872   | 588.2 ± 380-705 |
| K-kinase           | u/l                 | 14-107| 126.6 ± 110-171  | 121.4 ± 98-156 |
| Creatinine         | mkmol/l             | 56-162| 59.88 ± 56.8-62.7 | 76.52 ± 63.1-97.5 |
| Urea               | mmol/l              | 2.8-8.8| 3.5 ± 3.0-4.3     | 3.84 ± 3.6-4.2 |
| Uric acid          | mmol/l              | 37.5-119| 59.06 ± 43.45-74.9| 55.88 ± 55.55-64.69 |
| Cholesterol        | mmol/l              | 1.39-4.7| 2.41 ± 1.78-3.1  | 2.64 ± 1.95-3.4 |
| Triglycerides      | mmol/l              | 0.2-2.6| 0.2 ± 0.15-0.23   | 0.17 ± 0.13-0.25 |
| Calcium            | mmol/l              | 1.62-3.37| 2.19 ± 1.65-2.84 | 2.38 ± 2.30-2.46 |
| Phosphorus         | mmol/l              | 0.81-2.72| 1.35 ± 1.16-1.56 | 1.53 ± 1.0-1.7 |
| Magnesium          | mmol/l              | 0.7-1.2| 2.01 ± 1.9-2.13   | 1.76 ± 1.31-2.17 |
| Iron               | mkmol/l             | 10-29| 17.02 ± 12.8-20.3 | 18.2 ± 13.1-21.8 |

*P<0.01

The lower blood content of the young experimental group of the amylase enzyme and the higher content of aspartate aminotransferase, lactate dehydrogenase, gamma glutamyl transpeptidase and creatine phosphokinase enzymes are associated with a lower level of rumen starch fermentation. By optimizing the processes of the breakdown of fats in the liver and the biochemical transformation of creatine and adenosine triphosphate into creatine phosphate, the absorption of feed metabolic energy was increased and the energy supply of the body of young experimental group was improved.

The high content of alkaline phosphatase in the blood of gobies of the control group is probably due to an insufficient amount of transit nutrients in the rumen and a low intake of protein in the liver. As a result, dystrophy of her parenchyma occurs with the manifestation of cholestatic hepatitis. In peers of the experimental group, due to the feed additive “Ruprocol”, choline chloride entered the liver, which normalized phospholipid metabolism and prevented hepatosis. Therefore, the content of alkaline

Table 3. Indicators of biochemical analysis of blood.
phosphatase in the blood of gobies of the experimental group on average was almost at the level of the highest normal range.

At the final stage of the experiment, a control slaughter was carried out. During the period of fasting, the loss of live weight in the bulls of the experimental groups was almost the same, therefore, the superiority in the pre-slaughter live weight between the experimental and control animals remained the same (23 kg) as during the final weighing. During the control slaughter of the gobies of the experimental groups, a visual assessment of their liver and scar mucosa was carried out, which did not reveal deviations from the norm, which indicates the absence of negative consequences from the use of the feed additive. The calves of the experimental group, which had significant superiority in the pre-slaughter live weight, had 25.9 kg more mass of paired carcass, and its yield was almost 4% higher compared to the control. In animals of the experimental group, a slightly larger yield (difference is not significant) of internal fat was also recorded (table 4). As a result, the bulls of the control group were 28.2 kg (11.7%; P≤0.01) in terms of slaughter weight and peer of the experimental group by almost 2% in terms of slaughter yield.

**Table 4. Indicators of slaughter of gobies at the end of the experiment.**

| Denomination                                      | Experienced | Control    |
|--------------------------------------------------|-------------|------------|
| Slaughter live weight, kg                       | 427±1.07    | 404±0.59   |
| Weight of fresh carcass, kg                      | 231.1±0.78  | 205.2±1.33 |
| The mass of steam carcass,%                      | 54.12       | 50.8       |
| The mass of internal fat, kg                     | 10.55±0.8   | 8.20±0.6   |
| The mass of internal fat,%                       | 2.47        | 2.02       |
| Slaughter weight, kg                             | 241.65±1.9  | 213.40±1.6 |
| Slaughter yield,%                                | 56.59       | 52.82      |
| Weight of chilled carcass, kg                    | 227.7±0.58  | 202.1±0.87 |
| The mass of muscle tissue, kg                    | 172.14±1.0  | 150.17±1.2 |
| The output of muscle tissue,%                    | 75.6        | 74.3       |
| The mass of adipose tissue, kg                   | 11.15±0.5   | 8.89±0.2   |
| The yield of adipose tissue,%                    | 4.9         | 4.4        |
| The mass of muscle and fat tissue from the carcass, kg | 183.29±1.3  | 159.06±1.1 |
| Bone mass, kg                                    | 39.84±0.4   | 37.99±0.5  |
| The output of bones,%                            | 17.5        | 18.8       |
| The mass of cartilage and tendons, kg            | 4.55±0.1    | 5.05±0.2   |
| The output of cartilage and tendons,%            | 2.0         | 2.5        |
| The mass of bones, cartilage and tendons from the carcass, kg | 44.39    | 43.04      |
| Meat index                                       | 4.60        | 4.18       |
| Edible / inedible carcass ratio                  | 4.13        | 3.69       |

*P≤0.01

In the process of analyzing the morphological composition of the carcasses, it was revealed that the use of Valopro and Ruprocol feed additives in the feeding of Simmental gobies had a positive effect on the formation of muscle tissue. Its weight in the bulls of the experimental group was 22 kg (12.8%) more than that of the peers of the control group.

In addition, when assessing the morphological composition of the carcasses of young animals of the control group, it was found that they were 0.5% inferior to adipose tissue, and peers who used fodder supplements in their diet exceeded 1.8% in the yield of bones, cartilage and tendons. Therefore, the calves of the experimental group the mass of the edible part of the carcass was 24.2 kg (15.2%) more (P≤0.01) than the peers of the control group. In this regard, the calves of the experimental group had a significantly higher meat index and the ratio of edible to inedible parts of the carcass.
Consequently, the use of Valopro and Ruprokol feed additives in bull calves during the rearing period made it possible to obtain a live weight of 439 kg at 13 months, one kilogram of which contains 403 g of muscle tissue and 429 g of edible carcass elements. In peers of the control group, these indicators are 5-9% less.

An analysis of the economic indicators of the experiment made it possible to establish that the introduction of the experimental group of feed additives “Valopro” and “Ruprokol,” according to the scheme we studied, into the diet of Simmental gobies, and the higher feed intake, increased the total cost during the growing period. However, an increase in the amount of dry matter of the feed consumed, and most importantly more efficiently used by the bulls of the experimental group, had a positive effect on the increase in absolute growth and live weight during the growing period (table 5).

**Table 5. Performance indicators of young growth.**

| Indicator                                      | Groups    |
|------------------------------------------------|-----------|
| Live weight at the beginning of the period, kg | 311±1.4   |
| Live weight at the end of the period, kg       | 439±1.7   |
| Absolute increase, kg                          | 128±0.9   |
| Total consumed dry matter of feed per 1 head for the reporting period, kg | 732       |
| Feed consumption per 1 kg                      | 5.72      |
| Cost price 1 kg, RUB                          | 151.4     |
| Cost of growth, RUB                           | 19379.2   |
| Selling price of 1 kg of live weight, RUB     | 165       |
| The cost of growth for the period of experience, RUB | 21120    |

As a result, the total cost of growing one bull in the experimental group was almost 19% higher than that of the peers of the control group, but the feed cost per 1 kg of live weight gain was 18% lower.

With the same selling cost of 1 kg of live weight from each bull of the experimental group, the cost of growth was 21120 rub, and from peers of the control group it was 16830 rub. The contingent income or the difference between the cost and the cost of growth in control was 1132.2, and in the experience – 1740.8 rub, or 46.3% more.

4. Conclusion

Thus, the introduction into the diet of bulls grown for meat in an industrial complex, the composition of the feed additives “Valopro” and “Ruprokol” during the growing period increases the degree of use of feed nutrients, which reduces feed costs by 1 kg of live weight gain by 18%, it intensifies the growth energy and contributes to the production of 1600-1700 g of daily gain, and also provides additional profit.

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