Influence of complex feed additives on the meat productivity of young cattle in the conditions of Yakutia

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Abstract. The paper presents the results of fattening young cattle in the conditions of Yakutia with the use of complex feed additives from local natural raw materials in their diets. One of the ways to increase the meat productivity of livestock is to optimize feeding by inserting complex feed additives into their diets. Therefore, studies were conducted to determine the effectiveness of complex feed additives in the fattening of young cattle in the conditions of Yakutia. At the beginning of the experiment, the live weight of the animals in the groups did not differ much, but starting from the age of 12 months, the superiority of the animals from the experimental groups is noted. In the period of 12–15 months of age, the animals from the experimental groups exceeded the growth rate of the control group by 6.70% and 4.76%. In the period of 15–18 months old, the animals of the control group were inferior to the experimental groups by 28.31% and 16.54%. On average, the animals of the experimental groups grew more intensively in comparison with the control group by 12.73% and 8.66%. Analysis of animal slaughter data showed that the experimental groups were superior to the control group in a number of indicators, such as the mass of the steam carcass by 8.04% and 4.43%, the mass of visceral fat by 18.59% and 7.39%. The organoleptic evaluation of meat products also confirmed the superiority of the experimental groups over the control group. Thus, the use of complex feed additives in the feeding of young cattle on fattening showed its effectiveness.

1. Introduction

As of October 1, 2019, there are two large agricultural holdings in the region, FAIC “Tuymaada” and JSC LC “Tuymaada-Leasing”, 1,337 agricultural organizations, 571 agricultural consumer cooperatives, 3,098 peasant (farmer) farms, 427 individual entrepreneurs engaged in agriculture, 344 clan, tribal nomadic communities of indigenous peoples of the North and the Arctic [4, 10].

In Yakutia, the main herd of cattle is Simmental and Simmentalized cattle – 75.6 %, followed by the number of livestock is Kholmogorsky breed – 22.2 %, Yakut native cattle – 0.75 %, Kalmyk breed – 0.7 %, red steppe breed – 0.62 %, red mottled breed – 0.07 %, the remaining breeds are less than
0.06%. The analysis of the data of the cattle industry showed that from 1990 to 1993 there was a positive trend in the growth of the total number of cattle by 6.91% and cows by 6.9%, respectively. From 1993 to 1999, the total number of livestock decreased by 54.99%, including cows by 39.17%. It should be noted that the absolute maximum number of livestock in the history of Yakutia falls on 1917 – 487 thousand heads of cattle. The longest period of decline in the number of livestock falls on 2009 to 2018, if at the beginning of the period there were 248.8 thousand heads, then at the end the total number of livestock was 188 thousand heads, or the reduction in the number was 32.34%. In this period, the number of dairy cows decreased from 99 thousand heads to 74.2 thousand heads, or by 33.42%.

It should be noted that a significant part of the cattle livestock in the republic was preserved in the Central group of districts, namely Megino-Kangalassky, Churapchinsky, Ust-Aldansky and Khangalassky districts. In Yakutia, there are 47 main (basic) breeding reproducers and 33 farms – candidates for breeding farms. At the beginning of 2018, there were 3,697 heads of breeding cattle in the republic, of which 1,803 were dairy cows. The company “Kladovaya Olekma” of the Olekminsky district has a large breeding stock of cattle – 757 heads, of which 325 are dairy cows [4, 10].

Poor arrangement of cow feeding during mass calving affects, in addition to the dairy productivity of the animals, a decrease in the growth rate of young cattle [16, 19].

There is quite a lot of information on the organization of rational feeding of dairy cattle in Yakutia [1, 14, 18].

Science has accumulated knowledge on the possibilities of increasing the productivity of farm animals and birds in different geographical conditions of their breeding. Developed adaptive livestock breeding technologies allowed bringing agrarian production to a new level of development and creating competitive products in the market [8, 2, 5, 12, 13, 15, 17].

**The aim of the research:** to determine the effectiveness of complex feed additives in feeding young cattle on fattening.

**The objectives of the research:**
- to study the growth and development indicators of animals;
- to study the effect of complex feed additives on the meat productivity of animals.

### 2. Material and research methods

Scientific and economic experience in testing complex feed additives consisting of local natural resources in the fattening of young animals of Simmental breed was carried out in the conditions of the farm “Lonkur” of the Suntarsky district. The housing conditions for all groups of animals were the same, with the exception of complex feed additives in the diets of the bulls of the experimental groups. To study the detailed effect of complex feed additives on the productive indicators of fattening young animals, we studied the dynamics of live weight, slaughter qualities, such as pre-slaughter weight, carcass weight, visceral fat mass, slaughter weight, determined the yield of carcass and fat, as well as the slaughter yield. The meat productivity of the animals was determined by conducting a control slaughter of 3 heads from each group in slaughterhouses and analyzing them according to the appropriate methodological instructions [11]. At the same time, pre-slaughter and removable live weight, carcass weight, fat yield, and slaughter yield were taken into account. Dissection of carcasses was carried out taking into account the recommendations [20]. Separate studies on methodological guidelines [9]. Evaluation of the commercial and technological value of muscle tissue was determined by the methodical recommendations [3].

Feed additives consisted of coniferous flour, hongurin zeolite, and Kempendayansk salt. Coniferous flour contains dry matter – 20.7%, whole protein – 6.9%, carbohydrates – 32.8%, crude fat – 9.6%, crude fiber – 10.5%, organic acids – 9.6 %, other organic substances – 2.5 %, crude ash – 7.4 mg%, calcium – 0.5%, phosphorus – 0.4%, potassium – 2.3%, magnesium – 0.3%, iron – 174 mg, copper – 12.6 mg, manganese – 197 mg, carotene – 168 mg, Vitamin E – 220 mg, Vitamin B – 8.0 mg%, Vitamin C – 127.3 mg, Vitamin P – 27.8 mg.

The chemical composition of hongurin zeolite is presented in our previous work [7].
3. Results and discussion
The studies were conducted in accordance with the research program and the scheme of experience. The housing conditions for animals in all groups were the same. Except for the fact that in the experimental groups, animals were fed with experimental feed additives in different doses in addition to the main diet (Table 1).

Table 1. Scheme of scientific experience.

| Group         | n  | Feeding conditions                                                                 |
|---------------|----|------------------------------------------------------------------------------------|
| I - control   | 10 | Basic diet                                                                         |
| II experimental | 10 | Basic diet + coniferous flour 50 г + hongurin zeolite 0.7 г/kg of live weight + Kempendyaysk salt 35 г |
| III experimental | 10 | Basic diet + coniferous flour 100 г + hongurin zeolite 0.7 г/kg of live weight + Kempendyaysk salt 35 г |

Feed consumption per Simmental young bull is shown in Table 2.

Table 2. Feed and nutrient consumption per young bull.

| Feeds         | Average daily portion, kg | Duration of the period, days | Required for the fattening period, kg | Contained in feed exchange energy, MJ | digestible protein, kg |
|---------------|---------------------------|-----------------------------|--------------------------------------|--------------------------------------|-----------------------|
| Standard      |                           |                             |                                      |                                      |                       |
| Meadow hay    | 8                         | 175                         | 1400                                 | 8400                                 | 61                    |
| Haylage       | 9                         | 120                         | 1080                                 | 3240                                 | 33.7                  |
| Pasture grass | 20                        | 125                         | 2500                                 | 5750                                 | 50                    |
| Mixed fodder  | 3                         | 300                         | 900                                  | 8820                                 | 96.3                  |
| Total         |                           |                             |                                      | 26210                                | 240.9                 |
| Protein level in the diet, g |                             |                             |                                      |                                      | 91.95                 |
| Sufficiency, %|                           |                             |                                      |                                      | 86.25                 |

Table 3 shows the average daily diet of experimental animals during the summer period of maintenance.

Table 3. Average daily diet of 15 months old young bulls.

| Indicators         | Standard | Groups                                      |
|--------------------|----------|---------------------------------------------|
|                    |          | I - control | II - experimental | III - experimental |
| Pasture grass, kg  | 20       | 20          | 20                | 20                |
| Mixed fodder, kg   | 2        | 2           | 2                 | 2                 |
| the diet contains: |          |             |                    |                   |
| Exchange energy, MJ| 57       | 65.2        | 65.2               | 65.2              |
| Dry matter, kg     | 8.2      | 8.4         | 8.41               | 8.42              |
| Digestible protein, g| 605      | 560         | 628.34             | 639.53            |
| Crude fiber, g     | 1560     | 2138.59     | 2197.87            | 2298.77           |
| Starch, g          | 910      | 936.2       | 949.3              | 952.89            |
| Sugars, g          | 605      | 618.39      | 630.1              | 642.29            |
| Crude fat, g       | 270      | 274.31      | 289.7              | 299.67            |
| Calcium, g         | 45       | 62.65       | 63.87              | 65.35             |
| Phosphorus, g      | 24       | 25.22       | 27.99              | 29.12             |
| Sulfur, g          | 25       | 25          | 26.23              | 27.24             |
Data on the consumption of feed and nutrients by experimental young bulls of the Simmental breed during the feeding period showed that there is a shortage of copper, zinc, cobalt, and iodine according to feeding standards. The inclusion of complex feed additives from local natural raw materials provides an improvement in the nutrition of animals, contributing to a more complete provision of diets according to feeding standards.

One of the main indicators that characterize meat productivity is the dynamics of the live weight of fattening animals. Indicators of changes in the weight growth of experimental animals are presented in Table 4.

**Table 4. Dynamics of live weight of animals, (M±m, n=10).**

| Age, period | Groups |  |  |  |
|-------------|--------|-------------|-------------|-------------|
|             | I - control | II - experimental | III - experimental |  |
| dynamics of live weight, kg |  |  |  |  |
| 9 months | 208.6±2.01 | 207.9±1.57 | 208.1±1.7 |  |
| 12 months | 271.9±1.21 | 274.2±1.28 | 274.8±1.29 |  |
| 15 months | 328.6±2.25 | 334.7±1.89* | 334.2±1.52* |  |
| 18 months | 383±1.98 | 404.5±0.99*** | 397.6±1.94*** |  |
| for the experiment | 174.4±3.08 | 196.6±1.78*** | 189.5±1.81*** |  |
| average daily live weight gain, g |  |  |  |  |
| 9-12 months | 703.33±22.95 | 736.67±22.59 | 741.11±22.65 |  |
| 12-15 months | 630±16.73 | 672.22±10.24* | 660±16.58 |  |
| 15-18 months | 604.44±15.02 | 775.56±23.88*** | 704.44±18.38*** |  |
| for the experiment | 645.93±11.41 | 728.15±6.61*** | 701.85±6.74*** |  |

*Note: *P* > 0.95; ***P* > 0.999

If at the beginning of the experiment the live weight indicators were almost the same (207.9-208.6 kg), then in the middle of the experiment (the age period of 12-15 months) there is a difference. Thus, the control group of animals achieved 630 g per day of growth, being inferior in this indicator to the young bulls of the II and III experimental groups by 6.70% and 4.76%, respectively (P>0.95). This trend continued in the age period of 15-18 months. The control group of calves was inferior to the animals of the experimental groups by 28.31% and 16.54%, respectively (P>0.999). During the experiment period, an average daily increase was obtained for the groups: the control group – 645.93 g, the II experimental group – 728.15 g, the III experimental group – 701.85 g. The animals of the experimental groups that were fed with complex feed additives grew more intensively than their peers from the control group by 12.73% and 8.66%, respectively (P>0.999).

Thus, the inclusion of complex feed additives in the feed diet of fattening young animals of Simmental breed allowed improving the weight growth indicators. This was due to an improvement in
the intensity of the digestion of feed nutrients and a better metabolism in the body of animals due to the inclusion of experimental complex feed additives in their diet. At the end of the scientific and economic experiment, a control slaughter of experimental young bulls was carried out at the age of 18 months, 3 heads from each group. At the same time, such indicators characterizing meat qualities as pre-slaughter mass, mass of steam carcass, mass of visceral fat, slaughter mass, yield of carcass and fat, as well as slaughter yield were evaluated (Table 5).

Table 5. Indicators of control slaughter of animals, M±m).

| Indicators                        | Groups                        |
|----------------------------------|-------------------------------|
|                                  | I - control                  | II - experimental | III - experimental |
| Pre-slaughter mass, kg           | 38±0.58                      | 405.33±0.88      | 398.33±1.45***    |
| Mass of steam carcass, kg        | 203.33±2.33                  | 219.67±1.2**     | 212.33±2.03*      |
| Mass of visceral fat, kg         | 9.47±0.32                    | 11.23±0.38*      | 10.17±0.15        |
| Slaughter mass, kg               | 212.8±2.65                   | 230.9±1.57**     | 222.5±2.17*       |
| Yield of carcass, %              | 52.95±0.53                   | 54.19±0.18       | 54.3±0.31         |
| Yield of fat, %                  | 2.47±0.08                    | 2.77±0.09        | 2.55±0.03         |
| Slaughter yield, %               | 55.41±0.61                   | 56.96±0.26       | 55.86±0.34        |

Note: *P>0.95; **P>0.99; ***P>0.999

Inclusion of complex feed additives for animals from the II and III experimental groups. Thus, the young bulls from the control group were inferior to the experimental groups of animals in terms of pre-slaughter live weight by 5.55% and 3.73%, respectively (P>0.999). According to the indicator of the steam carcass, the control group was inferior to the II and III experimental groups by 8.04% (P>0.99) and 4.43% (P>0.95). The weight of visceral fat in the control group was less than in the experimental groups by 18.59% (P>0.95) and 7.39%. In the control group, a slaughter weight of 212.8 kg was obtained, while in the II experimental group, the indicator is 230.9 kg, and in the III experimental group, this indicator was equal to 222.5 kg. A similar pattern can be traced in the indicators of carcass and fat yield, in the control group the indicator was 52.95% and 2.47%, and in the II experimental group the indicators were 54.19% and 2.77%, and in the III experimental group these indicators were equal to 54.3% and 2.55%. Fattening young animals were characterized by high slaughter yield: control group – 55.41 %, II experimental group – 56.96 %, III experimental group – 55.86 %.

Thus, the feeding of experimental complex feed additives allowed increasing meat productivity, improving the quality indicators of carcass and fat yield.

The important aspect in the study of meat qualities of fattening animals is the organoleptic evaluation of meat products. Meat products that have undergone heat treatment are evaluated: boiled and fried. The assessment was carried out on a 9-point scale in accordance with the methodology [6]. The research data is presented in Table 6.

Table 6. Assessment of the quality of meat products.

| Indicators       | Samples            |
|------------------|--------------------|
|                  | I - control | II - experimental | III - experimental |
| Boiled meat      |             |                  |                  |
| Tenderness/hardness | 7.33       | 8.67              | 8                |
| Succulence       | 7.67        | 8.67              | 8.33             |
| Taste            | 7.33        | 8.33              | 7.67             |
| Smell            | 7.67        | 8.67              | 8.33             |
| Colour           | 7.67        | 8.33              | 8                |
| Average assessment | 7.53       | 8.53              | 8.07             |
| Roasted meat     |             |                  |                  |
| Tenderness/hardness | 7.33       | 8                 | 7.67             |
| Succulence       | 7.67        | 8.33              | 8                |
The conducted evaluation of meat products found that boiled meat in the II and III experimental groups was higher than the control group in a number of evaluated indicators, including tenderness, succulence, taste, smell, colors, as well as the average assessment. The above-listed indicators of the experimental group III are higher than the average data of the control group: 9.14%, 8.6%, 4.64%, 8.6%, 4.3% and 7.17%. The data of the experimental group II were low and were higher in relation to the control group by 18.28%, 13.04%, 13.64%, 13.04%, 8.60% and 13.28%.

This trend of superiority of the experimental groups over the control group was also observed in the indicators of roasted meat. The analysis of the ratings of the experimental group II showed that they exceeded the data of the control group in tenderness by 9.14%, succulence by 8.6%, taste by 9.14%, smell by 13.04%, color by 9.57%, as well as the average rating of roasted meat by 9.86%. The same parameters in the III experimental group were higher in comparison with the control group by 4.64%, 4.30%, 4.3%, 4.71% and 4.46%, respectively.

Differences in the quality parameters of the broth samples were established. The indicators of the II and III experimental groups in terms of smell and taste significantly differed from the data of the control group. The evaluation of the indicators of the strength of the richness established a slight superiority of the samples of the experimental groups over the data of the control group. The significant superiority of the experimental groups over the control group was established in terms of smell and taste. It was revealed that the color and transparency of the broth have a direct relationship. Analysis of the average ratings of the broth of different samples found that the control group was inferior to the II and III experimental samples by 10.34% and 5.79%.

Based on the presented data, it can be concluded that the improvement of animal feeding due to the introduction of experimental complex feed additives from natural raw materials into their diet positively affected the organoleptic characteristics of meat products, which received the highest ratings.

4. Summary

The conducted studies showed that the use of complex feed additives improved the growth rates for the fattening periods. The 12-15 months old animals from the experimental groups outperformed the control group in terms of average daily growth by 6.7% and 4.76% (P>0.95). At 12-15 months old animals of the experimental groups outperformed the animals of the control group in terms of growth rate by 28.31% and 16.54% (P>0.999).

Analysis of the data from the control slaughter of animals showed that the indicators of meat productivity improved in the II experimental group, the yield of carcass and fat was 54.19% and 2.77%, and in the III experimental group, these indicators were equal to 54.3% and 2.55%.

The evaluation of meat products (boiled and roasted meat, as well as broth) showed that the II and III experimental groups were superior to the control group in the average estimates of boiled meat by 13.28% and 7.17%, roasted meat by 9.86% and 4.46%, broth by 10.34% and 5.79%.

Thus, the use of complex feed additives in the fattening of young cattle can improve the indicators of meat productivity.

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