Productivity and quality of meat from Kalmyk bull calves stimulated by immunomodulating agents

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Abstract. The Laboratory of Biological Modulators developed a new drug IMA (immunomodulating agent). The purpose of the study was to analyze meat productivity and interior indices of bull calves subjected to an immunomodulating agent (IMA). The IMA injections to pregnant cows two months before calving contributed to the activation of metabolic processes in their bodies, which, in turn, improved fetal growth and development. The body weight of bull calves at birth was more by 1.59 and 2.89 kg. There was an increase in the average body weight of bull calves aged 18 months before slaughter by 7.8 and 12.2 % (P≤0.01). They had higher slaughter yield by 1.0 and 1.76 absolute percent, and the main indicators – edible index was higher by 12.91 and 19.24 %; fleshing index – by 11.11 and 17.43 % respectively. The muscle tissue of the bull calves of all experimental groups has high nutritional and biological value. It is recommended to use the injection of immune modulator IMA to cows two months before calving at a dose of 5.0 ml per head four times with an interval of 7 days.

1. Introduction
An important scientific task is to develop, test and validate dietary supplements, biogenic stimulants and to provide recommendations on the use of ecology-safe agents, natural metabolites, complex compounds actively influencing the productive qualities of animals [1–4]. The effect of biological stimulants is caused by their regulatory effect on the intensity of metabolic processes and the enhancement of the functional state of organs and systems [5–6].

The majority of bio-based products do not have energy properties, but significantly stimulate important physiological functions of animals thus increasing their productivity and general resistance to diseases [7–8].

The Laboratory of Biological Modulators developed a new immunomodulating agent – IMA. It is produced at Armavirskaya Bio-Factory.

IMA – cool dehumidified natural agent, visually resembling a uniform dry powder without inclusions and impurities, with color varying from white to light-yellow. The biologically active substances of fertile chicken eggs serve its active substance. Auxiliary substances: sucrose, polysorbate 80, mannitol, nipagin (TU 9337-002-92292950-2015).
All new biological agents shall be subject to a comprehensive validation on different types of animals in order to identify the most effective dose variants and the multiplicity of their use. Hence, this study seems quite relevant.

The purpose of the study was to analyze the meat productivity and interior indices of bull calves injected with an immunomodulating agent (IMA).

2. Materials and methods
The scientific experiment was carried out at Arl Agricultural Enterprise of Yashkul district, the Republic of Kalmykia.

The studies to determine the optimal schemes of using the immunomodulating agent (IMA) in the amount of 5.0 ml per head intramuscularly to Kalmyk cows at the age of seven months of pregnancy were carried out according to the developed scheme. Three groups (25 heads each) of meat cows of Kalmyk breed of the 2\textsuperscript{nd}–4\textsuperscript{th} lactation were formed in the farm, which were intramuscularly injected IMA 2 months prior to calving (Table 1).

| Indicator                                | Group (n=5)                  |
|------------------------------------------|------------------------------|
|                                          | I-control        | II-experimental | III-experimental |
| Number of cows, heads                   | 25               | 25             | 25               |
| Name of an agent                         | Physiological saline | IMA            | IMA              |
| Administration dose                      | 5 ml per head     | 5 ml per head  | 5 ml per head    |
| Injection frequency                      | Four times in 7 days | Two times in 7 days | Four times in 7 days |

The born calves were suckling, fed with concentrates, performance suckling (farm-type method of breeding).

The body weight dynamics of calves were studied at birth, at 60, 120, 180 and 205 days of postnatal development, as well as during the period of nursery for slaughter.

Hematological studies were carried out in the young cattle during suckling and nursery periods.

In order to study slaughter and meat qualities at 18 months of age, the control slaughter of bull calves of 3 heads from each experimental group was carried out.

The obtained experimental data were analyzed, compared with each other and subjected to biometric treatment using BIOSTAT.EXE.

3. Results and discussion
The administration of the IMA agent had a positive effect on the quality of milk and the milkability of cows, which is an important indicator of calves feeding during the suckling period (Table 2).

| Indicator                                | I                | II n=5           | III              |
|------------------------------------------|------------------|------------------|------------------|
| Fat, %                                   | 4.62±0.19        | 5.22±0.13*      | 5.36±0.11**     |
| Protein, %                               | 4.12±0.09        | 4.38±0.15*      | 4.60±0.13**     |
| NFMS, %                                  | 8.78±0.23        | 8.86±0.47       | 9.04±0.30       |
| Density, A/A                              | 29.00±0.45       | 29.88±0.66      | 30.24±0.76      |
| Milkability at 205 days, kg              | 165.64           | 178.50          | 181.70          |

Note: *P≤0.05; **P≤0.01

The analysis of milk quality showed an increase in fat, protein, nonfat milk solids (NFMS) and density.

The concept of body development is closely related to the dynamics of its growth, one of the indicators of which is the dynamic increase of the body weight in time (Table 3).
Table 3. Body weight of bull calves from calving to weaning at the age of 205 days

| Indicator                  | Group       | I       | II                      | III                     |
|----------------------------|-------------|---------|-------------------------|-------------------------|
| Number of bull calves, heads |             | 14      | 15                      | 13                      |
| At birth: kg %              |             | 21.21±0.86 | 22.80±0.68              | 24.10±0.7              |
| At 90 days: kg %            |             | 67.78±1.6 | 72.14±0.83              | 75.53±0.75             |
| At 205 days: kg %           |             | 186.85±2.57 | 201.30±2.38              | 205.80±2.10            |

IMA injections to cows at seven months of the pregnancy period positively affected the body weight of bull calves at birth. In the II and III experimental groups, they exceeded their herdmates from the I control group by 7.5 and 13.6 %.

At three months (90 days), the body weight of the bull calves of the II experimental group was 6.4 % and of the III – 11.4 % more than that of control animals.

At the time of weaning at the age of 205 days, the body weight of the bull calves of the II experimental group on average exceeded their control herdmates by 7.7 %. The body weight of the III experimental group was 10.2 % higher than that of the control group animals.

It is known that high level of metabolism (assimilation prevails over dissimilation) determines high degree of growth energy and serves an expression of the basic law of ontogenesis to achieve constant weight as quickly as possible. In other words, the manifestation of the genetic potential of the animal’s body.

Over a period of 91–205 days, the relative growth rate of the control group bull calves was 68.9 %, which is 25.6 % lower than the II experimental group and 23.7 % lower than the III experimental group.

Hematological analyses showed a significant increase in the studied indicators in the bull calves of experimental groups to the upper reference level (Table 4).

Changes were observed in the II and III experimental groups concerning such indicators as leukocyte content – by 20.3 % and 16.9 %; erythrocyte content – by 19.0 % and 23.1 %; hemoglobin content – by 5.1 % and 8.8 %.

In the II and III experimental groups the total protein increased by 5.12 and 5.7 % of the control value respectively (Table 5).

Table 4. Morphological and biochemical indices of serum in bull calves at 6 months of age

| Indicator                  | Group (n=5) | I       | II                      | III                     |
|----------------------------|-------------|---------|-------------------------|-------------------------|
| Leukocytes, 10⁹/l          |             | 6.10±0.40 | 7.34±0.25              | 7.13±0.39              | 4.5-2.0               |
| Erythrocytes, 10¹²/l       |             | 5.68±0.22 | 6.76±0.23              | 6.99±0.14              | 5.0-7.5               |
| Hemoglobin, g/l            |             | 102.8±0.73 | 108.0±0.71              | 111.8±1.07             | 99-129                |
| Total protein, g/l         |             | 69.92±1.31 | 73.18±1.66              | 73.60±0.75             | 70-85                 |
| Albumins, g/l α            |             | 23.11±0.74 | 25.03±1.21              | 26.67±1.15              | 18-42.5               |
|             | γ           | 12.29±0.59 | 12.99±0.89              | 12.19±0.47             | 7.2-17.0               |
| Globulins, g/l β           |             | 8.45±0.61 | 8.64±0.55              | 8.34±0.42              | 6.0-13.6               |
|             | γ           | 26.07±1.51 | 26.52±1.30              | 26.40±0.93              | 15.0-34.0               |
| AST, µkat/L                |             | 0.48±0.02 | 0.46±0.04              | 0.56±0.04              | 0.62                  |
| ALT, µkat/L                |             | 0.40±0.04 | 0.36±0.02              | 0.34±0.02              | 0.42                  |
| Glucose, mmol/L            |             | 2.53±0.07 | 2.50±0.09              | 2.54±0.04              | 2.22-3.33               |
| Cholesterol, mmol/L        |             | 4.60±0.12 | 4.24±0.20              | 4.50±0.21              | 1.6-5.0               |
| Urea, mmol/L               |             | 2.96±0.20 | 3.76±0.37              | 4.74±0.34              | 2.8-8.8               |
| Phosphorus, µg %           |             | 4.70±0.07 | 4.98±0.26              | 5.20±0.30              | 4.5-6.0                |
| Calcium, mg %              |             | 10.50±0.22 | 10.78±0.22              | 11.65±0.07              | 10-12.5               |
| Magnesium, mg %            |             | 2.02±0.18 | 2.06±0.18              | 2.29±0.15              | 1.7-2.9                |

Note: *P≤0.05; **P≤0.01; ***P≤0.001
The albumin content increased by 8.3 and 15.4% in these experimental groups of animals. The pathologically indicative marker enzymes ACT and ALT in the blood were within the normal limits.

The blood of the bull calves of the II and III experimental groups was characterized by higher urea content, as well as calcium – by 10.96% (P ≤ 0.05) and phosphorus – by 10.6% in the III experimental group. This also indicates a significant intensity of their physiological processes. This stimulation was noted within normal limits, which is also confirmed by the activity of AST and ALT marker enzymes.

By analyzing the body weight of the bull calves through the observation periods, we found that animals stimulated with IMA agent had a large body weight in all study periods (Table 5).

| Table 5. Body weight dynamics of experimental bull calves |
|-----------------------------------------------|
| Age, months | Group I (n=14) | Group II (n=15) | Group III (n=13) |
|-------------|----------------|----------------|------------------|
| 6.8         | 186.9±2.57     | 201.3±2.38     | 205.8±2.10       |
| 9           | 230.2±2.89     | 247.8±3.04     | 254.0±3.17       |
| 12          | 284.4±4.27     | 308.8±3.43     | 318.0±7.88       |
| 15          | 341.2±5.52     | 370.1±6.00     | 383.0±4.86       |
| 18          | 401.0±8.00     | 432.3±4.37     | 449.9±7.50       |

At nine months of age, the bull calves of group II and III exceeded the body weight of control herdmates by 17.6 and 23.8 kg (P<0.05 and P<0.01) and at twelve months of age – by 24.4 and 33.6 kg, respectively (P<0.01). At the age of 15 months, the body weight of the II experimental group was higher by 28.9 kg (P<0.01) and in the III – by 41 kg (P<0.001) than in the I group.

The growth rates also showed differences between the groups (Table 6).

| Table 6. Growth intensity indicators of experimental bull calves |
|-----------------------------------------------|
| Age, months | Duration, days | Group I (n=14) | Group II (n=15) | Group III (n=13) |
|-------------|----------------|----------------|----------------|------------------|
| 6.8 – 9     | 65             | 43.3±26.59     | 46.5±27.1      | 48.2±28.0        |
| 10 – 12     | 90             | 54.2±24.6      | 61.0±30.2      | 64.0±29.4        |
| 13 – 15     | 90             | 56.8±23.8      | 61.3±24.5      | 65.0±25.8        |
| 16 – 18     | 90             | 59.8±29.7      | 62.2±26.9      | 66.9±30.2        |
| 6.8 – 18    | 335            | 214.1±21.0     | 231.0±19.6     | 244.1±20.5       |

The absolute and average daily gain in the body weight was higher in the bull calves of the II and III experimental groups. They outperformed the herdmates of the I control group in absolute and average daily weight gain: between 6.8 and 9 months of age – by 3.2 and 4.9 kg, 49 (P<0.05) and 76 g (P<0.01); from 10 to 12 months – by 6.8 and 9.8 kg, 75 (P<0.01) and 108 g (P<0.001); from 13 to 15 months – by 4.5 and 8.2 kg, 50 (P<0.01) and 91 g (P<0.01); from 16 to 18 months – by 2.4 and 7.1 kg, 27 and 79 g (P<0.01); from 6.8 to 18 months – by 16.9 and 30 kg, 51 (P<0.01) and 90 g (P<0.001) respectively.

Thus, it can be concluded that the bull calves of cows stimulated by IMA have better growth and development indicators. This affected the slaughter and meat qualities that were made on the basis of the control slaughter of the bull calves – 3 from each experimental group at the age of 18 months (Table 7).
The bull calves of the II and III experimental groups were found to be superior to the I control group analogues, respectively, in terms of preslaughter weight by 30.51 and 49.69 kg (P<0.001); hot carcass weight – by 21.12 and 34.91 kg (P<0.001); carcass yield – by 0.99 and 1.66 absolute percent; weight of internal fat – by 1.15 and 2.22 kg (P<0.05); slaughter weight – by 22.27 (P<0.01) and 37.13 kg (P<0.001); slaughter yield – by 1.0 and 1.76 absolute percent.

**Table 7. Slaughter qualities of Kalmyk bull calves at the age of 18 months (n=3)**

| Indicator                  | Group I               | Group II              | Group III              |
|----------------------------|-----------------------|-----------------------|------------------------|
| Preslaughter weight, kg    | 400.66±2.09           | 431.17±1.59           | 450.33±1.67            |
| Hot carcass weight, kg     | 221.20±0.87           | 242.32±0.78           | 256.11±0.79            |
| Carcass yield, %           | 55.21                 | 56.20                 | 56.87                  |
| Weight of internal fat, kg | 14.64±0.17            | 15.79±0.20            | 16.86±0.18             |
| Yield of internal fat, %   | 3.65                  | 3.66                  | 3.73                   |
| Slaughter weight, kg       | 235.84±0.85           | 258.11±0.72           | 272.97±0.80            |
| Slaughter yield, %         | 58.86                 | 59.86                 | 60.62                  |

The studies revealed that there was also a difference in the morphological composition of carcass bull calves (Table 8).

**Table 8. Ratio of different tissues of carcass bull calves (n=3)**

| Indicator                  | Group I               | Group II              | Group III              |
|----------------------------|-----------------------|-----------------------|------------------------|
| Semi-carcass weight, kg    | 109.55±1.39           | 119.96±1.26           | 126.81±1.15            |
| including: muscular tissue:| 72.45±1.02            | 80.61±0.99            | 85.47±0.97             |
| including: fat tissue:     | 14.97±0.30            | 17.39±0.28            | 19.15±0.26             |
| Bones:                    | 19.06±0.32            | 19.20±0.30            | 19.40±0.34             |
| Cartilages and cords:      | 3.07±0.12             | 2.76±0.11             | 2.79±0.10              |
| Semi-carcass, %            | 2.80                  | 2.30                  | 2.20                   |
| including: edible muscular tissue: | 79.80 | 81.70 | 82.50 |
| including: inedible muscular tissue: | 20.20 | 18.30 | 17.50 |
| Edibility index            | 3.95                  | 4.46                  | 4.71                   |
| Meatness index             | 4.59                  | 5.10                  | 5.39                   |

The weight of the cooled semi-carcass in the control group was less than in the II and III experimental groups by 10.41 and 17.26 kg, respectively. The bull calves of the II and III experimental groups had higher boneless meat yield – by 10.58 and 17.20 kg (P<0.01), and in terms of the relative boneless meat yield they exceeded the control group by 1.9 and 2.7 absolute percent.

The muscle tissue yield in a carcass is an important indicator of animal meat productivity as it determines the nutritional value of meat, which is the source of proteins in the human body. Our studies revealed that the maximum yield of the muscle tissue was in the bull calves of the II and III experimental groups. They outperformed their herdmates of the I control group on average by 8.16 (P<0.01) and 13.01 kg (P<0.001), and in terms of the relative muscle tissue yield – by 0.9 and 1.1 %, respectively.

The fat content in the semi-carcass was also higher in the II and III experimental groups by 2.42 and 4.18 kg (P<0.01) and bones – by 0.14 and 0.34 kg, respectively, than in the control group.
Different intensity of muscle tissue synthesis and fat deposition in the bull calves of the experimental group affected the quality of meat. The edibility index exceeded the bull calves of the I control group by 12.91 and 19.24 %, and in terms of meatness – by 11.11 and 17.43 %, respectively.

Chemical composition and calorie content of minced meat, as well as the rib eye of the bull calves are given in Table 9.

It was found that the average meat sample of the II and III experimental groups contained more dry matter – by 0.51 and 1.02 abs % than in the similar tissue of the bull calves of the I control group. The same animals had higher protein content – by 0.18 and 0.36 abs % and fat content – by 0.64 and 0.70 abs % in the average meat sample. The differences noted are not statistically reliable.

| Table 9. Chemical composition and caloric content of muscle tissue (n=3) |
|---|---|---|
| Indicator          | I            | II          | III          |
| Moisture, %        | 65.55±0.59   | 65.04±0.51  | 64.72±0.47   |
| Dry matter, %      | 34.16±0.59   | 34.96±0.51  | 35.28±0.47   |
| Protein, %         | 18.16±0.39   | 18.34±0.28  | 18.52±0.33   |
| Fat, %             | 15.04±0.57   | 15.68±0.46  | 15.74±0.60   |
| Ash, %             | 0.96±0.02    | 0.94±0.01   | 1.02±0.02    |
| *Ripeness index, % | 52.56        | 53.75       | 54.51        |
| **Energy value, kJ | 1031.44      | 1061.18     | 1067.87      |
| Moisture, %        | 74.52±0.35   | 74.21±0.44  | 74.14±0.40   |
| Dry matter, %      | 25.48±0.35   | 25.79±0.44  | 25.86±0.40   |
| Protein, %         | 21.39±0.47   | 21.75±0.33  | 21.82±0.29   |
| Fat, %             | 2.99±0.26    | 3.02±0.22   | 3.04±0.25    |
| Ash, %             | 1.10±0.03    | 1.02±0.03   | 1.00±0.04    |
| *Ripeness index, % | 34.19        | 34.75       | 34.88        |
| **Energy value, kJ | 629.28       | 639.07      | 641.53       |

Note: * boneless meat ripeness ratio – dry matter to moisture ratio expressed as a percentage;
**meat energy value (Em) = (39.77×G) (23.86×B), where 1g of fat (F) – 39.77 kJ and 1g of protein (P) – 23.86 kJ.

The rib eye of the bull calves of the II and III experimental groups obtained from IMA-stimulated cows contained more dry matter – by 0.31 and 0.38 abs %, fat – by 0.36 and 0.43 abs % compared to the control group. In terms of fat, the differences between the groups were insignificant.

The ripeness coefficient of the average sample of minced meat of the bull calves of the I control group was less by 1.19 and 1.95 abs %, and in the rib eye – less by 0.56 and 0.69 abs %, respectively, than in the II and III experimental groups.

The calorie content of minced meat of the bull calves of the I control group was 1031.44 kJ, which is 29.74 and 36.43 kJ less than that of the II and III experimental groups.

The calorie content of a rib eye of the bull calves of the II and III experimental groups was higher than that of their herdmates of the I control group by 9.79 and 12.25 kJ.

The results of our studies showed the absence of statistically reliable differences between the experimental groups concerning physical and chemical indicators of a rib eye (Table 10).

The meat pH was at the level of 5.83–5.90 units, indicating good product quality and meat storage resistance.

The rib eye of the bull calves of all experimental groups had high moisture-retaining capacity. However, the bull calves of the II and III experimental groups born from IMA-stimulated cows outperformed their herdmates of the I control group by 1.27 and 1.38 abs %, respectively.

The appearance of meat is determined by the intensity of the muscle tissue color. We established significant differences in the intensity of muscle tissue color between the experimental groups. However, it should be noted that the muscle tissue of the bull calves of the II and III experimental
groups had a darker color and exceeded the color intensity of the similar control group by 5.26 and 6.39 extinction units.

| Indicator                                      | Group     |
|------------------------------------------------|-----------|
| Acidity (pH), units                            | I         |
|                                                | II        |
|                                                | III       |
| Moisture-retaining capacity, %                 |           |
|                                                | 57.18±0.82|
|                                                | 58.45±0.73|
|                                                | 58.56±0.80|
| Color intensity, extinction units               |           |
|                                                | 293.33±8.08|
|                                                | 298.59±8.75|
|                                                | 299.72±9.00|
| Juice losses when heated, %                    |           |
|                                                | 38.90±0.71|
|                                                | 36.64±0.80|
|                                                | 36.25±0.68|

The muscle tissue of the bull calves of the II and III experimental groups had a better technological quality index because it had less moisture loss under heat treatment by 2.26 and 2.65 abs % compared to the control group.

The biological value of the rib eye was determined by a protein quality indicator (ratio of amino acids: tryptophan to oxyproline) (Table 11).

| Indicator          | Group     |
|--------------------|-----------|
|                    | I         |
|                    | II        |
|                    | III       |
| Tryptophan, mg %   | 363.45±7.98|
|                   | 368.86±8.07|
|                   | 370.59±6.94|
| Oxyproline, mg %   | 58.43±1.25|
|                   | 57.64±1.06|
|                   | 57.37±0.99|
| Protein index      | 6.22±0.14|
|                   | 6.40±0.19|
|                   | 6.46±0.15|

It was found that the tryptophan content in the rib eye of the bull calves of the II and III experimental groups exceeded their herdmates of the I control group by 5.51 and 7.14 mg %, and the oxyproline content – by 0.79 and 1.06 mg %, respectively.

The protein quality index of the rib eye was higher in the bull calves of the II and III experimental groups compared to the I control group by 2.89 and 3.86 %. This indicates that in the rib eye of the bull calves of all experimental groups the amino acid content was at the optimal level.

4. Conclusion
1. IMA injections of pregnant cows two months before calving contributed to the activation of metabolic processes in their bodies, which in turn improved fetal growth and development.
2. During the nursery period, young cattle born from IMA-stimulated cows was developing more intensively. The average body weight of the bull calves aged 18 months increased before slaughter by 7.8 and 12.2 % (P≤0.01).
3. The IMA use improved the meat productivity of the bull calves. The edibility index was higher by 12.91 and 19.24 %; the meatness index – by 11.11 and 17.43 % respectively.
4. The muscle tissue of the bull calves of all experimental groups has high nutritional and biological value. The physical-chemical and commercial-technological properties of the muscle tissue of the bull calves born from IMA-stimulated cows did not deteriorate, but there was a tendency towards beef quality improvement.
5. In order to increase animal productivity and body resistance in the conditions of year-round pasture management and to increase the profitability of beef cattle breeding, it is recommended to use IMA injections of cows two months before calving in a dose of 5.0 ml per head four times with at an interval of 7 days.

References
[1] Tofastrud Morten, Hessle Anna and Rekdal Yngve Zimmermann Barbara 2020 Weight gain of free-ranging beef cattle grazing in the boreal forest of south-eastern Norway Livestock Sci. 233 103955 DOI: org/10.1016/j.livsci.2020.103955
[2] D'Occhio M J and Baruselli P S Giuseppe Campanile 2019 Influence of nutrition, body condition, and metabolic status on reproduction in female beef cattle: A review Theriogenology 125 277–84 DOI: org/10.1016/j.theriogenology.2018.11.010

[3] Andresen C E, Goad C L, Kriese-Anderson L et al 2019 Weaning weight trends in the US beef cattle industry Appl. Animal Sci. 35(1) 57–65 DOI.org/10.15232/aas.2018-01797

[4] Pardo A M, Elzo M A, Gama L T and Melucci L M 2020 Genetic parameters for growth and cow productivity traits in Angus, Hereford and crossbred cattle Livestock Sci. 233 103952 DOI: org/10.1016/j.livsci.2020.103952

[5] Patrícia Aparecida Cardosoda Luz, Cristiana Andrighetto et al 2019 Effect of integrated crop-livestock systems in carcass and meat quality of Nellore cattle Livestock Sci. 220 83–92 DOI.org/10.1016/j.livsci.2018.11.018

[6] Vohra Ashima, Syal Poonam and Madan Anshu 2016 Probiotic yeasts in livestock sector Animal Feed Sci. and Technol. 219 31–47 DOI: org/10.1016/j.anifeedsci.2016.05.019.

[7] Pogodaev V A, Komlatsky V I, Komlatsky G V et al 2017 Productive and interior features of piglets when using biogenic stimulators SITR and ST RJPBCS 8(6) 632–7

[8] Kulintsev V, Shakhmurzov M, Shevkhuzev A et al 2019 Productivity of Simmentals Livestock of Austrian Breeding in Climatic Conditions of the Karachay-Cherkess Republic Int. J. of Engineer. and Advan. Technol. (IJET) 9(1) 4561–4 ISSN: 2249 – 8958