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Using of EM-technology (effective microorganism) for increasing the productivity of calves

Alexey Belookov, Oksana Belookova,Vitaliy Zhuravel, Svetlana Gritsenko, Irina Bobyleva, Evgenia Ermolova, Sergey Ermolov, Yulia Matrosova, Maksim Rebezov, Evgeny Ponomarev

Abstract*: *The article presents the results of the influence of Effective Microorganisms (EM) technology products on the productive qualities of young cattle. The use of microbiological preparations in feeding livestock allows increasing the average daily weight gain of animals by 6.6-16.7%, the mass of hot carcass - by 4.57-20.37 kg, the mass of meat - by 19.36-41.7 kg depending on the type of preparation used. In addition, the EM-preparations increase the content of dry substances including protein and energy value of the meat of calves. The microbiological preparations improved the efficiency of conversion of feed protein and energy into food protein and, as a result, the profitability of cattle breeding production.

Index Terms*: *EM-preparations, effective microorganisms, preparation, calve, live weight gain, meat, conversion, feeding

I. INTRODUCTION

The modern requirements for livestock breeding in Russia established a set of tasks for increasing the livestock productivity up to the world standards level with reducing the costs for production of animal origin foods [1]. Providing the world's population with high-quality and ecologically safe food of animal origin is one of the most urgent tasks of the agro-industrial complex in many countries. The main reason hindering the increase in animal productivity, quality and competitiveness of products can be the imbalance of animals' feeding rations, which leads to feed overconsumption, decreasing the quality of feed and higher costs [2, 3].Industrial methods of animal husbandry do not always take into account the characteristics of the animal's body. Moreover, every animal can not easily adapt to changing of environmental conditions, as a result different diseases occur which lead to productivity decreases [4, 5]. The restoration of the livestock industry is possible using biotechnological methods, i.e. methods that use live microorganisms to treat animals and increase their productivity and natural resistance [6, 7].Many scientists studied the effect of probiotics on the productive qualities of cattle. Thus, Xiang Wang, Haijun Xie, Fu Liui and Yuhong Wang obtained positive results by studying the effect of feeding probiotic-fermented food on the average daily weight gain and milk producing ability of animals [8]. Similar results were obtained by Alexis J. Kelsey, Jessica D. Colpoys in the study of the effect of probiotics on the resistance and productive qualities of young cattle [2]. F. Gaggìma, P. Mattarelli and B.Biavati showed the beneficial effect of probiotic preparations on the intestinal microflora of animals [3]. In our studies, in order to increase the productivity of cattle, EM-drugs (Effective Microorganisms), i.e. drugs, representing a set of beneficial microorganisms. In the gastrointestinal tract of animals, the effective microorganisms suppress pathogenic microflora and synthesize biologically active substances, as a result of which parietal digestion is normalized, which promotes the absorption of vital metabolites into the blood and prevents the entering of various substances that violate the functions of all organs and systems in animal body [9, 10, 11].

The purpose of the research is to determine the feasibility of using drugs with effective microorganisms (EM) in a diet of growing calves of Hereford breed.

II. MATERIALS AND METHODS

In this work the following preparations were used: "EM-Kurunga" and "Baikal EM-1". The preparation "EM-Kurunga" is a white, dry powder. It consists of 64 to 90 strains of various microorganisms, including lactic acid bacteria, lactic acid streptococcus, yeast and bifidobacteria. The preparation was filled it with warm water with the addition of beet molasses. Souring was carried out at a temperature of +35 °C for 3 days. One package of the drug (12 g) is diluted with 1 liter of water. The preparation "Baikal EM-1" is a liquid concentrate - culture fluid containing bacterial cells and products of bacterial metabolism. It has a light to dark brown color with a pleasant kefir-silage smell. It includes the following set of microorganisms: lactic acid, yeast, nitrogen-fixing, photosynthesizing, etc.

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***** Correspondence Author (s)
Alexey Belookov, South Ural State Agrarian University, Troitsk, Russia
Oksana Belookova, South Ural State Agrarian University, Troitsk, Russia
Vitaliy Zhuravel, South Ural State Agrarian University, Troitsk, Russia
Svetlana Gritsenko, South Ural State Agrarian University, Troitsk, Russia
Irina Bobyleva, South Ural State Agrarian University, Troitsk, Russia
Evgenia Ermolova, South Ural State Agrarian University, Troitsk, Russia
Sergey Ermolov, South Ural State Agrarian University, Troitsk, Russia
Yulia Matrosova, South Ural State Agrarian University, Troitsk, Russia
Maksim Rebezov, Ural State Agrarian University, Yekaterinburg, Russia; V.M. Gorbatov Federal Research Center for Food Systems of Russian Academy of Sciences, Moscow, Russia; K.G. Razumovsky Moscow State University of technologies and management (the First Cossack University), Moscow, Russia
Evgeny Ponomarev, K.G. Razumovsky Moscow State University of technologies and management (the First Cossack University), Moscow, Russia

The working solution of the preparation "Baikal EM-1" was prepared according to the instructions given in the manual. To achieve this goal, we conducted research works on the basis of the Federal State Unitary Enterprise "Troitskoye", Troitsky District, Chelyabinsk Region. The duration of the experiment was 6 months. For this, three groups of calves of the Hereford breed of 10 animals each were selected. For I experimental group of calves' feeding ration additionally the preparation "Baikal EM-1" diluted 1:100 at a dose of 30 ml per head per day was included. The "EM-Kurunga" preparation at a dose of 500 ml per head per day was added to the ration of the experimental group II. Animals of the III (control) group received the basic ration adopted in the farm without any EM-preparations. The diet of the calves was made taking into account the nutritional value of the feed. It has been balanced in essential nutrients. Coarse, succulent, concentrated feed and mineral supplements were included in to the winter and summer rations of feeding of calves (Fig. 1, 2).

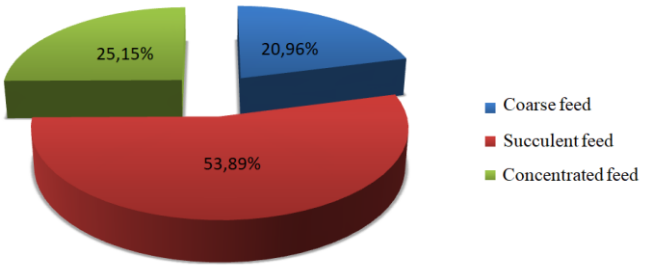

Figure 1 – Winter time ration of feeding of calves

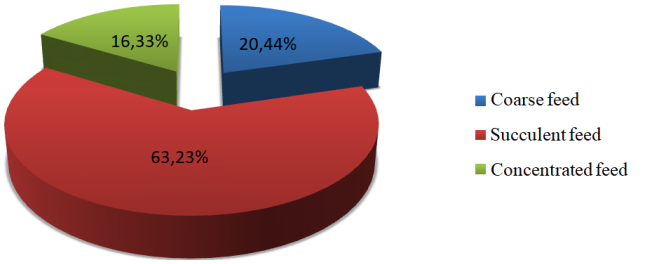

Figure 2 – Summer time ration of feeding of calves

The amount of digestible protein per 1 Energetic Feed Unit (EFU) was as follows: in winter - 88.9 g, in summer - 99.7 g at the normal rate of 88.9 g. The coefficient of exchange energy was 8.8 and 9.9 MJ, respectively, at the rate of 9.3 MJ.

Meat productivity of young animals was determined at the age of 16 months. according to the technique described in [12], by slaughtering of 3 calves from each group. The pre-slaughter, slaughter mass and slaughter yield were determined. Morphological composition of carcasses (meat, bones, cartilage and tendons) was determined according to the method of P.A. Glagoleva, V.A. Ippolitova (1977) [13]. The chemical analysis of samples of the carcass and the longest back muscle was performed by the method of P.Kh. Popandopulo et al. (1956) [14]. The yield of the main nutrients, the bioconversion of protein and feed energy into food protein and energy of edible products of slaughter in experimental animals were determined by the method of VASKhNIL (1983) [15]. The economic efficiency of growing and fattening experimental calves was calculated by the method of All-Russian Academy of Agricultural Sciences [].

III. RESULTS AND DISCUSSION

Using of EM-preparations in the diet of livestock had an impact on the growth of experimental calves (Fig. 3).

As can be seen from the figure 3, at the beginning of the experiment, the cow calves had the same live weight, but by the end of the experiment the live weight of the experimental groups (I and II) were higher than that of the control group.

The absolute liveweight gain of the calves of the control group was 144.7 kg and of the experimental groups was higher by 9.5–23.9 kg. At the same time, the average daily gain in live weight of calves of the control (III) group was 803.17 g, and in experimental groups it was higher by 6.6-16.7%.

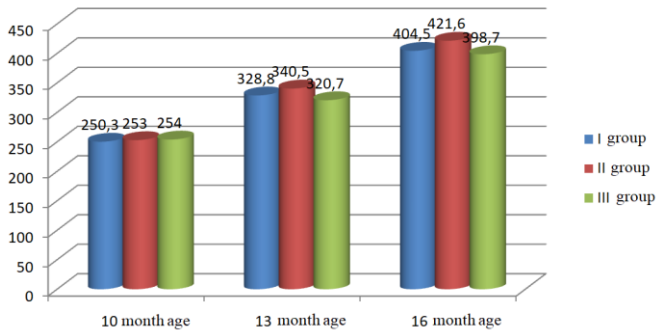

Figure 3 – Live weight of calves, kg

Each group of calves was slaughtered at the age of 16 months. As can be seen from the table 1, the maximal weight of hot carcasses were obtained from the calves of the II experimental group 216.9 kg (P <0.05), the difference with the control group was 20.4 kg (10.4%). Slaughter yield was the highest in the II experimental group — 55.0%, whereas in the control group — 52.6%.

Table 1: The results of slaughtering of calves, *(n = 3, $\bar{X} \pm m_x$)*

Indicator	Group		
	I	II	III control
Preslaughter weight, kg	392.67±4.33	409.33±6.98*	387.33±1.45
Weight of hot carcass, kg	201.10±4.85	216.90±6.39*	196.53±2.58
Carcass yield, %	51.23	52.97	50.73
Weight of internal fat, kg	7.87±0.09*	8.20±0.15**	7.37±0.03
Выход внутреннего жира, %	2.01	2.01	1.91
Carcass weight, kg	208.97±4.94	225.12±6.56*	203.90±2.61
Slaughter yield, %	53.20	54.97	52.63

* P<0,05; **P<0,01; ***P<0,001

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Table 2 – Morphological composition of carcasses, *(n = 3, $\bar{X} \pm m_x$)*

Indicator	Croup		
	I	II	III control
Weight of cooled carcass, kg	199.20±4.94	215.22±6.29*	194.20±2.57
Weight of meat, kg	157.77±3.98	172.43±5.80*	153.07±2.17
Meat yield, %	78.43	79.47	77.87
Weight of bones, kg	32.67±0.67	34.93±2.05	33.43±0.22
Bones yield, %	16.47	16.50	17.00
Weight of cartilage and tendon, kg	7.93±0.13	7.70±0.35	8.53±0.33
Yield of cartilage and tendon, %	4.07	3.53	4.33
Meat yield for 100 kg of live weight, kg	40.17±0.59	42.10±0.70*	39.50±0.42
Meatiness value	4.83	4.95	4.58

As can be seen from the table, the mass of the cooled carcass of II group calves was higher by 21.0 kg or 10.8% compared with the control. In terms of the meat weight, the second group of calves exceeded the control group by 19.3 kg (12.6%) (P <0.05), and in calves from I group by 14.6 kg (9.3%). The yield of bones in the experimental groups (16.5%) was lower than in the control (17.0%), the same pattern was observed in the content of cartilage and tendons. Therefore, the coefficient of meatiness in the experimental groups was higher (4.83 and 4.95) than in the control (4.58). Slaughter indicators and morphological composition of cattle carcasses do not give a comprehensive description of the quality of beef. Food quality of meat is determined by the presence of essential nutrients. The taste of meat depends on its tenderness, juiciness, flavor, density of muscle tissue and the presence of fat that characterize its "marbling". The meat quality is largely determined by its chemical composition and the ratio of protein and fat (Table 3).

Table 3: Chemical composition and energy value of calves forcemeat, *(n = 3, $\bar{X} \pm m_x$)*

Indicator	Group		
	I	II	III control
Moisture, %	66.00±0.21	65.90±0.50	69.37±0.49
Dry substances, %,	34.90±0.38	35.40±0.26*	33.10±0.58
including: protein, %	20.40±0.21	20.60±0.07*	19.80±0.20
Fat, %	13.50±0.17*	13.80±0.21*	12.40±0.32
Ash, %	0.96±0.02	0.95±0.05	0.98±0.06
Calcium, mg/kg	91.90±1.16	93.00±0.67	94.90±1.87
Phosphorous, g/kg	1.85±0.02	1.86±0.03	1.86±0.02
Meat ripeness rate, %	20.43±0.29*	20.97±0.44*	17.87±0.55
Protein fat ratio, %	151.13±0.59	149.60±2.46	159.53±2.55
Energy value of 1 kg of meat, kcal	2420.00	2460.00	2284.70
Energy value of 1 kg of meat, MJ	10.10	10.30	9.60

Table 4: Conversion of protein and energy of feed into the food protein and energy of meat of the calves

Indicator	Group		
	I	II	III control
Synthesized into the edible parts of the carcass, kg			
Protein	32.19	35.51	30.31
Fat	21.30	23.79	18.98
Yield for 1 kg of live weight, g			
Protein	81.97	86.76	78.26
Fat	54.24	58.12	49.01
Energy, MJ	4.07	4.34	3.78
Used for 1 kg of liveweight gain			
Feed protein, g	722.40	658.90	783.70
Feed energy, MJ	76.20	66.80	82.90
Feed protein conversion rate, %	11.30	13.20	10.00
Feed energy conversion rate, %	5.30	6.50	4.60

The table shows that the calves from the experimental groups used less feed protein for increasing 1 kg of the live weight than in the control group. Moreover, the best results for this indicator were in the II experimental group (658.9 g), the difference with the control group was 15.9%.

The calves of the compared groups had different conversion ratios of protein feed into food protein. The calves of the I experimental group transformed 11.3% of the protein of the feed, the II experimental group - 13.2%, which are higher than in the control group by 1.3 and 3.2, respectively. The conversion rate of the exchange energy was higher in the experimental groups: I group - 5.3%, II group - 6.5%, the difference with the control was 0.7 and 1.9 points, respectively. Thus, the use of EM technology products in the feeding of young cattle during the period of growing and fattening increases the conversion of protein and feed energy into food protein and the energy of the edible part of the carcass.From there, the production technology of beef should provide not only the maximum live weight gaining, but also the possibility of better utilization of feed nutrients and, in particular, their conversion into food protein.

This, ultimately, will allow to get more meat with a high content of food protein.The most important criterion for assessing the growing and fattening of cattle for meat are indicators of economic efficiency.

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The economic efficiency of growing and fattening calves of the Hereford breed for meat which used EM preparations was determined by production and economic indicators: costs, profits, profitability level (Table 5). Calculations were carried out in rubles of the Russian Federation, the exchange rate of the ruble to the US dollar according to the data of the central bank of Russia at the time of the research was 31 rubles per $1.As can be seen from the table, the highest absolute increase in live weight over the period of research was obtained from II group of calves - 168.3 kg, and the lowest in the III control group - 144.7 kg, the difference was 14.0%. The cost of feed needed for increasing 1kg in live weight in the control group amounted to 8.29 EFU (Energetic Feed Unit), which is more than in the experimental groups, respectively, by 8.8 and 24.1%.

Table 5: The economic efficiency of calves growing

Indicator	Group		
	I	II	III control
Body weight, kg	404.5	421.6	398.7
Absolute gain, kg	154.2	168.3	144.7
Feed cost during the research works			
For 1 calve, EFU	1175.6	1124.6	1199.1
For 1kg of live weight gain, EFU	7.62	6.68	8.29
Total costs for 1 calve, Ruble, including costs for EM-preparations	4505.0 340.6	4193.2 30.0	4356.4 -
Prime-cost of 100 kg weight gain, Ruble	2921.5	2491.5	3010.6
Realization value of 1 calve, Ruble	18607.0	19393.6	18340.2
Cost of live weight gain during research works, Ruble	7093.2	7741.8	6656.2
Profit, Ruble	2588.2	3548.6	2299.8
Level of profitability, %	57.5	84.6	52.8

The total costs for 1 calve were the lowest in the II experimental group. In I experimental group the costs per head amounted to 4505 rubles, which is more by 311.8 and 148.6 rubles than in II experimental and control groups, respectively. The realization value of one head in I experimental group was higher by 267 rubles, in II experimental groups - by 1,053.4 rubles, compared with the control. Consequently, the profit in the experimental groups was higher than in the control by 288.4 - 1248.8 rubles, respectively. Calves growing and fattening was profitable in all groups, but a higher level of profitability was determined in II group (84.6%), and compared with the control group the difference was 31.8 points, and 27.1 points for I group.

IV. CONCLUSION

The use of EM technology products in the diet of Hereford breed calves had a significant effect on:

- increasing the absolute gain in the body weight by 9.5-23.9 kg,
- average daily gains - by 6.6-16.7%.
- the slaughter yield of calves at the age of 16 months. increased from 52.63% in the control to 53.20 and 54.97% in the experimental groups.
- the coefficient of meatiness in the experimental groups was higher by 0.25-0.37 points.
- the energy value of 1 kg of meat increased by 5.2-7.3%.

The conversion coefficients of the metabolizable energy of feed increased from 4.6% in the control group to 5.3 and 6.5% in the experimental groups.

Thus, the use of EM preparations in the feeding of calves is one of the efficient ways to increase the the meat productivity, improve the quality characteristics of meat and conversion ratios of feed protein and energy into food protein, profitability of production.

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