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Research paper

Realization of meat qualities of Black Motley bull-calves against the background of immunoprophylaxis with biological Preparations

Vladimir G. Semenov[1], Nikolay I. Kosyaev[2], Anatoly Yu. Lavrentyev[3], Gennady A. Larionov[4], Nikolay V. Evdokimov[5], Gerald M. Toboyev[6], Dmitry A. Nikitin[7], Sergey D. Nazarov[8]

[1]Chuvash State Agricultural Academy, Russian Federation, 428003, Chuvash Republic, Cheboksary, K. Marx St., 29

Abstract

For the first time on the basis of complex studies the zootechnical expediency of the developed biological preparations Prevention-N-A and Prevention-N-E in beef production technology for the realization of bioresource potential of meat qualities of Black Motley bull-calves was scientifically and experimentally proved. Activation of the growth and development of bull-calves in the periods of growth, rearing and fattening was established against the background of biopreparations, which resulted in higher slaughter and meat qualities of the carcasses and, as a consequence, in a higher yield of valuable cuts: brisket and sirloin by 6.1 and 4.0 kg (P < 0,01-0,001), rump by 2,6 and 1,7 kg (P <0,05-0,01) and thick flank by 8,6 and 7,1 kg (P <0,001) (compared with the control group). The largest content of highest-quality meat came from the carcasses of the bull calves of the 1st (27.8 ± 0.72 kg) and the 2nd (26.7 ± 0.58 kg) test groups: 3.5 and 2.4 kg more, respectively, as compared with the control group (24,3 ± 0,73 kg), and also from their cuts: brisket and sirloin - 0,9 and 0,7 kg more, respectively, rump - 0,5 and 0,3 kg, and thick flank – 2,3 and 1, 5 kg (P <0.05-0.001). The high quality of meat carcasses by organoleptic, biochemical and spectrometric indicators and, consequently, the safety of the tested preparations was proved. It was found that biological preparations lead to the realization of bioresource potential of the organism due to activation of haemopoiesis, cellular and humoral factors of non-specific resistance (with a more pronounced Prevention-N-A effect). The novelty of the data obtained is confirmed by the patents of the Russian Federation for invention No. 2602687 and No. 2622765 registered in the Public Register of Inventions of the Russian Federation on October 26, 2016 and June 19, 2017, respectively.

Keywords: *Bull-calves; growth; rearing; fattening; biopreparations Prevention-N-A and Prevention-N-E; meat qualities.*

1. Introduction

Russian cattle breeding is one of the main life-supporting sectors of domestic agrarian production, which has a decisive influence on the level of the country’s food supply and determines the health of the nation.

The industry development strategy is aimed at increasing the share of domestic production, forming dairy and meat resources in accordance with scientifically based consumption standards, increasing its competitiveness and investment attractiveness, and finding solution to the most important socio-economic task of providing the population with biologically wholesome products [2, 4, 11, 17, 21].

In terms of production volumes, the domestic cattle-breeding industry lags behind the targets by 25%, with more than 95% of beef produced by slaughtering replacements and the rejected adult livestock of dairy and combined productivity, the slaughter contingent of which and the level of productivity do not provide the necessary production volumes [1, 5, 9, 15, 20, 29, 30]. In most regions of Russia, Chuvashia included, the predominant dairy cattle breed remains Black Motley (55.7%), as the most highly productive with good feed payment. As a result of the selection, the cattle acquired features inherent in the dairy type, but with good meat qualities, and therefore has a great potential for productivity, overtopping many other breeds by zootechnical and economic indicators. Thus, for beef production young Black Motley calves are most commonly used, being more adapted and maximally realizing the bioresource potential under optimal feeding and maintenance conditions [6, 22, 24].

In order to prevent immunodeficiency, to stimulate the level of non-specific resistance of the organism a wide range of feed and bioactive additives, immunocorrectors, antioxidants and biopreparations are used to fight environmental and technological stress factors and to realize the bioresource potential of the meat qualities of bull-calves; however, many of them do not exhibit the desired bioeffect [3, 7, 13, 14, 16, 18, 19, 26, 34, 35, 36].

In this context, the development and introduction of complex biologics into the beef production technology to activate the protective-adaptive functions of the organism to the habitat conditions and to realize the bioresource potential of the meat qualities of bull-calves is an actual problem of modern zootechnical science and practice [19].

The aim of the present study is to realize the bioresource potential of meat qualities of Black Motley bull-calves by using biopreparations Prevention-N-A and Prevention-N-E.

2. Materials and Methods

The experimental research was carried out on the dairy farm (an agricultural production cooperative) ‘Novyi Put’ of the Alikovsky District of the Chuvash Republic in accordance with the plan of scientific research of Chuvash State Agricultural Academy, and the processing of materials was carried out in the Chuvash Republican Veterinary Laboratory of the State Veterinary Service of the Chuvash Republic; in the laboratory of bio- and nanotechnologies and in the laboratory of the Department of morphology, obstetrics and therapy of Chuvash State Agricultural Academy in the period from 2013 to 2017.

The objects of the research were three groups of Black Motley bull-calves (15 animals each), from birth to 540 days of age. Newborn bull-calves of all the groups were kept with their mother in the maternity ward for 1 day, then in the dispensary up to 21 days, then in the standard conditions for growth up to 180 days, then in the premises for rearing up to 360 days, and then in the premises for fattening up to 540 days of age.

To realize the bioresource potential of the meat qualities of the bull-calves in the technology of their growth and rearing, complex biopreparations were used developed from natural raw materials by the scientists of Chuvash State Agricultural Academy: Prevention-N-A (V.G. Semenov, F.P. Petryankin, V.A. Vasiliev and others) and Prevention-N-E (V.G. Semenov, D.A. Nikitin, V.A. Vasiliev and others). The animals of Test Group 1 were injected intramuscularly with Prevention-N-A at a dose of 3 ml on 2-3 and 7-9 days of life; the animals of Test Group 2 were injected intramuscularly with Prevention-N-E at the indicated dose and at the same time. To the control group no biopreparations were administered.

Prevention-N-A is a complex preparation to activate non-specific resistance of the organism and to realize the production potential of young animals. It an aqueous suspension containing a polysaccharide complex of yeast cells of Saccharomyces cerevisiae immobilized in agar gel with the addition of a benzimidazole derivative and bactericidal preparation of aminoglycoside group.

Prevention-N-E is a complex preparation to stimulate non-specific resistance of the organism and to prevent diseases of farm animals. It is an aqueous suspension containing a polysaccharide complex of yeast cells Saccharomyces cerevisiae immobilized in agar gel with the addition of a benzimidazole derivative and an antibiotic group of macrolides.

3. Results

It is established that the microclimate in the premises for growth, rearing and fattening of bull-calves corresponded to zoo-hygienic norms.

The average daily rations for bull-calves in periods of growth up to 90 and 180 days, rearing up to 360 days and fattening up to 540 days provided the body's needs for energy and nutrients, mineral elements and vitamins in accordance with detailed feeding standards.

The use of Prevention-N-A and Prevention-N-E in the technology of bull-calves breeding stimulates their growth and development. Thus, by the end of the fattening period, the bull-calves of Test Groups 1 and 2 exceeded the control peers:

- by 20.8 and 16.8 kg in live weight,
- by 5.2 and 3.8 cm in the withers height,
- by 3,3 and 2,0 cm in the chest width behind the blades,
- by 2,3 and 1,9 cm in the depth of the chest;
- by 4,8 and 4,2 cm in the girth of the chest behind the blades,
- by 6,8 and 4, 6 cm in the oblique length of the trunk;
- by 2.2 and 1.8 cm in the width of the hips;
- by 0.8 and 0.7 cm in the metacarpus, respectively ($P <0.05$-0.01).

The average daily growth rate of the animals of the test groups also turned out to be higher than in the control during all the periods of postnatal ontogenesis.

The index of leg length in the test groups decreased as they grew; the indices of being well-set and chest and pelvic indices, on the contrary, increased, while the bone index practically did not change.

The live weight in Test Group 1 and 2 (466.4 ± 3.03 kg and 462.4 ± 3.53 kg, respectively) was higher after fattening compared to the control group (445.6 ± 2.79 kg): by 20.8 kg (4.7%, $P <0.001$) and 16.8 kg (3.8%, $P <0.01$). The bull-calves of Test Goup 1 (454.0 ± 3.51 kg) and 2 (449.6 ± 3.39 kg) had bigger pre-slaughter weight than the control group (430.7 ± 2.71 kg) by 23.3 kg (5.4%, $P <0.001$) and 18.9 kg (4.4%, $P <0.01$), respectively. The carcass weight of the bull-calves receiving intramuscular injections of Prevention-N-A was 16.5 kg (7.2%, $P <0.001$) bigger than in the control group, and with the use of Prevention-N- E it was 12.9 kg (5.6%, $P <0.01$) bigger. The slaughter weight of Test Group 1 was 18.0 kg (7.4%, $P <0.001$) bigger, of Test Group 2 it was 13.9 kg (5.7%, $P <0.01$) than in the control group. According to the slaughter outcome, Test Groups 1 and 2 also had an advantage in comparison with the control group by 1.1 and 0.8%, respectively.

Thus, against the background of immunoprophylaxis, biopreparations have been found to improve the slaughter qualities of bull-calves.

The data presented in Table. 1 shows that the bulls of Test Groups 1 and 2 exceeded their control peers by:

weight of the chilled carcass - 16.1 and 11.9 kg ($P <0.01$);
total meat outcome - 13.5 and 9.7 kg ($P <0.05$-0.01);
total fat outcome - 1.5 and 1.0 kg ($P <0.05$-0.01);
cartilage and tendons - 0.5 and 0.3 kg ($P> 0.05$);
bones - 2.1 and 1.9 kg ($P> 0.05$), respectively.

The relative outcome of the tendons and bones in the experimental groups was, on the contrary, lower by 0.04 and 0.06%, respectively, and by 0.35 and 0.11% ($P> 0.05$) than in the control group.

Table 1: Morphological composition of bull-calves carcasses

Parameter	Group		
	Control	Test 1	Test 2
Chilled carcass weight, kg	220,6±2,37	236,7±2,47**	232,5±2,55**
Meat weight, kg	172,1±2,22	185,6±2,31**	181,8±2,36*
Meat outcome,%	78,01	78,41	78,19
Fat weight, kg	12,0±0,32	13,5±0,22**	13,0±0,16*
Fat outcome,%	2,8	3,0	2,9
Cartilage and tendons weight, kg	8,3±0,12	8,8±0,25	8,6±0,19
Cartilage and tendons outcome,%	3,76	3,72	3,70
Bone weight, kg	40,2±0,75	42,3±0,66	42,1±0,71
Bone outcome,%	18,22	17,87	18,11
Meat outcome per 100 kg of pre-slaughter live weight			
Meat index	39,96±0,17	40,89±0,25*	40,45±0,23
	4,29±0,12	4,39±0,06	4,32±0,09

Legend: * P≤0,05, ** P≤0,01.

The meat outcome per 100 kg of the pre-slaughter weight in Group 1 was 40.89 ± 0.25 kg (an increase by 0.93 kg or 2.3% ($P <0.05$)), while in Group 2 it was 40.45 ± 0.23 kg (an increase by 0.49 kg or 1.2% ($P> 0.01$)) than in the control group – 39.96 ± 0.17 kg. According to the meat index characterizing the ratio of meat and bones, the bull-calves of Test Group 1 differed favorably – the aforementioned index was 4,39 – more than in the control group and Test Group 2 (0,10 and 0,07, accordingly).

Assessing the meat productivity it is important to take into account not only the ratio of carcass tissues but also of the anatomical parts from which different types of meat are obtained. The analysis of the data received (Table 2) indicates that the large carcass mass of test groups also determined high outcome of the most valuable cuts: brisket and sirloin – 6.1 and 4.0 kg (P <0.01-0.001), rump – 2.6 and 1,7 kg (P <0,05-0,01) and thick flank – 8,6 and 7,1 kg (P <0,001), compared with the control group. In this case, the outcome of these cuts relative to the carcass mass of the bull-calves from Test Group 1 and 2 was higher by 0.7 and 0.3%, by 0.4 and 0.2%, by 1.4 and 1, 4% respectively, compared with the control group.

Table 2: Weight and outcome of cuts from bull-calves carcasses

Parameter	Group		
	Control	Test 1	Test 2
Carcass weight, kg	220,6±2,37	236,7±2,47**	232,5±3,55**
cuts:			
neck, kg	23,8±0,12	23,4±0,24	23,5±0,22
%	10,8	9,9	10,1
chuck and blade, kg	41,0±0,22	40,2±0,20	40,4±0,19
%	18,6	17,0	17,4
brisket and sirloin, kg	61,8±0,66	67,9±0,51***	65,8±0,45**
%	28,0	28,7	28,3
rump, kg	23,2±0,40	25,8±0,48**	24,9±0,45*
%	10,5	10,9	10,7
thick flank, kg	70,8±0,85	79,4±0,80***	77,9±0,82***
%	32,1	33,5	33,5

Legend: * P≤0,05, ** P≤0,01, *** P≤0,001.

The carcasses Of Test Groups 1 (27.8 kg) and 2 (26.7 kg), respectively, were characterized by the largest outcome of highest quality meat (Table 3) - by 3.5 and 2.4 kg compared with the control group (24.3 kg, P <0.05-0.001). At the same time, the relative outcome of highest quality beef in relation to the total meat weight was higher in the animals of the test groups – by 0.9 and 0.6% compared with the control group.

Table 3: Meat quality composition of bull-calves carcasses

Parameter	Group		
	Control	Test 1	Test 2
Meat weight, kg	172,1±2,22	185,6±2,31**	181,8±2,36*
Highest quality meat weight, kg	24,3±0,73	27,8±0,72**	26,7±0,58*
Highest quality meat outcome,%	14,1	15,0	14,7
First-grade meat weight, kg	99,1±1,23	108,6±1,35***	105,6±1,29**
First-grade meat outcome,%	57,6	58,5	58,1
Second-grade meat weight, kg	48,7±0,62	49,2±0,60	49,5±0,59
Second-grade meat outcome,%	28,3	26,5	27,2

Legend: * P≤0,05, ** P≤0,01, *** P≤0,001.

From the culinary point of view, the meat quality composition of the individual anatomical parts of carcasses is of some interest (Table 4).

Table 4: Meat quality of cuts from bull-calves carcasses

Parameter	Group		
	Control	Test 1	Test 2
Neck			
Meat weight, kg	20,3±0,37	18,7±0,44	18,9±0,48
Highest quality meat weight, kg	1,9±0,13	1,8±0,14	1,8±0,17
Highest quality meat outcome,%	9,3	9,5	9,5
First-grade meat weight, kg	12,2±0,37	11,4±0,29	11,4±0,51
First-grade meat outcome,%	60,2	61,2	60,6
Second-grade meat weight, kg	6,2±0,25	5,5±0,32	5,7±0,25
Second-grade meat outcome,%	30,5	29,3	29,9
Chuck and blade			
Meat weight, kg	30,6±0,29	28,8±0,34	30,0±0,35
Highest quality meat weight, kg	4,1±0,19	4,0±0,16	4,1±0,10
Highest quality meat outcome,%	13,4	13,9	13,6
First-grade meat weight, kg	19,0±0,35	18,0±0,22	18,7±0,30
First-grade meat outcome,%	62,0	62,6	62,4
Second-grade meat weight, kg	7,5±0,22	6,8±0,20	7,2±0,25
Second-grade meat outcome,%	24,6	23,5	24,0
Brisket and sirloin			
Meat weight, kg	45,7±0,89	52,1±1,05**	51,0±0,84**
Highest quality meat weight, kg	4,6±0,19	5,5±0,16**	5,3±0,12*
Highest quality meat outcome,%	10,1	10,5	10,3
First-grade meat weight, kg	21,4±0,37	24,6±0,51***	24,0±0,42**
First-grade meat outcome,%	46,9	47,3	47,1
Second-grade meat weight, kg	19,7±0,34	22,0±0,47**	21,7±0,44**
Second-grade meat outcome,%	43,0	42,2	42,6
Rump			

Meat weight, kg	19,4±0,31	21,7±0,37**	20,5±0,32*
Highest quality meat weight, kg	3,0±0,11	3,5±0,17*	3,3±0,15
Highest quality meat outcome,%	15,7	16,1	15,9
First-grade meat weight, kg	11,8±0,24	13,2±0,25**	12,5±0,14*
First-grade meat outcome,%	60,8	61,0	60,9
Second-grade meat weight, kg	4,6±0,21	5,0±0,27	4,7±0,22
Second-grade meat outcome,%	23,5	22,9	23,2
Thick flank			
Meat weight, kg	56,1±0,97	64,3±0,94***	61,4±0,81**
Highest quality meat weight, kg	10,7±0,18	13,0±0,22***	12,2±0,25**
Highest quality meat outcome,%	19,1	20,2	19,9
First-grade meat weight, kg	34,7±0,68	41,4±0,75***	39,0±0,71**
First-grade meat outcome,%	61,8	64,4	63,5
Second-grade meat weight, kg	10,7±0,12	9,9±0,17	10,2±0,19
Second-grade meat outcome,%	19,1	15,4	16,6

The analysis of the data obtained indicates that the neck cut up to the seventh vertebra mainly consists of first- and second-grade meat. At the same time, the bull-calves of the test groups were inferior to the control group by the weight of the highest quality meat (0.1 kg) and first-grade meat (0.8 kg), yet the difference was unreliable. In case of chuck and blade cuts, the difference between all the three groups was insignificant (P> 0.05). In brisket and sirloin cuts, the largest highest quality meat outcome was in the test groups, the total outcome being 0.9 and 0.7 kg more, and the relative being 0.4 and 0.2% more.

The amount of highest grade meat in the rump cuts in Test Group 1 was 0.5 and 0.2 kg more than in the control and Test Group 2, respectively; the relative outcome was also 0.4 and 0.2% more, respectively. The largest and most valuable cut of the carcass is the thick flank, as it gives the highest outcome of highest quality meat; in Test Groups 1 and 2 this amount was 2.3 and 1.5 kg more (P <0.01-0.001) than in the control group. At the same time, the relative outcome of the highest quality meat was 19.1% in the control group, 20.2% in Test Group 1 and 19.9% in Test Group 2.

Thus, brisket and sirloin, rump and thick flank cuts in the test groups were characterized by the highest outcome of highest quality meat in comparison with the control group.

The results of beef quality assessment by organoleptic, biochemical and spectrometric indicators are presented in Table 5.

The beef had a dry crust and a pale pink color. The cut was uneven, soaked with blood more intensively than in other parts of the carcass; there was no blood in the muscles and blood vessels. Small vessels under the pleura and peritoneum were not visible. The lymph node cuts were light gray in color. Meat was dense, elastic; when pressing a finger on its surface a dimple was formed which quickly disappeared. The muscles on the incision were slightly moistened and did not leave a moist spot on the filter paper, had a light red color. The broth prepared from the meat was transparent, fragrant, with a small accumulation of large drops of fat on its surface.

It was found that the beef pH in the test experimental groups varied within a narrow range and amounted to 5.96 ± 0.03, 5.98 ± 0.01 and 5.94 ± 0.02 in the control, Test Group 1 and 2, respectively. The content of amino-ammonium nitrogen in the beef samples was 1.20 ± 0.01 mg (control group), 1.17 ± 0.01 (Test Group 1) and 1.18 ± 0.01 mg (Test Group 2) – in other words, within the norm. In the studied samples the reaction with formalin turned out to be negative, with peroxidase - positive, and with copper sulphate - negative.

Table 5: Assessment of beef quality

Parameter	Group		
	Control	Test 1	Test 2
Organoleptic:			
surface appearance and color	the meat samples are covered with a dried-up crust of pale pink color		
muscles on the cut	slightly moist, do not leave a wet spot on the filter paper; light red in color		
consistency	meat is dense, elastic on the cut; the dimple formed with a finger is quickly aligned		
smell	specific, typical of fresh beef		
surface fat	has a yellowish color; the consistency is hard, crumbles when pressed		
tendons condition	elastic, dense; joints surface is smooth and shiny		
broth transparency and smell	transparent, fragrant, large drops of fat on the surface		
Biochemical:			
pH (5,6 – 6,2)	5,96±0,03	5,98±0,01	5,94±0,02
amino-ammonium nitrogen, mg (not more than 1.26in 10 ml extracts from fresh meat)	1,20±0,01	1,17±0,01	1,18±0,01
formalin test	negative		
peroxidase test	positive		
copper sulphate test	negative		
Spectrometric, mg/kg			
lead (not more than 0,5)	0,08±0,01	0,08±0,01	0,07±0,01
cadmium (not more than 0,05)	not found	same as control	same as control
arsenic (not more than 0,1)	not found	same as control	same as control
copper (not more than 5,0)	0,81±0,04	0,84±0,02	0,83±0,03
zinc (not more than 70)	27,5±0,24	27,8±0,16	28,2±0,21
mercury (not more than 0,03)	not found	same as control	same as control

In lead concentration, the samples were practically indistinguishable – it averaged 0.08 ± 0.01 mg/kg in the control group, 0.08 ± 0.01 in Test Group 1 and 07 ± 0.01 mg/kg in Test Group 2. Such toxic elements as cadmium, arsenic and mercury in beef samples were not detected. The level of copper and zinc in the meat samples was within the permissible limits: 0.81 ± 0.04 and 27.5 ± 0.24 mg/kg in the control group, 0.84 ± 0.02 and 27.8 ± 0.16 mg/kg in Test Group 1 and 0.83 ± 0.03 and 28.2 ± 0.21 mg/kg in Test Group 2. Consequently, by spectrometric parameters the meat of the bull-calves of the experimental groups practically did not differ from the control data.

Thus, the veterinary and sanitary examination found that organoleptic, biochemical and spectrometric indicators of meat of bull-calves grown on the background of intramuscular injection of

Prevention-N-A and Prevention-N-E did not differ from those in the control group and met the requirements of the Technical Regulations of the Customs Union 'On Food Safety' TR CU 021/2011 and the Technical Regulations of the Customs Union 'On the Safety of Meat and Meat Products' TR CU 034/2013, which indicates the safety of the test preparations and good quality of meat carcasses.

Based on the analysis of the age-related dynamics of the clinical and physiological state, it was established that body temperature, pulse rate and respiratory movements in the calves of the compared groups during the periods of growth, rearing and fattening were within the physiological norms, and the difference in them was insignificant (P> 0, 05).

Prevention-N-A and Prevention-N-E tested in experiments on Black Motley breed activate the production of red blood cells and increase the concentration of hemoglobin in the blood, that is, improve haemopoiesis, but do not affect leucopoiesis.

Against the background of immunoprophylaxis of experimental bull-calves, cellular and humoral factors of non-specific protection are activated, which is especially important in the early period of postnatal ontogeny. On the 30th day of the growth period, the bulls of Test Groups 1 and 2 exceeded the control peers by 4.8 and 4.2% in phagocytic activity of the leukocytes, in phagocytic index by 1.1 and 0.8, in lysozyme activity in plasma by 2.1 and 1.5%, in bactericidal activity in serum by 6.3 and 5.5%, and in the concentration of immunoglobulins in blood serum by 3.1 and 2.1 mg/ml.

The phagocytic activity of neutrophilis segmented leukocytes towards Staphylococcus aureus in the bull-calves in the three groups gradually increased as they grew and developed - from 31.0 ± 1.26 to 64.6 ± 1.44%, from 30.6 ± 1.21 to 71.6 ± 1.47% and from 30.8 ± 1.02 to 70.0 ± 1.41%, respectively (control, Test Group 1, Test Group 2). The most pronounced activity of this cellular factor of non-specific resistance of the organism was observed in 30, 90, 18, 360 and 540-day-old animals of Test Group 1 (intramuscular injections of Prevention-N-A) in comparison with the control data for 4.8, 6.8, 7.0, 6.9, and 7.0% (P <0.05-0.01). This activity of leukocytes in the animals of Test Group 2 (intramuscular injections of Prevention-N-E) was also significantly higher than in the control group, starting from their 30-day-old age and till the fattening period: in 30-day-old bull-calves by 4,2%, 90-day – 5.6%, 180-day – 5.6%, 360-day – 5.4% and 540-day-old – 5.4% (P <0,05).

The phagocytic index in the animals of the three groups increased from the 1st to the 5th day of studies from 2.3 ± 0.12 to 9.2 ± 0.37, from 2.1 ± 0.10 to 10.2 ± 0.41 and from 2.5 ± 0.22 to 9.4 ± 0.40, respectively. It should be noted that the average number of bacteria in one phagocyte in the animals of Test Group 1 was significantly higher than in the control group on the 30th, 90th and 180th days of the growth period (by 16.6%, 16.7 and 13.7%, respectively) and on the 360th day of the rearing period by 17.5% (P <0.05). The phagocytic index in the bulls of Test Group 2 was also higher in comparison with the control group, yet the difference proved to be reliable only on the 30th and 90th day – by 12.2 and 12.5% (P <0.05).

The lysozyme activity in the blood plasma in the control group and in Test Group 2 increased consecutively during the period of growth – from the 1st to the 90th day, respectively by 7.1 ± 0.36 to 20.3 ± 0.55%, and from 7.3 ± 0.35 to 22.6 ± 0.42%. However, on the 180th day of the indicated period it decreased to 20.0 ± 0.41 and 22.2 ± 0.58%, and subsequently during the periods of rearing and fattening it steadily increased, reaching the peak at the end of the fattening period - 24.4 ± 0.51 and 26.4 ± 0.40%. The muramidase activity of this enzyme in Test Group 1 was continuously increased during the experiment from 7.1 ± 0.33 to 26.5 ± 0.39%. This indicator of the humoral link of the non-specific resistance of the organism in the animals of Test Groups 1 and 2 was significantly higher than in the control group, starting from the 30-day of age till slaughter: in 30-day-old animals by 2.1 and 1.5%, in 90-day-old by 3.4 and 2.3%, in 180-day-old animals by 3.9 and 2.2%, in 360-day-old by 2.3 and 1.8%, and in 540-day-old by 2.1 and 2.0% (P <0.05-0.001), respectively.

It was found that bactericidal activity of blood serum of tested animals tended to increase as they grew and developed from the 1st to the 540th day: in the control group the increase was from 33.6 ± 1.07 to 60.0 ± 0.85%, in Test Group 1 from 33.3 ± 1.19 to 63.3 ± 0.96%, and in Test Group 2 from 33.4 ± 1.14 to 61.9 ± 1.16%. Here, the bactericidal activity of blood serum in Test Group 1 was higher than the control data for all the periods of research: on the 30th day by 6.3%, on the 90th day – 6.1%, on the 180th day – 4.6%, on the 360th day – 3.8% and on the 540th day by 3.3% (P <0.05-0.01). It should be noted that this activity in Test Group 2 also had a higher rate than that in the control group, especially during the growth period. Thus, the 30-day-old bull-calves of this group exceeded their control peers by this factor of the humoral link of the non-specific resistance by 5.5%, 90-day-old bull-calves by 5.5% and 180-day-olds by 5.6% (P <0, 05-0.01).

It was established that the concentration of immunoglobulins in the blood serum of the bull-calves of the test groups increased as they grew and developed: in the control group, from 11.6 ± 0.68 to 28.1 ± 0.93 mg/ml, in Test Group 1 from 11.5 ± 0.64 to 32.1 ± 0.76 mg/ml and in Test Group 2 from 11.4 ± 0.70 to 31.8 ± 0.72 mg/ml. The level of indicated immunocompetent factor of blood serum in the test groups was significantly higher – by 3.1 and 2.1 mg/ml, 3.6 and 2.0 mg/ml, 4.1 and 2.9 mg/ml, 3.9 and 3.1 mg/ml and 4.0 and 3.7 mg/ml (i.e., 19.2 and 13.0%, 16.3 and 9.0%, 15.6 and 11.1%, 13.9 and 11.1% and 14.2 and 13.2%) after 30, 90, 180, 360 and 540 days after the experiments, compared with the control group (P <0.050.01).

Based on the analysis of immunological studies, it was established that bull-calves receiving biopreparations and reared and fattened in standard conditions had higher rates of cellular and humoral non-specific defense of the organism. Moreover, the immunostimulating effect of Prevention-N-A was more pronounced than Prevention-N-E.

4. Discussion

At the present stage of cattle breeding development to ensure reliable health protection and realization of the bioresource potential and the meat qualities of bull-calves, it becomes necessary to activate the non-specific protective factors of the organism against the technological and environmental factors of the habitat during periods of growth, rearing and fattening by biological preparations which are characterized by high bioavailability and harmlessness to the organism.

The pharmaceutical market offers a wide range of diverse products, many of chemical origin and thus of low bioavailability. In addition, the previously proposed drugs only work on individual factors of non-specific resistance, which does not fully ensure the activation of the immune system. In secondary immune deficiencies, pathogenic microorganisms play an important role in the development of the disease, therefore, in the treatment of animals antibiotics that can have an immunosuppressive effect are used [8; 10; 14; 16; 23; 25; 27; 28; 31; 33].

The authors of the present study believe it is most expedient to use immunostimulants made of natural raw materials with antibacterial drugs. When combined, a double strike is applied to the pathogen: the antibacterial drug suppresses the functional activity of the pathogen, increasing its sensitivity to phagocytosis, and the immunostimulant activates the phagocyte, increasing its ability to neutralize the pathogen.

In view of the foregoing, a scientific study was devoted to the realization of the bioresource potential of meat qualities of Black Motley bull-calves by directed correction of postnatal formation and development of non-specific resistance of the organism with the help of biopreparations Prevention-N-A and Prevention-N-E in connection with hygienic conditions of maintenance and feeding.

The dynamics of the live mass, both absolute and relative, gives an accurate prediction about the development of meat productivity of an animal, both in its lifetime and after slaughter [32]. In conditions of two intramuscular injections of Prevention-N-A and Prevention-N-E on the 2nd-3rd and 7th-9th day in a dose of 3 ml growth and development boost was established. By the end of the growth period, 180-day-old bull-calves of the test groups outperformed the control peers by 7.2 and 4.8 kg of live weight, by 14.6 and 12.0 kg during rearing and by 20.8 and 16.8 kg after fattening, respectively (P <0.05-0.001).

The classics specialist of Russian zootechnics Bogdanov E.A., Kuleshov N.N., Ivanov M.F., Goldobin M.I. and others pointed out that only constitutionally strong animals meet economic and biological requirements. The data obtained and the analysis of the external-constitutional features of the bull-calves in the dynamics show that the animals of the test groups exceeded the control peers both in height and girth. For example, at the end of the fattening period the parameters were as follows: withers height by 5.2 and 3.8 cm, chest width behind the blades by 3.3 and 2.0 cm, chest depth by 2.3 and 1.9 cm, chest girth behind the blades by 4.8 and 4.2 cm, oblique length of the trunk by 6.8 and 4.6 cm, hips width by 2.2 and 1.8 cm, and in metacarpus by 0.8 and 0.7 cm, respectively.

In order to assess the meat productivity and quality, control bull-calves were slaughtered at the age of 18 months (5 animals from each group). It was found that the bull-calves of Test Groups 1 and 2 exceeded the control peers by the weight of the chilled carcass by 16.1 and 11.9 kg (P <0.01), the total meat outcome by 13.5 and 9.7 kg (P <0,05-0,01), fat by 1.5 and 1.0 kg (P <0,05-0,01), cartilage and tendons by 0.5 and 0.3 kg (P> 0.05), bones by 2.1 and 1.9 kg (P> 0.05), respectively. The relative outcome of tendons and bones in test groups was, on the contrary, lower by 0.04 and 0.06%, respectively, and by 0.35 and 0.11% (P> 0.05) than in the control group. Thus, full-bodied carcasses were obtained from test groups; nevertheless, the bull-calves of Test Group 1 were leading along all the indicators.

Nutritional value, taste and culinary benefits of various natural anatomical parts of the carcass are not the same. In the present experiment, the larger weight of carcasses of the bull-calves of the test groups determined the high outcome of the most valuable cuts: brisket and sirloin by 6.1 and 4.0 kg (P<0.01-0.001), rump by 2.6 and 1.7 kg (P <0.05-0.01) and thick flank by 8.6 and 7.1 kg (P <0.001) compared with the control group.

The composition of meat largely determines its further use by meat processing plants, and the range of meat products. The largest outcome of highest quality meat was from the carcasses of the test groups (3.5 and 2.4 kg, respectively) in comparison with the control group (P <0.05-0.001). In the carcass, the largest and most valuable cut is the thick flank, as it gives the highest outcome of premium quality meat. The amount of such meat in the test groups was 2.3 and 1.5 kg larger (P <0.01-0.001) than in the control group.

The quality of meat products is determined by its chemical composition and biological wholesomeness, which in turn is determined by the conformity of the product to the needs of the human body and the guaranteed harmlessness of its use in accordance with physiological standards [12]. As a result of the veterinary and sanitary examination, the compliance of beef with the requirements of the Technical Regulations of the Customs Union ‘On Food Safety’ TR CU 021/2011 and the Technical Regulations of the Customs Union ‘On the Safety of Meat and Meat Products’ TR CU 034/2013 was established, indicating the good quality of meat carcasses.

Prevention-N-A and Prevention-N-E tested on Black Motley bull-calves increased the number of erythrocytes and the hemoglobin concentration in blood, that is, improved haemopoiesis, and also activated cellular and humoral factors of non-specific resistance.

5. Conclusions

Under the influence of Prevention-N-A and Prevention-N-E the growth and development of Black Motley bull-calves is accelerated during the periods of growth, rearing and fattening, which causes their higher slaughter and meat qualities and, as a consequence, the outcome of valuable cuts – brisket and sirloin, rump and thick flank, and also of highest quality and first-grade beef. It was experimentally proved that the realization of the bioresource potential is caused by the activation of haemopoiesis, cellular and humoral factors of the non-specific resistance with the help of biological preparations, with a more pronounced corresponding effect of Prevention-N-A.

1. Using Prevention-N-A and Prevention-N-E in the technology of growing bull-calves twice on the 2nd-3rd and 7th-9th day in the dose of 3 ml stimulates their growth and development.

By the end of the fattening period the bull-calves of the test groups exceeded the control peers by 20.8 and 16.8 kg in live weight, by 5.2 and 3.8 cm at the withers, by 3.3 and 2.0 cm in chest width behind the blades, by 2.3 and 1.9 cm in chest depth, by 4.8 and 4.2 cm in chest girth behind the blades, by 6.8 and 4.6 cm in the oblique length of the trunk, by 2.2 and 1.8 cm in hips width and by 0.8 and 0.7 cm in metacarpus, respectively (P <0.05-0.01). The average daily growth of the animals of the test groups also turned out to be higher than in the control during all the periods of postnatal ontogeny.

Leg length index of the animals of the test groups decreased as they grew, the indices of stretch, breach, chest and pelvic, on the contrary, increased, and the bone index practically did not change.

2. Against the background of the application of biological preparations, the fattening and slaughtering qualities of the bull-calves improve.

An increase in the pre-slaughter live weight of animals of the test groups by 23.3 and 18.9 kg was established, the weight of the carcass was increased by 16.5 and 12.9 kg, the slaughter outcome by 1.1 and 0.8%, the total meat outcome by 13.5 and 9.7 kg, internal fat by 1.5 and 1.0 kg and meat index by 0.10 and 0.07, respectively (P <0.05-0.01). The outcome of the most valuable cuts also increased: brisket and sirloin by 6.1 and 4.0 kg (P <0.01-0.001), rump by 2.6 and 1.7 kg (P <0.05-0.01) and thick flank by 8.6 and 7.1 kg (P <0.001) than in the control group.

3. Including Prevention-N-A and Prevention-N-E in the technology of growing bull-calves promotes the improvement of meat qualities.

The largest outcome of highest quality meat was from the carcasses of the bull-calves of Test Group 1 (27.8 ± 0.72 kg) and 2 (26.7 ± 0.58 kg), respectively by 3.5 and 2.4 kg, as compared with the control group (24.3 ± 0.3 kg), and also of their cuts: brisket and sirloin by 0.9 and 0.7 kg, rump by 0.5 and 0.3 kg, thick flank by 2.3 and 1.5 kg (P <0.05-0.001).

The beef conformed to the requirements of the Technical Regulations of the Customs Union ‘On Food Safety’ TR CU 021/2011 and the Technical Regulations of the Customs Union ‘On the Safety of Meat and Meat Products’ TR CU 034/2013.

4. The use of Prevention-N-A and Prevention-N-E in the technology of growing, rearing and fattening bull-calves does not affect the clinical and physiological state of the organism.

5. Prevention-N-A and Prevention-N-E tested on Black Motley bull-calves activate the production of erythrocytes and increase the concentration of hemoglobin in the blood, that is, improve haemopoiesis, but do not affect leucopoiesis.

6. Against the background of immunoprophylaxis of experimental bull-calves, cellular and humoral factors of non-specific resistance are activated, which is especially important in the early period of postnatal ontogeny. On the 30th day of the growth period the animals of the test groups exceeded the control peers by 4.8 and 4.2% in phagocytic activity of the leukocytes, in phagocytic index by 1.1 and 0.8, in lysozyme activity of the plasma by 2.1 and 1.5%, in

bactericidal activity of serum by 6.3 and 5.5%, and in the concentration of immunoglobulins in blood serum by 3.1 and 2.1 mg/ml.

6. Recommendations

To implement the bioresource potential of meat qualities of Black Motley bull-calves the authors recommend the use of complex biopreparations Prevention-N-A and Prevention-N-E, which are immunostimulants based on the polysaccharide complex of yeast cells Saccharomyces cerevisiae in combination with bactericidal preparations of aminoglycoside and natural macrolides:
1) intramuscularly injecting Prevention-N-A twice daily for newborn calves for on the 2nd-3rd and 7th-9th day in the dose of 3 ml;
2) intramuscularly injecting Prevention-N-E twice on the 2nd-3rd and 7th-9th day in the dose of 3 ml.
The proposed biopreparations contribute to the realization of the bioresource potential of the meat qualities of bull-calves due to the activation of the protective-adaptive functions of the organism against environmental and technological factors and the selective mobilization of the hematologic profile and cellular and humoral factors of non-specific resistance, with a more pronounced corresponding effect of Prevention-N-A.

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