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Stimulation of Adaptogenesis in Aberdeen-Angus Calves for Improving Productive Qualities

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Abstract*: Regularities in forming protective and adaptive functions in the organism of imported beef cattle in the conditions of the Nizhny Novgorod region have been described by the morphological and biochemical profiles of blood, cellular and humoral factors of nonspecific resistance. It has been found that immunization of calves with biological preparations PS-6 and Prevention-N-E implements their bioresource potential of meat productivity. On the background of using the preparations, the pre-slaughter weight of the calves increased by 15.4 and 22.0 kg, the slaughter weight increased by 13.8 and 17.5 kg, and the weight of hot carcass increased by 9.9 and 19.6 kg. The veterinary and sanitary expertise has proven the good purity of beef.

Index Terms*: Aberdeen-Angus Bulls, Adaptiogenesis, Biological Preparation Prevention-N-E, Carcass Morphological Composition, Cuts Yield, Meat Chemical Composition, Meat Quality.

I. INTRODUCTION

The world experience shows that satisfying the demand for beef in sufficient quantities is impossible without developed specialized meat cattle breeding, the share of which in total cattle breeding in Europe and North America ranges from 40 to 85 % [1-4]. In Russia, beef production is now by 90 % based on the sales of cattle of milk and combined breeds [5, 6].In almost all countries of the world, the same breeds are used in all climatic zones in beef cattle breeding. However, during animals' transportation from continent to continent, from country to country, even if the countries have similar climates, time and efforts of specialists are required for animals adaptation [7-12].To activate adaptogenesis in the imported specialized beef cattle to the natural temperature conditions of the environment and to implement the bioresource potential of the organism, the veterinary market offers a wide range of pharmacological agents, but most of them are of chemical origin and feature low bio-availability [13-17].In light of the above, development and introduction into practical veterinary medicine of complex biopreparations for activation of protective and adaptive functions in the organism of imported beef cattle to the adaptive technology of growing, rearing and fattening and, consequently, commercialization of the bioresource potential of the organism is an urgent problem of modern science and practice [18-22].

The research was aimed at activating the adaptogenesis and commercialization of the bioresource potential of specialized beef cattle in the conditions of the Nizhny Novgorod region using biological preparations PS-6 and Prevention-N-E.

II. MATERIALS AND METHODS

The experimental part of the research was performed at the breeding farm of OOO Agrofirma Myaskom in the Lyskovo area of the Nizhny Novgorod region. The objects of the research were purebred Aberdeen-Angus calves. During the scientific-production experiment, three groups of calves analogs were formed, 15 animals in each group. During the growing period up to 210 days of age, the animals of all groups were kept at foot with mother cows in pens in the open air, and during the subsequent periods of rearing up to 360 days of age, and fattening up to 540 days of age – in open areas under canopies, i.e., using the adaptive technology. The calves were kept in the conditions of clean air at the natural temperature conditions in all seasons of the year.The research was performed on the background of balanced feeding according to the diets tailored to the organism's need in energy and main nutrients during the periods of growing, rearing and fattening of the calves in accordance with the feeding norms and diets based on the assessment of the nutritional value of the forage and the level of the feed base [23-25].With the aim of activating adaptogenesis in imported beef cattle to the climatic conditions of the Nizhny Novgorod region, and for most complete commercialization of the bioresource potential of the organism in the conditions of the natural temperatures of the environment, environmentally safe composite biopreparations were used.

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Animals in the 1st experimental group were injected intramuscularly with biopreparation PS-6 in the dosage of 3 ml on days 2 – 3 and 7 – 9 of life, in the 2nd experimental group – with preparation Prevention-N-E in the same dosage and at the same time, and in the reference group, the animals did not receive any biological preparations.

III. RESULTS AND DISCUSSION

It has been found that double intramuscular injection of calves with biological preparations PS-6 and Prevention-N-E did not affect the clinico-physiological state of the organism. The animals in the experimental groups featured the incidence rate of respiratory and digestion diseases reduced 2.5 and 5.0 times, and the recovery time reduced by 1.5 and 2.3 days, respectively, compared to the reference (P < 0.05).Selective mobilization of morphological and biochemical profiles of blood, cellular and humoral factors of nonspecific resistivity of the organisms of the calves in the experimental groups was detected in the conditions of the adaptive technology of keeping in open pens [13, 26]. The preparations used in the experiments had a wide range of bioeffect: – they intensified the production of red blood cells and increased the hemoglobin concentration in the blood of calves, i.e., improved hematopoiesis, but did not have a stimulatory effect on the production of white blood cells; – caused physiological eosinophilia, moderate neutropenia with the shift of the neutrophilic nuclei to the right, and lymphocytosis; – increased protein metabolism, mainly by synthesis of the albumin and the γ-globulin fractions; and – activated cellular and humoral factors of nonspecific resistivity of the organism [27, 28].It has been found that intramuscular injection of PS-6 and Prevention-N-E to calves stimulates their growth and development. By the end of the period of keeping at foot, 210-day-old calves in the 1st and the 2nd experimental groups had exceeded their peers in the reference group in terms of live weight by 6.6 and 9.2 kg, by the end of rearing (360 days) – by 10.4 and 14.8 kg, and by the end of fattening (540 days) – by 14.2 and 22.2 kg, respectively (P < 0.05 – 0.01). A similar regularity was observed in the nature of the changes in the exterior measurements and the growth rate of the animals in the compared groups. Slaughter qualities of the calves are shown in Table 1.

Table 1: Indicators of calves' check slaughtering

Indicator	Group		
	Reference	Experimental 1	Experimental 2
Live weight when removed from fattening, kg	497.2 ± 3.37	511.4 ± 3.44*	519.4 ± 3.87**
Pre-slaughter live weight, kg	483.4 ± 3.56	498.8 ± 3.95*	505.4 ± 4.13**
Hot carcass weight, kg	269.8 ± 1.93	279.4 ± 2.16*	289.4 ± 2.38***
Carcass yield, %	55.8	56.0	57.3
Weight of internal fat, kg	6.5 ± 0.25	7.1 ± 0.33	7.0 ± 0.25
Internal fat yield, %	1.34	1.42	1.38
Slaughter weight, kg	277.5 ± 2.06	291.2 ± 2.60**	301.4 ± 2.66***
Slaughter yield, %	57.4	58.4	58.7

Note: * P < 0.05; ** P < 0.01

The table shows that the live weight of the young calves in the 1st (511.4 ± 3.44 kg) and 2nd (519.4 ± 3.87 kg) experimental groups when removed from fattening was higher than in the reference (497.2 ± 3.37 kg) by 14.2 kg (or 2.8 %; P < 0.05) and by 22.2 kg (or 4.5 %; P < 0.01). The results of check slaughter have shown that calves in the 1st (498.8 ± 3.95 kg) and the 2nd (505.4 ± 4.13 kg) experimental groups surpassed their peers in the reference group (483.4 ± 3.56 kg) in terms of pre-slaughter live weight by 15.4 kg, or by 3.2 % (P < 0.05), and by 22.0 kg, i.e., by 4.5 % (P < 0.01). It has been found that the weight of hot carcasses of the animals grown in the conditions of adaptation to the cold in pens on the background of intramuscular injection of PS-6, followed by rearing and fattening in open areas under canopies, surpassed similar indicators of the animals in the reference group by 9.6 kg, or by 3.5 % (P < 0.05), and with the use of biological product Prevention-N-E – by 19.6 kg, i.e., by 7.3 % (P < 0.001). The calves in the 1st and the 2nd experimental groups also were slightly superior to their peers in the reference group in terms of internal fat weight by 0.6 kg and 0.5 kg; however, the difference was not veracious (P > 0.05). The slaughter weight of the animals in the 1st experimental group was higher by 13.7 kg, or by 4.9 % (P < 0.01), and in the 2nd experimental group – by 23.9 kg, or by 8.6 % (P < 0.001), compared to the reference. The morphological composition of calves' carcasses is shown in Table 2.

Table 2: Morphological composition of calves' carcasses

Indicator	Group		
	Reference	Experimental 1	Experimental 2
Chilled carcass weight, kg	260.2 ± 2.27	269.8 ± 2.35*	278.6 ± 3.23**
Pulp weight, kg	206.8 ± 2.35	214.8 ± 2.33*	222.4 ± 3.11**
Pulp yield, %	79.48	79.61	79.82
Weight of internal fat, kg	15.4 ± 0.58	16.3 ± 0.31	16.1 ± 0.29
Fat yield, %	5.92	6.04	5.78
Weight of tendons, kg	8.9 ± 0.17	9.2 ± 0.12	9.3 ± 0.17
Yield of tendons, %	3.42	3.41	3.34
Weight of bones, kg	44.5 ± 0.75	45.8 ± 0.66	46.9 ± 0.74
Yield of bones, %	17.10	16.97	16.83
Pulp yield per 100 kg of pre-slaughter live weight	42.78 ± 0.12	43.06 ± 0.24	44.04 ± 0.29**
Meatiness index	4.65 ± 0.15	4.69 ± 0.11	4.74 ± 0.08

Note: * P < 0.05; ** P < 0.01

The table shows that the weight of chilled carcasses of the animals in the 1st experimental group, compared with the reference, was higher by 9.6 kg (P < 0.05), or by 3.7 %, and in the 2nd experimental group – by 18.4 kg (P < 0.01), i.e., by 7.1 %. As a result of carcasses evisceration, it has been found that in terms of the absolute yield of the muscle tissue, the calves in the 1st and the 2nd experimental groups surpassed their peers in the reference group by 8.0 and 15.6 kg, or by 3.9 and 7.5 % (P < 0.05 – 0.01); in the carcasses of the animals from the experimental groups, the weight of meat expressed as a percentage to the weight of the carcass was greater by 0.13 and 0.34 %.

The absolute fat yield from carcasses of the calves in the 1st and the 2nd experimental groups was higher, compared to the reference group, by 0.9 and 0.7 kg, or by 5.8 % and 4.5 % (P > 0.05). The morphological composition of carcasses is significantly affected by the content of cartilage and tendons.

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No pattern was found in the absolute yield of tendons in the experimental groups of calves, and it varied in a narrow range from 8.9 ± 0.17 to 9.3 ± 0.17 kg. The absolute yield of bones from the carcasses of the animals in the 1st and the 2nd experimental groups was higher by 1.3 and 2.4 kg, or by 2.9 and 5.4 % (P > 0.05), respectively, than in the reference group. However, the yield of bones expressed as a percentage, relative to the weight of the carcass; in the calves from the experimental groups, on the contrary, was lower by 0.13 and 0.27 %, respectively. The meat yield per 100 kg of pre-slaughter weight of the calves from the 1st experimental group was 43.06 ± 0.24 kg, i.e., it was greater by 0.28 kg or 0.6 % (P > 0.01), and in the 2d experimental group – by 44.04 ± 0.29 kg, i.e., it was greater by 1.26 kg, or by 2.9 % (P < 0.01) than in the reference group – 42.78 ± 0.12 kg.The meatiness index of the carcasses shows the meat to bones ratio. In terms of this indicator, carcasses of the calves from the 2d experimental group stood out. Their meatiness index was 4.74, which was more than in the calves from the reference group and the 1st experimental groups by 0.09 and 0.05 scores, respectively. In assessing the meat productivity of the cattle, an important role is played not only by the share of tissues in the carcass, but also by the shares of the anatomical parts, from which varieties of meat are obtained. Each part of the carcass has certain meatiness, depending on its biological importance in the organism [29, 30]. In the experiment, the carcasses were divided into separate pieces (cuts): shoulder, cervical, lumbar, spinal-thoracic, and coxal. Each piece has a specific meat yield that determines the value of each carcass. The weight and the yield of the cuts from the carcasses of calves are shown in Table 3.

Table 3: The weight and yield of the cuts from the carcasses of calves

Indicator	Group		
	Reference	Experimental 1	Experimental 2
Carcass weight, kg	260.2 ± 2.27	269.8 ± 2.35*	278.6 ± 3.23**
including the cut:			
cervical, kg	29.1 ± 0.15	27.2 ± 0.23	26.5 ± 0.24
%	11.2	10.1	9.5
scapulohumeral, kg	48.7 ± 0.21	47.2 ± 0.12	47.6 ± 0.22
%	18.7	17.5	17.1
spinal-pectoral, kg	74.9 ± 0.72	82.9 ± 0.54***	86.4 ± 0.62***
%	28.8	30.7	31.0
lumbar, kg	33.3 ± 0.40	35.1 ± 0.37*	36.5 ± 0.60**
%	12.8	13.0	13.1
coxal, kg	74.2 ± 0.59	77.4 ± 0.62**	81.6 ± 0.71***
%	28.5	28.7	29.3

Note: * P < 0.05; ** P < 0.01, *** P < 0.001

The maximum weight of cervical cuts was noted in the calves from the reference group (29.1 ± 0.15 kg), i.e., it was greater than that of the peers in the 1st (27.2 ± 0.23 kg) and the 2nd (26.5 ± 0.24 kg) experimental groups by 1.9 and 2.6 kg, respectively. However, the difference turned out to be unveracious. The yield of the cervical cut in the reference, relative to the weight of carcasses, was higher by 1.1 and 1.7 % (P > 0.05) than in the experimental groups.The weight of the scapulohumeral cuts of the calves from the reference group (48.7 ± 0.21 kg) was also better than from the peers from the 1st (47.2 ± 0.12 kg) and the 2d (47.6 ± 0.22 kg) experimental groups by 1.5 and 1.1 kg, respectively. The yield of the cuts relative to the carcass weight in the reference group was higher by 1.2 and 1.6 % than in the experimental groups, but in this case, the difference was not veracious (P > 0.05).Development of the spinal-pectoral part was the most powerful in the calves from the 1st and the 2nd experimental groups. Their superiority over the calves from the reference group in terms of the weight of spinal-pectoral cuts was 8.0 and 11.5 kg (P < 0.001), the yield, compared to the carcass weight, was 1.9 and 2.2 %, respectively.It has been found that the calves from the 1st and the 2nd experimental groups were superior in terms of the weight of the lumbar cut by 1.8 and 3.2 kg (P < 0.05 – 0.01), and of the coxal cut – by 3.2 and 7.4 kg (P < 0.01 – 0.001), respectively, as compared to the reference. With that, the yields of these cuts relative to the carcass weight in the calves from the 1st and the 2nd experimental groups were higher by 0.2 % and 0.3 %, and by 0.2 % and 0.8 %, respectively, than in the reference. The results of studying meat grades of the carcasses of experimental calves are shown in Table 4.

Table 4: Grades of meat of calves carcasses

Indicator	Group		
	Reference	Experimental 1	Experimental 2
Pulp weight, kg	206.8 ± 2.35	214.8 ± 2.33*	222.4 ± 3.11**
The weight of top grade meat, kg	49.0 ± 0.77	52.2 ± 0.63*	54.7 ± 0.65***
The yield of top grade meat, %	23.7	24.3	24.6
The weight of first grade meat, kg	107.3 ± 1.40	112.1 ± 1.17*	117.4 ± 1.53**
The yield of first grade meat, %	51.9	52.2	52.8
The weight of second grade meat, kg	50.5 ± 0.53	50.5 ± 0.59	50.3 ± 0.60
The yield of second grade meat, %	24.4	23.5	22.6

Note: * P < 0.05; ** P < 0.01, *** P < 0.001

The highest top-grade meat content was found in carcasses of the calves from the 1st (52.2 ± 0.63 kg) and the 2nd (54.7 ± 0.65 kg) experimental groups, respectively, which was higher by 3.2 and 5.7 kg, compared to the reference group (49.0 ± 0.77 kg; P < 0.05 – 0.001). With that, the yield of top-grade beef, relative to the total weight of the meat, was higher by 0.6 and 0.9 % in the animals of the experimental groups. From the calves in the 1st and the 2nd experimental groups, the averages of 112.1 ± 1.17 kg and 117.4 ± 1.53 kg of first-grade beef were obtained, which were more than from the calves in the reference group by 4.8 kg and 10.1 kg (P < 0.05 − 0.01), respectively.

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The animals in these experimental groups were superior to their peers in the reference group in terms of the yield of first-grade meat, relative to the total weight of meat, by 0.3 and 0.9 %. The content of second-grade meat in the carcasses of the calves from the experimental groups was virtually at the same level: in the reference – 50.5 ± 0.53 kg, in the 1st experimental group – 50.5 ± 0.59 kg, and in the 2nd experimental group – 50.3 ± 0.60 kg. By its organoleptic, biochemical and spectrometric characteristics, the beef was consistent with the requirements of Technical Regulations of the Customs Union "On Safety of Food Products" CU TR 021/2011 and Technical Regulations of the Customs Union "On Safety of Meat and Meat Products" CU TR 034/2013, which indicated the good quality of meat carcasses.

IV. CONCLUSION

The results of studying the use of biopreparations for activation of protective and adaptive functions of the calves' organism to the conditions of adaptive technologies of growing, rearing and fattening, and commercialization of bioresource potential of the organism show that PS-6 and Prevention-N-E increase the adaptive plasticity of the organism to low temperatures of the environment, intensify hemopoiesis, cellular and humoral factors of nonspecific resistance, decrease the number of respiratory diseases and diseases of the digestion tract, accelerate growth and development, and increase meat productivity.

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