REPUBLIC OF AZERBAIJAN

On the rights of the manuscript

ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

STUDY OF THE BIOLOGICAL AND ECONOMICALLY USEFUL TRAITS OF ABERDEEN-ANGUS AND BLACK-AND-WHITE CROSSBREDS UNDER THE CONDITIONS OF AZERBAIJAN

Specialty: 3110.03 – "Special zootechnics, technology of production of livestock products"

Field of science: Agrarian sciences

Applicant: **Sanam Zabit Ibrahimova**

Ganja – 2026

The work was performed at Department of "General and Special Zootechnics" of the Faculty of Zootechnics of the Azerbaijan State Agrarian University of the Ministry of Agriculture of the Republic of Azerbaijan.

Scientific supervisor: Doctor of Agrarian Sciences, Professor
Ganbar Gara Abdullayev

Official opponents: – Corresponding Member of ANAS, Doctor of Biological Sciences, Professor
Panah Zulfugar Muradov
– Doctor of Philosophy in Agrarian Sciences
Ramil Telman Mammadov
– Doctor of Philosophy in Agrarian Sciences, Associate Professor
Gunay Isfandiyar Sadigova

One-time Dissertation council BFD 4.01 of the Supreme Attestation Commission under the President of the Republic of Azerbaijan operating at Azerbaijan State Agrarian University of the Ministry of Agriculture of the Republic of Azerbaijan

Chairman of the Dissertation council:
Doctor of Biological Sciences,
Fuad Mamay Gulubeyov

Scientific secretary of the Dissertation council:
Doctor of Philosophy in Veterinary Sciences
Maryam Rza Musayeva

Chairman of the scientific seminar:
Doctor of Agrarian Sciences, Professor
Arif Alirza Taghiyev

GENERAL DESCRIPTION OF THE RESEARCH

Relevance of the topic and degree of its development. Agriculture is considered one of the oldest and most important fields of activity in the history of humanity. In almost all countries of the world, people are engaged in such types of activities as agriculture, hunting and fishing. On a global scale, approximately 1 billion people, that is, a significant part of the working-age population, work in this sector. However, the level of employment in agriculture is not the same across countries and shows significant differences. For example, while the share of the working-age population employed in agriculture averages 9% in Western European countries and 6% in North America, this indicator reaches approximately 30% in Azerbaijan. In some developing countries, the share of those employed in agriculture varies between 70–80%[1].

In our country, due to the high demand for agricultural products, including animal products, and the relatively low level of livestock production, the development of cattle breeding on a scientific basis is of great importance. In 2024, per capita consumption of meat and meat products was 36.1 kg, while milk and dairy products amounted to 244.9 kg. Although these indicators have increased compared with previous years, they remain below the recommended standards for healthy nutrition. According to the minimum consumer basket standards in the Republic of Azerbaijan, annual per capita consumption is set at 32.9 kg for meat and meat products and 223.6 kg for milk and dairy products. International recommendations suggest an even higher annual consumption level for milk and dairy products[2].

Therefore, the scientifically based development of cattle productivity in meat and dairy directions, introduction of new breeds, and production of crossbred animals are of great biological and economic importance.

In this regard, research aimed at obtaining highly productive meat and dairy crossbreds through effective crossing and studying

[1] Abdullayev, Q.Q., Mirzəyev, V.A. İntensiv və ekstensiv maldarlıq. Bakı: Ecoprint, 2022, 248 s.

[2] Azərbaycan Respublikası Dövlət Statistika Komitəsi. AzStat. www.stat.gov.az

their economically important farm indicators is highly relevan

Purpose of the research. One of the main purposes of the research work is to achieve an increase in the productivity of cattle in the meat and dairy directions in Azerbaijan through industrial crossing and to study the biological and economically useful characteristics of the obtained crossbreds.

The objectives set were to study the resistance of crossbred animals to natural climatic conditions, their growth and development, to analyze body indices, to study the morphological and physiological structure of internal organs, meat yield, hematological parameters of their blood, and to study the biometric analyses of the selected variants. At the same time, the study of the economic efficiency of the research on the basis of scientific-economic experiments is also the purpose of the research work.

Objectives of the research. To study the effectiveness of inseminating dairy-type Black-and-White cows with the semen of beef-type Aberdeen-Angus sires, as well as the impact of industrial crossbreeding on the growth and development of the offspring, particularly on the meat productivity of young cattle.

To this end, the following aspects were investigated.

- Determination of the control and experimental group animals according to their age, lactation period, and health status;
- Artificial insemination of the control and experimental group animals;
- Preparation of feed rations in accordance with the physiological periods of the animals;
- Studying the growth and development of calves obtained for the purpose of studying the zootechnical and economic efficiency of insemination of animals with different production directions by the method of industrial crossing, as well as studying their effect on meat productivity and product quality;
- Determination of the feeding and nutrition characteristics by periods of experimental and control animals placed for fattening;
- Calculation of body indices of the individual groups of experimental and control animals based on body measurements;
- Study of the interior characteristics of animals of different genotypes and the morphological structure of blood;

- Study of meat productivity, fatness categories, grade composition of meat, dry matter, protein, fat and ash content of meat, caloric value, carcass weight, meat yield, fat yield, morphological composition of meat, and chemical composition of meat;

- Determination of by-products, their categories, including characterization of the hide, its weight, area, hide yield, leather yield, and physical and mechanical properties;

- Study of the economic efficiency of animals of different genotypes depending on their meat productivity;

- After solving the issues set forth, providing recommendations for production based on the most favorable results.

Research object and research methodology. The research work was carried out at the livestock farm of "Gilan Dairy Farms" LLC located in Gabala District. In order to study the biologically and economically significant traits of Aberdeen-Angus and Black-and-white crossbreds, scientific-production experiments were conducted, and control and experimental groups similar in age, live weight and other traits were selected. In each group, 15 cows belonging to the Black-and-white breed were selected.

In order to carry out the work envisaged on the subject of the research, a number of laboratory, scientific-economic and production experiments were conducted. A scheme of the research work was developed, and the indicators were studied according to this scheme.

Provisions submitted for defense:

- Study of the biological and economically useful characteristics of crossbreds obtained from highly productive cattle breeds;

- Methods of studying growth. Study of growth at different age periods;

- Effect of feeding on the growth of young animals. Study of feed expenditure for 1 kg of weight gain;

- Study of the scientific-theoretical foundations of the heterogeneity characteristics occurring during crossing;

- Effect of feeding on absolute and relative growth indicators by months;

- Evaluation of the meat productivity of the obtained crossbreds;

- Comprehensive evaluation of the raw hide product;

- Biometric analysis of the reliability of the research;
- Study of economic indicators.

Scientific novelty of the research. For the first time in Azerbaijan, insemination was carried out using cows of the Black-and-white breed of the dairy direction as dams and semen of breeding Aberdeen-Angus bulls of the meat direction. The biological and economically useful characteristics of the obtained crossbreds were evaluated based on the results of comprehensive studies.

In the research work we conducted, for the first time in the republic, insemination of Black-and-white cows with semen of Aberdeen-Angus bulls of the meat direction using the industrial crossing method was carried out, and its effect on the growth and development of the obtained crossbreds, meat productivity, and the chemical and morphological composition of meat was studied.

Theoretical significance of the work. Studying the biological characteristics of crossbreds obtained as a result of applying industrial crossbreeding in many regions of Azerbaijan is of great importance for increasing meat productivity. The analysis of crossbreeding efficiency resulting from crossbreeding on a scientific basis and these results are theoretically substantiated for the preparation of teaching aids, as well as for obtaining a number of materials.

Practical significance of the research. The Black-and-White breed has high milk productivity, but its low meat productivity makes beef production difficult. However, its high body measurement indices make crossbreeding with the Aberdeen-Angus breed theoretically and practically important for more efficient utilization and increased meat productivity.

Considering the lack of scientific research in this direction in the country, the biologically and economically important indicators of crossbred animals obtained by inseminating Black-and-White cattle with Aberdeen-Angus breeding bulls were determined. At "Gilan Dairy Farms" LLC, industrial crossbreeding of cows with decreased milk yield with Aberdeen-Angus sires was studied to obtain two-breed crossbreds with high meat productivity, growth and development, meat yield, and resistance to blood-parasitic diseases.

- Due to the crossbreeding of Black-and-White animals with

Aberdeen-Angus sires, meat productivity improves, and meat yield as well as feed utilization efficiency increase.

- The feed utilization efficiency of crossbreds was higher than that of purebred young animals.

- In terms of growth and development, the performance indicators of the crossbred young animals showed favorable results

- During the study of animal meat productivity, when industrial crossbreeding is carried out, the growth and development of the obtained individuals proceed intensively, meat productivity increases, the chemical and morphological composition of the meat improves, and meat quality yields high results.

- When animals on the farm were artificially inseminated with the semen of Black-and-White bulls, their meat productivity was lower compared to the crossbreds (Aberdeen-Angus × Black-and-White).

Experiments on young animals show that crossing different genotypes improves hematological indicators, meat productivity, the chemical and morphological composition of meat, and meat yield. Profitability was 9.29% higher in crossbreds obtained from Aberdeen-Angus bull semen than in animals obtained from Black-and-White bull semen. For increasing meat productivity, artificial insemination with semen from bulls of different genotypes is recommended.

Reliability of the scientific work. The parameters obtained from the research were comparatively analyzed across groups. A complete analysis was conducted of biometric measurements, growth and development dynamics, meat productivity at 18 months, hide raw materials, feeding, and zootechnical indicators specified in the methodology. The biometric analysis based on probability theory confirms the reliability of the research results.

Approbation of the work. 14 works related to the topic of the dissertation have been published, 10 of which are scientific articles. The results and individual provisions of the dissertation were discussed in the annual reports of the Department of "Technology of livestock and fish products production" (currently "General and Special Zootechnics") of ASAU in 2013–2019, and were published in the materials of the scientific-practical conference "Development of environmentally clean agriculture in Azerbaijan" (Ganja, 2019), the

international scientific-practical conference “Behavioral theories and practice of Russian science” (St. Petersburg, 2021), the international scientific-practical conference “Current state and development prospects of science and technologies in the era of the fourth industrial revolution” (Ganja, 2024), and the the international scientific-practical conference “Scientific achievements in veterinary medicine and animal husbandry: from theory to practice” (Yekaterinburg, 2025).

Name of the organization where the dissertation work was carried out. The dissertation work was carried out at the Department of “General and Special Zootechnics” of the faculty of Zootechnics of the Azerbaijan State Agrarian University of the Ministry of Agriculture of the Republic of Azerbaijan.

Total volume of the dissertation in characters, indicating the volume of its individual structural sections. The dissertation work consists of an introduction, four chapters, conclusions, recommendations for production, a list of 151 references used, and appendices. It contains 9 figures, 9 diagrams, 26 tables and appendices. In the structure of the dissertation, the title section and table of contents comprise 3 pages and 3,132 characters; the introduction comprises 6 pages and 10,871 characters; Chapter One comprises 43 pages and 81,577 characters; Chapter Two comprises 12 pages and 13,971 characters; Chapter Three comprises 32 pages and 43,449 characters; Chapter Four comprises 30 pages and 42,786 characters; the conclusions comprise 2 pages and 2,758 characters; the recommendations for production comprise 1 page and 491 characters; and the list of references consists of 151 titles, comprises 15 pages, and contains 22,132 characters. The total textual part of the dissertation (excluding figures, diagrams, tables and the list of references) comprises 116 pages of computer-typed text, or 185,957 characters.

CHAPTER I. LITERATURE REVIEW

In the first chapter of the dissertation work, the current state of cattle breeding in our country and in the world, development trends, and current problems of the field were extensively analyzed. In this regard, the theoretical and biological foundations of crossing, one of the main selection methods for improving the gene pool and increasing

meat productivity in cattle breeding, were reviewed. In the chapter, the morphological and physiological characteristics and economically useful traits of crossbred generations obtained as a result of the crossing process were compared based on scientific sources. Among the initial parental breeds used in the research, the adaptability and biological potential of the Black-and-white breed to local climatic conditions were analyzed in detail. In parallel, the biological characteristics and genetic capabilities of the Aberdeen-Angus breed, distinguished by high dressing percentage and meat quality, were investigated. The degree of manifestation of the hereditary traits of both breeds in crossbred generations was comparatively highlighted based on scientific literature data. In addition, the general principles of feeding, balancing of rations, and nutritional value of feeds, which are decisive factors in realizing the genetic potential of animals, were scientifically substantiated in the chapter. Finally, the biological and economic factors considered were summarized, creating the necessary scientific and theoretical basis for the experimental part of the dissertation.

CHAPTER II. MATERIAL AND METHODOLOGY OF THE RESEARCH

2.1. Brief characterization of the research object and research methodology. The research work was carried out at “Gilan Dairy Farms” LLC in Gabala District. The total area of the farm is 12 hectares. The area contains 6 barns, a milking system, silage pits, 4 enclosed feed storage facilities, 4 hay sheds, 3 calf facilities, and other auxiliary buildings. Feed crops are cultivated on an area of 2,500 hectares in order to meet the feed requirements of the animals kept on the farm.

There are a total of 2,200 head of Black-and-white cattle on the farm, of which 850 are milking cows of different lactations.

In order to study the biological and economically significant traits of Aberdeen-Angus and Black-and-white crossbreds, scientific-production experiments were conducted, and control and experimental groups similar in age, live weight, and other traits were selected. In each group, 15 cows belonging to the Black-and-white breed were selected.

During the gestation period, both groups of animals were fed in accordance with the farm's program. The animals' feed ration was provided from raw materials available on the farm.

A scheme of the research work was developed, and the indicators given in the scheme were studied.

2.2. General characteristics of the methods and approaches used during the research. When studying the growth and development indicators in the control and experimental groups, daily, absolute, and relative growth were studied by weighing the animals monthly from birth to 18 months of age. Meat breeds and their crossbreds were weighed at birth, at weaning, and at 6, 9, 12, 15, and 18 months of age, and their growth was studied.

For the purpose of studying development, height at withers, height at rump, body length, chest width, chest depth, rump width, half-girth of the back, etc. were measured. Body measurements may not provide reliable results in the correct characterization of animals. Therefore, the study of changes in body indices was determined according to the method of A.A. Aghabayli.

In order to obtain the desired growth and carcass, the feed ration was formulated in such a way as to ensure that it was economically inexpensive and that fattening produced high results within a short period. The fattening program was formulated taking into account market demand, the availability of feed supply, financial condition, environmental factors, and labor force.

Five head from each group were taken for the purpose of studying meat productivity and changes in economically significant traits related to age. During slaughter, the following indicators were determined:

1. Live weight (at separation and before slaughter);
2. Carcass weight (fresh and chilled);
3. Weight of fat (internal, subcutaneous, and intramuscular);

- carcass and fat dressing percentage (kg, %);
- weight of all internal organs (each separately);
- yield of first- and second-category by-products (kg, %);
- commodity-technological characterization of the skin and leather.

On the left carcass, the bones were separated from the muscle,

and its morphological characteristics, as well as the muscle, fat, connective, and bone tissues of the meat were determined.

Fat in the meat was determined by the S.B. Rushkovsky method, and protein by the Kjeldahl method. The caloric characteristics of the meat were determined by the combustion method.

The physicochemical composition of meat was studied using the average composition of a sample taken from the longissimus muscle, and the water-holding capacity of the muscle was studied by the Grou and Gamma methods. The methods of Grekhema and Smith were used to determine the protein quality of meat and tryptophan, and the methodology of Verbiskom and Deteridjunu was used to study its hydrolysis.

The coefficients of complete meatiness and muscularity of the carcass were determined.

The technological characterization of the raw hide product of crossbred and purebred males was studied, including hide weight (kg); hide length and width measurements (mm), hide thickness at the elbow and rib (mm), weight of the entire finished leather (kg); its area (dm^2), thickness in the neck area and under the abdomen (mm), yield (%), and heavy leather (%) indicators.

Morphological and biological analyses of the animals' blood were carried out.

- general blood analysis — using a Mindray analyzer;
- hemoglobin — using acetone anhydride;
- the number of leukocytes and erythrocytes — determined by counting in a Goryaev chamber.

Based on the results of the scientific research work, analyses of biometric indicators were carried out. Here, X — arithmetic mean, m — error of the arithmetic mean, σ — standard deviation, C_v — coefficient of variation, td — reliability criterion, and P — probability were calculated on the basis of the Student criterion.

CHAPTER III. RESEARCH RESULTS

3.1. Feeding conditions of dams and young animals according to the research groups. According to the research methodology, the cows of the control group were inseminated with the semen of Black-and-white bulls, while the experimental group was

inseminated with the semen of Aberdeen-Angus bulls.

The inseminated cows of both groups were provided with a complete and balanced ration during the embryonic period of their calves (from insemination until 60 days before birth, 60...21 days (Dry-2), 21...0 days (Dry-1, until calving)) and the post-embryonic period (21 days after birth).

The ration of the cows included corn silage, hay, barley straw, barley groats, soybean, cottonseed, corn, wheat bran, and wheat screenings. The deficit of mineral substances was compensated for by marble powder, monocalcium phosphate, and salt-containing microelements.

When the calf was born, it was fed colostrum by a tube during the first 2 hours in an amount equal to 10% of its live weight. When the young animals were fed with colostrum and normal milk until the age of 80–90 days, they had high growth characteristics.

At 3 months of age, in order for each head of young animals to reach the desired live weight, the feed contained 894 g of dry matter and 11.1 MC of energy per 1 kg of feed.

The initial period of fattening of young cattle covered 6–12 months. During this period, the animals gained 200–350 kg of live weight. High-quality roughage, namely dry alfalfa hay, was used in feeding. The ration contained 9.49 kg of feed in terms of dry matter. To meet the daily energy requirements, the ration contained 98.28 MC of energy and 1198.89 g of crude protein in terms of dry matter.

During the 12–18-month feeding and fattening period, a number of changes were made to the feed ration in order to increase the live weight of the animals in both groups to 300–550 kg. In the structure of the feed provided, concentrated feeds amounted to 7.09 kg and roughage to 4.26 kg in terms of dry matter. Taking into account daily and absolute weight gain, concentrated feed constituted 62.5% and roughage 37.5% of the ration provided.

For both groups, during the period from 6 to 12 months, 98.28 MC of energy and 1198.89 grams of protein were consumed per day. During the 12–18-month period, compared with the initial months, consumption increased to 118.23 MC of energy and 1315.6 grams of protein per day. The feeds provided were both maintenance and productive.

3.2. Growth dynamics, exterior characteristics and hematological indicators of the studied animals. In accordance with the research methodology, the weight and linear growth dynamics of male and female individuals were studied up to 18 months of age (Table 3.2.1).

If we comparatively analyze Table 3.2.1, it becomes clear that in both groups, the difference in live weight between the male and female calves at birth was 1.8–1.9 kg. Therefore, while the deviation relative to the arithmetic mean in the males of the Black-and-white breed was 1.8 kg and the coefficient of variation was equal to 5.37%, in the males of the crossbreds the deviation relative to the arithmetic mean was 1.3 kg and the coefficient of variation was equal to 3.69%.

Table 3.2.1.

Growth dynamics of young animals by live weight up to 18 months of age, kg.

Age month	Sex	Control			Experimental		
		Black-and-white			Aberdeen-Angus × Black-and-white		
		X±m	σ	Cv	X±m	σ	Cv
At birth	Male	33,6±0,9	1,8	5,37	35,2±1,2	1,3	3,69
	Female	31,7±0,7	1,1	3,47	33,4±1,1	1,2	3,59
3 month	Male	118,0±2,4	5,6	4,74	129,7±3,1	5,9	4,54
	Female	109,5±2,3	5,3	4,84	121,7±3,0	5,8	4,76
6 month	Male	188,2±4,6	6,9	3,66	213,2±4,9	7,8	3,65
	Female	176,1±4,5	6,3	3,57	193,6±5,1	7,5	3,87
9 month	Male	269,1±5,7	7,8	2,89	298,7±6,2	8,2	2,74
	Female	239,1±5,6	7,6	3,17	267,4±6,1	8,6	3,21
12 month	Male	354 ,6±5,9	7,9	2,22	383,8±6,6	8,2	2,13
	Female	312,0±5,8	7,8	2,5	348,9±6,4	8,1	2,32
15 month	Male	432,9±6,8	8,3	1,91	455.8±7,5	8,2	1,79
	Female	392,1±6,7	8,1	2,06	424,6±7,4	8,1	1,90
18 month	Male	509,4±7,9	9,4	1,84	540,4±8,1	8,3	1,53
	Female	474,7±7,4	8,3	1,74	501,8±8,0	8,2	1,63

At 3 months of age, the arithmetic mean in the males of the control group was 118.0 kg, the deviation relative to the arithmetic mean was 5.6 kg, and the coefficient of variation was 4.74%. In the 3-month-old crossbreds of the Aberdeen-Angus breed, the arithmetic mean indicator was 129.7 kg, the deviation relative to the arithmetic mean was 5.9 kg, and the coefficient of variation was 4.54%.

At 6 months of age, compared with the males in the control group, the arithmetic mean indicator of the animals in the experimental

group was 25.0 kg higher. In the young animals of the control and experimental groups, the deviation indicators relative to the arithmetic mean were 6.9 kg and 7.8 kg, respectively.

At 9 months of age, the arithmetic mean indicator of the crossbreds was also higher than that of the Black-and-white breed by 29.6 kg in males and 28.3 kg in females. At 9 months, the deviation in the males of the control group was 7.8 kg, while in the experimental group it was 8.2 kg; in females of the same age, these values were 7.6 kg and 8.6 kg, respectively. The coefficient of variation in females of the control and experimental groups was 3.17% and 3.21%, and in males it was 2.89% and 2.74%, respectively.

At 12 months of age, the arithmetic mean indicator was also higher in the crossbreds. The deviation from the arithmetic mean was 7.9 kg in the males of the Black-and-white breed and 8.2 kg in the males of the crossbreds. In females of the same age, the deviation was 7.8 kg and 8.1 kg, respectively. The coefficient of variation did not differ significantly between the groups.

At 18 months of age, while the male calves of the Black-and-white breed had a live weight of 509.4 kg, this indicator in the crossbreds was 540.4 kg, respectively. This indicator means that at 18 months of age, a 6.1% higher weight was obtained from the male crossbreds.

A comparative analysis of the weight indicators reflected in the table shows that the crossbred animals had a markedly higher live weight in both male and female individuals compared with their purebred peers.

In the studies we conducted, absolute, daily, and relative growth were calculated.

At birth, while the live weight of the male calves of the Black-and-white breed was 33.6 kg, the live weight of the males of the Aberdeen-Angus × Black-and-white crossbreds was 35.2 kg. This means an additional live weight of 1.6 kg, or 4.8%, compared with the calves of the Black-and-white breed. If an absolute gain of 84.4 kg was obtained from the Black-and-white males over a period of 3 months, this gain was 94.5 kg in the crossbreds. While the daily gain indicator in the male calves of the control group was 927 grams, the daily weight

gain in the crossbreds of the experimental group reached 1036 grams.

At 6 months of age, the live weight of the male calves of the Black-and-white breed was 188.2 kg, while this indicator in the crossbreds was 213.2 kg.

At 9 months of age, the live weight indicator of the male calves of the Black-and-white breed was 269.1 kg, while this indicator in the crossbreds was 298.7 kg. At 9 months of age, the live weight of the male crossbreds of the experimental group was 29.6 kg higher than that of the control group.

At 12 months of age, while the live weight of the males of the control group was 354.6 kg, the absolute gain indicator was 85.5 kg, and the daily gain indicator was 937 g, in the experimental group the live weight was 383.8 kg, the absolute gain was 85.1 kg, and the daily weight gain was 933 g.

At 18 months of age, the absolute, daily, and relative growth indicators of the crossbreds of the experimental group were higher than the indicators of the young animals of the control group. Thus, while the male young animals of the control group had a live weight of 509.4 kg at 18 months of age, this indicator in the crossbreds was 540.4 kg, respectively. This means that a 6.1% higher weight was obtained from the crossbreds at 18 months of age.

The presented analysis shows that in crossbred animals, during the period from birth to 18 months of age, all the main biological and economic indicators in both male and female individuals are characterized by high dynamics.

In order to study the comparative growth rate of the young animals, measurements were carried out by the linear method.

At birth and at 6, 12, and 18 months of age, the body measurements taken by the linear method differed both according to age period and in comparison between the groups. Thus, at birth, the withers height of the calves in the control group was 88.4 cm, and at 6 months this figure reached 99.5 cm. This shows that the withers height of the male calves increased by 11.1 cm over 6 months. At 12 months, the withers height increased by 8.5 cm over 6 months and reached 108 cm, while at 18 months it increased by 10 cm and was observed to be 118 cm. In the animals of the experimental group, the effect of

different genes manifested itself somewhat more strongly. Thus, in the experimental group, the withers height was 92 cm at birth, increasing by 11 cm at 6 months to 103 cm, by 11 cm at 12 months to 114 cm, and by 8 cm at 18 months to 122 cm. In the measurement of the oblique body length, an increase of 18.7 cm in the first 6 months, 12.3 cm at 12 months of age, and 12 cm at 18 months was observed in the experimental group. These indicators were higher than those of the control group by 7 cm at birth, 2.7 cm at 6 months, 7 cm at 12 months, and 10 cm at 18 months, respectively.

Based on the measurements taken, the body indices of rump slope, rump-chest, fullness, boniness, meatiness, etc. were calculated to determine and correctly evaluate the proportionality of development.

At birth, while the fullness index was 121.42% in the calves of the control group, it was 123.07% in the calves of the experimental group. At 6 months of age, it was 105.6% in the control group and 106.19% in the experimental group; at 12 months, it was 106.08% and 106.55%, respectively, in the experimental group.

During the study of body indices, the massiveness index, one of the important indices requiring study, was calculated (Diagram 3.2.1). When characterizing the indicators, while the massiveness index in the control group was 115.38% at birth, 113.56% at 6 months, and 112.96% at 12 months, in the animals of the experimental group, as a result of the effective effect of crossbreeding, the massiveness index was 121.4% at birth, 113.1% at 6 months, and 114.03% at 12 months, and was higher than that of the control group. At 18 months of age, while the massiveness index in the control group was 124.57%, this indicator was 136.88% in the crossbreds of the experimental group.

In the control group, the coefficient of standard deviation relative to the arithmetic mean was 16.25 at birth, 10.60 at 6 months, and 10.83 at 12 months, while in the experimental group it was 15.4, 13.27, and 12.0, respectively, by months.

In order to study the variability of hereditary traits, the coefficient of variation was calculated on the basis of the deviation relative to the arithmetic mean. While the massiveness index in the control group animals was 14.08 at birth, 9.33 at 6 months, and 9.58

at 12 months, changes in hereditary traits occurred in the experimental group as a result of crossbreeding. Thus, the coefficient of variation in the experimental group was 12.65 at birth, 11.73 at 6 months, and 10.52 at 12 months, and was higher than in the control group.

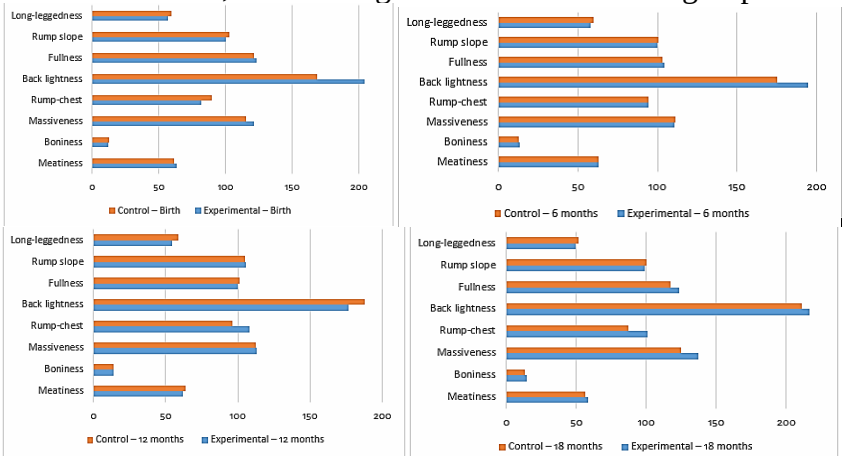


Diagram 3.2.1. Body indices of animals of different groups at different age periods.

While the long-leggedness index of the male Black-and-white animals at 18 months was 53.40%, the long-leggedness index of the crossbreds of the Aberdeen-Angus breed was 50.81%.

The fullness index is also considered an index characterizing the meatiness characteristics. This indicator was 118.54% in the control group at 18 months and 124.62% in the crossbreds. These indicators show that the fullness index was 6.08% higher in the crossbreds of the experimental group.

At 18 months of age, while the boniness index was 15.08% in the control group, this indicator was 15.57% in the experimental group. The deviation indicators relative to the arithmetic mean and the coefficients of variation did not differ significantly.

At the same age periods, while the meatiness index was 57.62% in the control group, this indicator was 59.83% in the experimental group.

In 18-month-old animals, while the rump-chest index was 88.15% in the animals of the control group, this indicator was 102.56% in the crossbreds of the experimental group. Again, the crossbreds

were superior by 14.41%.

The analysis of the results of the measurements along the overall line showed that, since the body indices of the animals of the experimental group were superior to those of the control group animals, they were inclined toward meat production.

Up to 12 months of age, the experimental group (crossbreds) was superior according to erythrocyte, leukocyte, and hemoglobin indicators. However, if we analyze the erythrocyte, leukocyte, and hemoglobin indicators of each group separately according to age, it becomes clear that, while there were 8.4 million erythrocytes per 1 mm^3 of blood in the males of the control group at birth, this was 8.25 million at 6 months of age. However, at 12 months of age, this had relatively decreased and reached 7.4 million per 1 mm^3 of blood.

It was established that the amount of erythrocytes in the blood of the crossbreds was 8.84 million per 1 mm^3 at birth, this indicator was 8.35 million at 6 months, and 7.9 million per 1 mm^3 at 12 months.

When analyzing the seasonal dependence of the formed elements of the blood in both groups, it was observed that the amount of erythrocytes and hemoglobin in the blood increased during the spring and summer months, whereas these indicators were lower during the autumn and winter months. However, while the amount of leukocytes decreased relative to both indicators during the spring and summer months, during the autumn and winter months the amount of leukocytes in the blood was higher than erythrocytes and hemoglobin.

CHAPTER IV. ANALYSIS OF THE RESEARCH RESULTS.

4.1. Quantitative and qualitative indicators of products obtained after slaughter of males of different groups. As can be seen from Table 4.1.1, carcass weight, internal fat, and slaughter weight indicators were superior in the crossbreds. Thus, at separation, the live weights of the crossbreds were 31.0 kg higher than those of the purebred animals. This means a 6.1% superiority in the crossbreds.

The carcass weight was 239.28 kg in the males of the control group, whereas this indicator was 270.82 kg in the crossbreds of the experimental group. This is an 13.2% superior carcass weight indicator compared with the control group.

While internal fat was 17.8 kg in the animals of the control group, this indicator was 19.9 kg in the crossbreds of the experimental group.

Table 4.1.1.

Meat productivity indicators.

No.	Genotype of males		Live weight, kq		Mass, kq		
			At separation, x±m	Before slaughter, x±m	Carcass , x±m	Internal fat , x±m	Slaughter weight x±m
1.	Control group		509,4±7,9	496,2±6,23	239,28±2,3	17,8±0,53	257,08±3,1
2.	Experimental group	Fact	540,4±8,1	517,3±5,5	270,82±1,7	19,9±0,32	290,72±1,9
		Relative no control group, %	106,1	104,2	113,2	111,8	113,1

The high carcass and slaughter weights are the main factors directly ensuring profitability in the slaughterhouse. This superiority proves that, morphologically, the bone-muscle ratio in the experimental group changed in favor of meatiness, that the body was more fully formed.

Each type of anatomical structure has its own quality indicators of meat. Thus, the greater quantity of meat corresponding to the first category in the carcass by groups increases its quality (Diagram 4.1.1). While the cooled carcass of the males of the control group was 233.28 kg, this indicator was 268.92 kg in the experimental group. While neck meat was 21.99 kg in Black-and-white, this indicator reached 25.19 kg in the crossbreds. Five males from each group were taken for slaughter. Here, while the deviation in carcass weight relative to the arithmetic mean was 3.42 kg in Black-and-white, this indicator was 2.77 kg in the crossbreds.

The comparison carried out according to the natural-anatomical parts proves that the experimental group surpasses the control group not only in total weight, but also in the morphological structure of the carcass.

The higher weight of valuable parts (pelvic-thigh and loin) in the experimental group is a key biological factor that directly increases both meat commercial value and farm net profit.

While the total blood in the males of the control group was 17.4 kg, i.e. 3.5% of the live weight, this indicator in the crossbred males

of the experimental group was 18.96 kg, i.e. 3.66% of the total live weight. It is clear from the results of our studies that the weight of first- and second-category by-products in the control group was 41.26 kg. This constituted 8.3% relative to the pre-slaughter live weight. In the experimental group, this indicator was 45.16 kg and was on average 3.9 kg higher than in the purebreds.

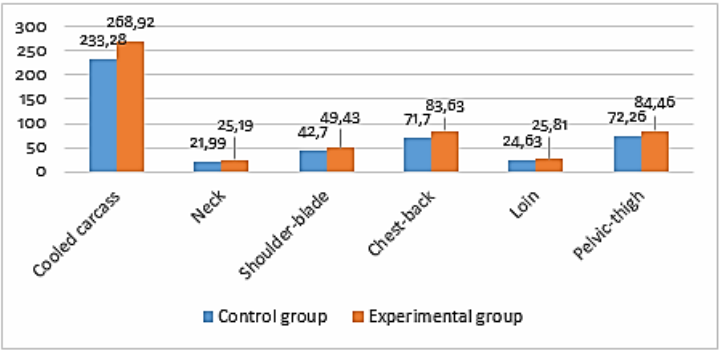


Diagram 4.1.1. Natural-anatomical parts of the carcass by groups, kg.

The weight of the organs belonging to the first category was 10.14 kg in the males of the control group, whereas this indicator reached 10.44 kg in the experimental group. The weight of the organs belonging to the second category was 31.12 kg in the control group, whereas this indicator was 34.72 kg in the experimental group.

The weight of the front legs was 4.07 kg in the control group males, and 4.54 kg in the experimental group males.

As can be seen from Table 4.1.2, when the carcass was weighed 24 hours after slaughter, it became clear that while the carcass weight of the males of the control group was 233.28 kg, this indicator was 268.92 kg in the experimental group. For both groups, the muscle part of the left carcass was separated from the bone and a comparative analysis was carried out.

Foreleg weight was 4.07 kg in control males and 4.54 kg in experimental males.

It was established that in Black-and-white, 180.8 kg of the carcass was muscle and 45.1 kg was bone. However, in the crossbreds, the muscle was 213.0 kg. This means that they had 17.8% more muscle compared with Black-and-white.

Table 4.1.2.

Morphological structure of the carcass, kg

Indicators	Groups		
	Control	Experimental	
		Fact	Relative to the control group, %
Cooled carcass weight	233,28 ± 2,3	268,92 ± 3,2	115,3
Muscle	180,8 ± 2,9	213,0 ± 3,5	117,8
Bone	45,1 ± 0,7	47,7 ± 1,05	105,8
Tendons and cartilage	6,58 ± 0,3	7,32 ± 0,3	111,2
Loss during separation	0,8 ± 0,03	0,9 ± 0,05	112,5

The study of the chemical composition of meat was carried out on the basis of the established general methodology. Thus, while total water in the muscle was 70.8% in the control group, this indicator was 69.56% in the crossbred males of the experimental group. In purebred animals, dry matter in the carcass was 29.2%, while in the crossbreds of the experimental group it was 30.44%; protein in the respective groups was 19.5% and 19.95%. There was no particularly significant difference between the groups.

The fat-to-protein ratio, which is the main quality indicator of the carcass, constitutes the basis of nutritional value. In the purebred males of the control group, the fat-to-protein ratio was 2.41, while in the male crossbreds of the experimental group it was 2.08.

Thus, the morphological and chemical composition of the carcasses of purebred animals and crossbreds being satisfactory, it indicates that the young animals of the Aberdeen-Angus x Black-and-white crossbreds (experimental group) had high meat productivity and technological indicators of meat, with a high slaughter yield.

The skin weight was 34.2 kg in the control group, while this indicator was 39.1 kg in the experimental group (Diagram 4.1.2). When calculated as yield percentage relative to the total live weight, it was established that while this indicator was 6.89% in purebred animals, it was higher in the crossbreds, reaching 7.56%. In general, when considering the qualitative and quantitative indicators of the skin, it becomes clear that the weight of each skin depends on its breed, which is its standard indicator, and on the high level of feeding.

The total skin area of the young animals of the control group was equal to 380.3 dm². However, in the crossbreds, the average skin area indicator was 425 dm². The quality indicator of the skin is characterized not only by its weight, but also by the quality of the product (leather) obtained after tanning.

While the total area of the leather was 321.0 dm² in the control group, this indicator was 380.2 dm² in the experimental group. In our study, the leather product obtained from 18-month-old young animals of the Black-and-white breed was 16.9 kg. This constituted 49.40% of the raw skin yield. However, 20.3 kg of leather was obtained from the raw skin of the crossbreds (Aberdeen-Angus x Black-and-white). This constituted 51.9% of the total raw skin.

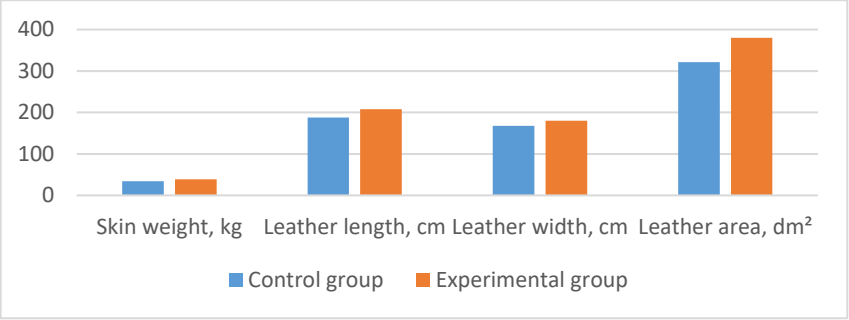


Diagram 4.1.2. Skin indicators by groups.

This superiority in the skin and leather indicators proves that the crossbreeding carried out had a positive effect not only on the animal's internal meat productivity, but also on the development of its external tissues.

It became clear from the results of our research that the expenditure incurred for the animals in both groups from birth until sale amounted to 2846.0 manats. In the control group, the income obtained from meat sales was 3849.1 manats, while in the experimental group it was 4437.2 manats. The total income included income obtained from skin and other income (head-feet, internal organs).

According to the research work, the income obtained from the sale of total products per head was 4004.1 manats in the control group and 4606.2 manats in the experimental group.

While the net income per head was 1158.1 manats in the control group (Black-and-white), it was 1760.2 manats in the crossbreds of the experimental group (Aberdeen-Angus x Black-and-white).

4.2. Economic efficiency of meat productivity

Table 4.2.1.

Economic efficiency of fattened males by different groups

No	Indicators	Groups	
		Control	Experimental
1	Expenditure incurred until sale, manats	2846	2846
2	Price of 1 kg of meat, manats	16,5	16,5
3	Carcass weight, kg	233,28	268,92
4	Income from meat sales, manats	3849,1	4437,2
5	Income from skin, manats	30,0	35
6	Other income (head-feet, internal organs)	125	134
7	Total income, manats	4004,1	4606,2
8	Net income per head, manats	1158,1	1760,2
9	Profitability level, %	28,92	38,21

According to the overall level of profitability, both groups were profitable. However, in terms of profitability expressed as a percentage, while it was 28.92% in the Black-and-white breed, this indicator was 38.21% in the crossbreds.

In order to obtain high efficiency from the crossbred animals, it is considered more efficient to slaughter males fattened for meat production within a short period (at 15–18 months of age). For this purpose, creating optimal conditions during fattening allows the genetic potential of these crossbreds to be manifested within a short period. This plays a major role in beef cattle breeding in increasing meat productivity.

RESULTS

1. Artificial insemination of Black-and-white cows with the semen of Aberdeen-angus sires using industrial crossbreeding is the main source for the development of crossbred herds that are hardy, early maturing and capable of achieving high live weight gains with low feed consumption. When intensive feeding was applied, the two-breed crossbreds achieved a 6.1% advantage in meat productivity compared with purebred animals.

2. In response to feeding and housing conditions, the effect of heterosis was observed in crossbred young animals. Compared with

the purebred Black-and-white breed, the crossbreds had higher live weight indicators. At birth, the crossbreds were 1.6 kg heavier than the purebreds. At 3 months, the crossbreds weighed 129.7 kg, which means 9.9% more than the purebreds; at 6 months, they weighed 213.2 kg, representing 13.2% more weight gain compared with the purebreds. At 9 months, the crossbreds weighed 298.7 kg compared with 269.1 kg for the purebreds; at 12 months, 383.8 kg compared with 354.6 kg; at 15 months, 455.8 kg compared with 432.9 kg; and at 18 months, 540.4 kg (+31.0 kg or 6.1%). Daily live weight gain was 927 grams in the crossbreds compared with 838 grams in the purebreds.

3. The crossbreds obtained by crossing dairy Black-and-white breeds with Aberdeen-angus sires were inclined toward the characteristics of the paternal breed in terms of exterior structure and body conformation. The crossbreds were superior to the Black-and-white breed in terms of body massiveness and fullness, chest depth, chest width and light-boned characteristics.

4. During the rearing and fattening period, the two-breed crossbreds consumed 8.3 kg of feed on a dry matter basis per 1 kg of weight gain. This was 1.5 kg less than that consumed by young animals of the Black-and-white breed.

5. Although clinical and hematological indicators in the studied groups (purebred and two-breed crossbred) varied within the physiological norm, the two-breed crossbreds were distinguished by their high adaptive capacity and tolerance to environmental conditions.

6. The pre-slaughter live weight, carcass weight and yield of the crossbreds were higher than those of the purebreds. For example, the pre-slaughter live weight of the crossbreds was 517.3 kg. This means that they had 21.1 kg more weight compared with the purebreds (496.2 kg).

7. In the control group, the weight of first- and second-category by-products was 41.26 kg. This accounted for 8.3% of the pre-slaughter live weight. In the experimental group, this indicator was 45.16 kg, which was on average 3.9 kg higher than in the purebreds.

8. During slaughter, heavier hides were obtained from the crossbreds. These hides differed from those of purebred animals in

terms of both absolute and relative yield. In the purebreds, the fresh hide weight was 34.2 kg, and its ratio to the pre-slaughter live weight (496.2 kg) was 6.89%, whereas in the two-breed crossbreds it was 7.56%, respectively. The leather yield was 51.9% in the crossbreds and 49.4% in the purebreds.

9. Crossbreeding low-producing and culled dairy cows with Aberdeen-angus sires creates conditions for increasing meat productivity on farms by 10–15%. Under intensive fattening, the profitability rate of purebred animals was 28.92%, whereas this indicator was 38.21% in the two-breed crossbreds, proving that the method is more economically advantageous.

RECOMMENDATIONS FOR PRODUCTION

1. In farms of the Republic, it is recommended to artificially inseminate low-producing dairy cows and heifers with the semen of Aberdeen-angus sires in order to form highly productive crossbred herds with minimum resource consumption, as well as to increase meat and hide production.

2. In order to reveal the genetic potential of the crossbreds and increase meat and raw hide productivity, it is recommended to apply intensive technologies and a feeding system based on a complete and balanced ration in their rearing.

List of scientific works published on the dissertation topic:

1. İbrahimova S.Z. Azərbaycan şəraitində Aberdin - anqus və Qara-ala mələzinin bioloji və təsərrüfat faydalı əlamətlərinin öyrənilməsi metodikası // AMEA Gəncə Regional Elmi Mərkəz, Xəbərlər Məcmuəsi, № 75. Gəncə: -2019, -s. 113-118.

2. İbrahimova S.Z. Məzələzlərin böyüməsinə təsir göstərən genotipik və paratipik amillər // ADAU-nun Elmi Əsərləri, № 1. Gəncə: -2019, -s. 82...85.

3. İbrahimova S.Z. Mələzlərdə xətt üzrə böyümənin öyrənilməsi // ADAU-nun Elmi Əsərləri, № 2. Gəncə: -2019, -s. 83-86.

4. İbrahimova S.Z. Sənaye çarpazlaşmanın iqtisadi səmərələliyi // Azərbaycan Aqrar Elmi, № 4. Bakı: -2019, -s.184...187.

5. Ибрагимова С.З. Мясная продуктивность быков различных генотипов // Зоотехния, № 8. Москва: -2019, -с. 23-25.

6. İbrahimova S.Z. Müxtəlif genotipli cavan erkəklərin dərisinin keyfiyyəti / "Azərbaycanda ekoloji təmiz kənd təsərrüfatının inkişafı" mövzusunda elmi-praktiki konfrans. Gəncə: -2019, -s. 147-150.

7. İbrahimova S.Z. Morfoloji quruluşun ətin keyfiyyətinə təsiri // ADAU-nun Elmi Əsərləri, № 1. Gəncə: -2020, -s. 34-38.

8. Ибрагимова С.З. Влияние сбалансированного кормления на биологические особенности помесей / «Поведенческие теории и практика российской науки». Сборник научных статей по итогам международной научно-практической конференции. Санкт-Петербург: -2021, - с. 16-19.

9. Ибрагимова С. З. Откорм животных разных генотипов // Нижневартовск: -Издательский центр "Наука и практика", -2022, -с. 228...232.

10. İbrahimova S.Z. Cavan erkəklərdə hematoloji göstəricilərə çarpazlaşdırmanın təsiri // Azərbaycan Texnologiya Universiteti Elmi xəbərlər, № 4. Gəncə: -2022, -s.92-97.

11. İbrahimova S.Z. Müxtəlif cinsli qaramal buğaların mələzlərin subməhsullarının kəmiyyət göstəriciləri // Azərbaycan Texnologiya Universiteti Elmi xəbərlər, № 1. Gəncə: -2024, -s.70-74.

12. İbrahimova S.Z. Mələz heyvanlarda ət məhsuldarlığının iqtisadi səmərəliliyi / "Dördüncü sənaye inqilabı dövründə elm və texnologiyaların mövcud vəziyyəti və inkişaf perspektivləri" mövzusunda Beynəlxalq elmi-praktik konfrans. Gəncə: -2024, -s. 133-135.

13. Ибрагимова С.З. Оценка биологических и хозяйственных свойств помесей Абердин-ангус и Черно-пестрой породы // Международный журнал Аграрной науки и образования, № 4. Москва: -2024, -с. 45-51.

14. Ибрагимова С.З. Значение скрещивания в животноводстве и его влияние на продуктивность помесей / Научные достижения в ветеринарии и животноводстве: от теории к практике. Сборник международной практической конференции в честь 95-летия Уральского от НИВИ. Екатеринбург-2025,-с.50-58

The defense will be held on "04" December 2026 at 14^{00} at the meeting of the BFD 4.01 One-Time Dissertation council under the Azerbaijan State Agrarian University.

Address: AZ 2000, 450 Atatürk Avenue, Ganja city, Republic of Azerbaijan.

Dissertation is accessible at the library of the Azerbaijan State Agrarian University.

Electronic version of the abstract is available on the official website of the Azerbaijan State Agrarian University.

The abstract was sent to the required addresses on "28" October 2026.

Signed for print: 20.10.2026
Paper format: 210 × 297 1/4
Volume: 39,300
Number of hard copies: 20