

ABSTRACT

Of the dissertation work by Ainur Orakbayeva on the topic “Development of the meat content of young Saryarka fat-tailed coarse-wooled sheep breed (intra-breed Zhanaarka type)” submitted for the degree of Doctor of Philosophy (PhD) in the educational program 8D080201 – “Technology of Production of Livestock Products”.

Relevance of the Research Topic.

Sheep breeding is a key branch of Kazakhstan’s agricultural sector, with fat-tailed meat-type sheep playing a dominant role. The country’s vast pasture resources—about 84% of the total 222.3 million ha of agricultural land—are located mainly in desert and semi-desert zones, where modern fat-tailed sheep breeding originated and developed. These conditions make fat-tailed sheep the most advantageous species for effective use of pastures compared to other livestock.

Improving sheep breeding efficiency requires rational use of the genetic potential of existing fat-tailed breeds and creation of promising populations combining high meat and wool productivity with the adaptive traits of indigenous sheep. Global experience shows that increasing industry competitiveness depends on full utilization of mutton production. Specialization in mutton production demands breeds with high meat productivity and precocity. Meat productivity is one of the main economically valuable traits determining sheep quality, which is why studying meat formation in fat-tailed sheep is of great importance.

The development and improvement of highly productive breeds and types of sheep with enhanced productive and breeding qualities is now impossible without the use of modern achievements in animal genetics. Many countries apply genetic markers to create new breeds and types. Genotype-level trait marking, in addition to classical selection methods, significantly increases the efficiency of breeding and allows achieving desired results within a few generations.

This dissertation is devoted to a comprehensive study of the formation of meat qualities in young Saryarka fat-tailed sheep (Zhanaarka intra-breed type) using traditional selection methods alongside modern DNA technologies and molecular-genetic markers associated with key economically valuable traits. The work is scientifically and practically significant.

This research was carried out within the thematic plan of the Department of Zooengineering and Biotechnology of the Kazakh National Agrarian Research University and within the projects of the Ministry of Agriculture of the Republic of Kazakhstan (state registration number 0106RKO1349) and the Ministry of Science and Higher Education (Grant AR05131896).

Research Goal and Objectives

Goal: Comprehensive study of the development of meat qualities in young Saryarka fat-tailed coarse-wool sheep (Zhanaarka type). **Objectives:**

1. Study productive qualities of the base flock;
2. Investigate growth and development patterns of skeleton and muscle tissues;
3. Evaluate meat productivity and chemical composition of meat and fat of rams of different ages;
4. Study biochemical and morphological blood parameters of sheep;
5. Perform molecular-genetic analysis of sheep blood;
6. Determine interrelationships of key breeding traits;
7. Assess economic efficiency of breeding Saryarka fat-tailed sheep.

Novelty of the Research

For the first time at the ‘Zhenis’ breeding farm a comprehensive evaluation of meat formation in Saryarka lambs was conducted; growth and development patterns of skeleton and muscle tissue were established; meat productivity and chemical composition of meat and fat of rams were evaluated. A molecular-genetic analysis of blood was performed for the first time. The allelic diversity and single-nucleotide polymorphisms were identified in seven genes: IGFBP6, ST7, DTNBP1, SCD5, KYNU, FGF12 and FTO. These results provide a basis for marker-assisted selection using DNA markers as indirect criteria.

Practical Significance

The scientific statements, conclusions and recommendations of the dissertation have been applied in the practical breeding of Saryarka fat-tailed sheep in their breeding zone. The research results enabled the creation of a large population of Saryarka sheep with high productivity and consolidated maternal heritability. At the ‘Zhenis’ breeding farm a highly productive herd of Saryarka sheep was formed with ewes averaging 63.7–66.1 kg live weight and wool yield of 2.3–2.5 kg, exceeding breed standards by 6.2–10.1%.

Research Materials and Methods

The object of study was Saryarka sheep. Productive qualities and biological features were studied by generally accepted methods, including growth dynamics from birth to 18 months, body measurements, indices, and meat productivity via control slaughter at different ages. Chemical composition and energy value of meat and fat were analyzed in specialized laboratories. Biochemical and hematological studies were performed using standard protocols and modern analyzers.

The body size clustering graph was analyzed using the PCA method (Principal Component Analysis). Blood sampling was carried out by veterinarians in special 9 mL EDTA vacuum tubes (Leuven, Belgium). The samples were transported in thermocontainers with cooling elements to the Molecular Genetic Analysis Laboratory of the “Kazakh Research Institute of Animal Husbandry and Forage Production” LLP.

DNA extraction and quality control. DNA extraction was performed using the GeneJET Genomic DNA Purification Kit (Thermo Scientific) according to the manufacturer’s instructions. The quality of the isolated DNA was assessed using a NanoDrop One spectrophotometer and a Qubit fluorometer (Thermo Scientific, USA).

For SNP genotyping, DNA concentration was standardized within the range of 50–100 ng/μL.

SNP genotyping. SNP genotyping was carried out on the Illumina iScan system using the OvineSNP50 Genotyping BeadChip, which includes 54,241 SNPs. Genotypic data were stored in map and ped formats, and quality control was performed using the PLINK 1.90 software.

GWAS analysis. Genome-wide association study (GWAS) analysis was performed in PLINK 1.90, taking into account genetic relatedness among individuals and population structure. Significant SNP markers associated with each phenotypic trait were identified based on the Ovis aries genome (Oar_v3.1) using the BioMart platform. Manhattan plots were generated using the R package (v4.4.1).

DNA was extracted with the DNA-Sorb-B kit, PCR and PCR-PDRF analyses were conducted at Ahi Evran University (Turkey). Morphological ‘signal’ traits were visually assessed for early productivity prediction. Data were processed using Microsoft Excel 2010 and biometric methods of N.A. Plokhinsky and E.A. Merkur'yeva (1977). Economic efficiency was calculated based on productivity, rearing costs, cost per quintal of gain (tenge), and profit from meat and young stock sales.

Doctoral Candidate's Contribution

Ainur Orakbayeva mastered modern scientific research methods and actively participated in all technological processes at the ‘Zhenis’ breeding farm. Under her advisor's guidance she performed laboratory studies in the laboratories of KazNARU and Ahi Evran University (Turkey). Observations, experiments, and biometric data processing were carried out independently. Together with scientific advisors, she selected research objects, mastered methodologies, developed the dissertation structure, interpreted data, prepared scientific articles, planned experiments, and analyzed research results. She was an executor of the 2018–2020 research project funded by the Ministry of Science and Higher Education of Kazakhstan (Grant AR05131896).

Key Provisions for Defense

- Zootechnical characteristics of the breeding traits of the base flock;
- Patterns of growth and development of skeleton and muscle tissue;
- Meat productivity, meat and fat quality of rams of different ages;
- Molecular-genetic analysis of sheep blood;
- Relationships among breeding traits;
- Economic efficiency of breeding.

Approbation of Research Results

The main principles of the dissertation were reviewed and discussed at the Scientific and Technical Council of the Faculty of Technology and Bioresources of the Kazakh National Agrarian Research University and at an extended meeting of the Department of Zooengineering and Biotechnology. The main results were presented at international scientific-practical conferences and included in interim and final reports of scientific research projects (0106RKO1349; 05131896).

Publications

A total of 5 scientific works have been published, including 5 based on the dissertation research. Of these, 1 article is in a SCOPUS-indexed journal (percentile 53) and 2 articles are in journals recommended by the Committee for Quality Assurance in Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan.

Volume and Structure of the Dissertation. The dissertation comprises 118 pages, includes 111 references, 16 figures, 46 tables, and 8 appendices.