

ABSTRACT

Of the dissertation work by Sansyzbayeva Bibigul on the topic *"Productive and breeding qualities of sheep of new factory lines of saryarkinsky fat tail breed (zhanaarka type) "* submitted for the degree of Doctor of Philosophy (PhD) in the specialty 6D080200 – "Technology of Livestock Production."

Relevance of the Research Topic

It is widely recognized that fat-tailed sheep possess a number of highly valuable traits acquired through centuries of natural selection and breeding. One of their most important distinguishing features, alongside their relatively high heritable endurance, adaptability, and precocity, is the presence of the fat-tail— a unique characteristic of these breeds. For the coming decades, fat-tailed sheep will remain the only viable means for the sustainable utilization of the desert and semi-desert zones of our country, and they represent one of the most profitable sectors of the agricultural industry.

Currently, domestic scientists continue their efforts to improve existing breeds and develop new, competitive types, factory lines, and flocks of sheep with high productivity. Developing methods for the efficient use of the gene pool of existing fat-tailed breeds, introducing low-cost technologies for livestock production, and identifying additional reserves for improving economic efficiency are among the most urgent tasks today. These goals can largely be achieved through the rational use of the specific combination of genetic potential of domestic fat-tailed sheep breeds of meat-tallow and coarse-wool productivity orientation, with the aim of creating promising populations that combine high meat and wool productivity with valuable adaptive traits. These traits will significantly contribute to the efficiency of fat-tailed sheep breeding, making further genetic improvement of local fat-tailed breeds a key issue in modern animal science.

As is well known, the highest form of breeding work in purebred livestock reproduction is line breeding, which plays a critical role in genetic improvement. Line breeding allows not only the use of heritable beneficial traits but also the potential for expressing tendencies toward such traits—those that may only manifest phenotypically under specific environmental (paratypic) conditions. Each line is characterized by certain unique features, which form a critical basis for the further improvement of the breed and the development of intra-breed heterosis.

Line breeding is one of the most effective methods for breed development, as it enables the propagation of valuable qualities of individual sires across thousands of animals over time. In this context, studying the variability in productive and breeding traits of two factory lines of Saryarka sheep and identifying accurate genetic markers associated with productivity and their distribution within the population provides a solid foundation for evaluating the genetic potential of animals. These findings will support the development of scientifically grounded and effective selection methods for improving the Saryarka fat-tailed breed, thus underscoring both the scientific and practical significance of this research and highlighting the relevance of the present study.

This scientific research was carried out within the framework of projects and programs supported by the Ministry of Agriculture of the Republic of Kazakhstan (MoA RK): – R&D Program 042 under the national project "Applied Scientific Research in the Agro-Industrial Complex" (2018–2020), MoA RK registration number 0116RK00359, titled *"Development of effective selection methods in livestock sectors"*; – and the Grant Funding Program of the Ministry of Education and Science of the Republic of Kazakhstan (MES RK): 2018–2020, project number 05131896, titled *"Development of modern selection methods for predicting the genotype of fat-tailed sheep breeds."*

Purpose and Objectives of the Research

Purpose:

To study the **productive and breeding qualities** of sheep from new **factory lines** of the **Saryarka fat-tailed breed** (intra-breed Zhanaarka type).

Research objectives include:

- Investigation of the productivity traits of the initial livestock population;
- Study of phenotypic and genotypic variability in young animals of different factory lines;
- Examination of the biological characteristics of sheep from different lines;
- Assessment of genetic diversity within the population;
- Determination of economic efficiency.

Justification of the Novelty of the Results

For the first time, under the conditions of the “Zhenis” pedigree farm in the Ulytau region, a comprehensive study of the productive and biological characteristics of different lines was carried out, revealing inter-line differences in the expression of key breeding traits in factory lines of the Saryarka fat-tailed breed (Zhanaarka type). For the first time, the distribution of allelic variants of the CAST and KAP6.1 genes was analyzed among animals from different lines.

This is also the first study to investigate the influence of CAST gene polymorphism on the growth rate, meat productivity, and nutritional and biological value of meat in Saryarka sheep, and the influence of the KAP6.1 gene on wool productivity. These findings expand the current knowledge base regarding the genetic factors affecting the productivity and breeding qualities of sheep.

Practical Significance

Significant intergroup differences in key breeding traits were identified between sheep of factory lines № 2030 and №2145. At 3.5 years of age, live weight and wool clip of breeding rams reached 102.3 kg and 97.5 kg, and 3.4 kg and 3.0 kg respectively. For ewes, these indicators were 65.8 kg and 60.8 kg in live weight, and 2.0 kg and 2.2 kg in wool clip, respectively.

Overall, the productivity indicators of animals from both lines exceed the elite class standard requirements, with ram live weights surpassing the standard by 8.3–13.6% and ewe weights by 9.5%.

At birth, ram lambs from line №2030 had 16.6% higher live weight than those from line №2145, and ewe lambs exceeded their counterparts by 5.5% ($P > 0.999$). At four months of age, ram lambs of line №2030 exceeded those of line №2145 by 7.7%, and ewe lambs by 14.4% ($P > 0.999$).

Slaughter data showed that at 4–4.5 months of age, lambs of line № 2030 exhibited higher meat productivity, with carcass weight and slaughter yield being 10.5% and 12.1% higher, respectively, compared to lambs of the other line.

Genetic markers were identified, and the distribution of allelic variants of the CAST gene in lambs of factory line №2030 and the KAP6.1 gene in animals of sire line №2145 was analyzed. The presence of the CAST gene in the blood of lambs from line No. 2030 explains their advantage in live weight and meat productivity compared to peers from line № 2145, while the presence of the KAP6.1_XX genotype in animals of line №2145 accounts for their superior wool productivity.

The scientific statements, conclusions, and recommendations presented in the dissertation have been widely implemented in the practical selection of Saryarka fat-tailed sheep in their breeding zone. Application of the research results has enabled the formation of a large population of Saryarka sheep characterized by high productivity and consolidated hereditary traits in breeding females.

Materials and Methods of Research

The **experimental subjects** of this study were **Saryarka fat-tailed sheep** from factory lines **No. 2030 and No. 2145**. The scientific and production experiments were conducted at the **"Zhenis" breeding farm** located in the Ulytau region.

The study of productive traits and biological characteristics of sheep from the two factory lines was carried out in accordance with **generally accepted zootechnical methods**.

Age-related changes in body weight were monitored by weighing animals at birth, at 4–4.5 months, 7 months, and 18 months. In adult rams and ewes, live weight was recorded annually in autumn, after the fattening period. Conformational traits were assessed by taking body measurements and calculating body conformation indices (according to E.Ya. Borisenko). Meat productivity in young animals was evaluated by conducting control slaughtering of ram lambs aged 4–4.5 months, with 6 heads per group. Parameters measured included pre-slaughter weight (after 24 hours of fasting), hot carcass weight excluding fat-tail, fat-tail weight, internal fat, slaughter weight, and yields of these respective components. Based on carcass deboning results (excluding the fat-tail), the morphological composition and meatiness index of the carcass were determined. The chemical composition of the muscle tissue and energy value of lamb meat at 4, 5, 7, and 12 months of age were analyzed at the Food Safety Research Institute.

Wool productivity was assessed using bonitation records and individual fleece weight accounting. Wool quality parameters were studied in the wool laboratory of the Sheep Breeding Research Center under KazAgroInnovation LLP, following the methodology of VIZH (1958) [90].

Fertility was determined by calculating the number of lambs born per 100 ewes that lambed. Survivability was assessed based on lamb mortality from birth to weaning. DNA was extracted from blood samples using the DNA-Sorb-B reagent kit, and PCR and PCR-RFLP analyses of the isolated blood serum were performed in the laboratory of Ahi Evran University (Kırşehir, Turkey). The obtained zootechnical and biochemical data were processed using Microsoft Excel 2010, and subjected to biometric analysis following the methodologies of P.F. Plokhinsky (1970), E.A. Merkureva (1977), and O.Yu. Rebrova (2002).

Doctoral Student's Contribution

Bibigul Kuatzhanyzy Sansyzybayeva mastered **modern scientific research methods** in accordance with her individual doctoral study plan. The doctoral candidate actively participated in **technological processes** at the **"Zhenis" breeding farm**, conducted **laboratory research** under the guidance of her scientific advisors in the following laboratories:

- KAZNAIU Center for Collective Use of Scientific Equipment (Kazakhstan),
- Ahi Evran University (Kırşehir, Turkey),
- Food Safety Research Institute,
- Wool Laboratory of the Sheep Breeding Research Center (LLP "Scientific and Production Center for Livestock and Veterinary Science").

All observations, experimental work, and biometric data processing were conducted independently by the doctoral student. In collaboration with scientific advisors, she also participated in the selection of research objects, mastering research methods, designing the structure of the dissertation, interpreting and preparing scientific publications, planning experiments, and analyzing results.

The doctoral candidate was also a participant in scientific research projects (2018–2020) focused on improving the Saryarka, Degeres, and Edilbay fat-tailed sheep breeds.

Key Provisions for Defense

- Study of **productive traits** of the initial livestock population;
- Growth dynamics and development of young animals from new factory lines;
- Meat productivity;
- Wool productivity;
- Biological characteristics of sheep from different lines;

- Assessment of genetic diversity;
- Phenotypic and genotypic variability, interrelationships among economically significant traits, and their association with certain morphological characteristics.

Approbation of Dissertation Results

The main principles and findings of the dissertation were reviewed and discussed at the Scientific and Technical Councils of the Faculty of Technology and Bioresources of the Kazakh National Agrarian Research University, as well as at an extended meeting of the Department of Animal Science and Biotechnology. The key results of the dissertation were presented at international scientific and practical conferences. The outcomes of the research have been incorporated into interim and final reports of scientific research projects (0106PKO1349; 05131896).

Publications

Within the framework of the dissertation, five scientific papers were published, including:

- 1 article in a journal indexed in the Scopus database (percentile – [not specified]),
- 3 articles in journals recommended by the Committee for Quality Assurance in the Field of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan,
- 1 article in the proceedings of international conferences.

Additionally, recommendations entitled “Guidelines for the Application of Modern Methods for Predicting the Genotype of Fat-Tailed Sheep Breeds” were published in co-authorship.

Volume and Structure of the Dissertation

The total volume of the dissertation comprises 112 pages. The list of references includes 99 sources. The dissertation contains 1 figures, 48 tables, and appendices.