ABSTRACT

The dissertation work of Zhassulan Otebayev titled «Meat and dairy productivity of Kushum horses in the conditions of the Baiserke Agro farm» is submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy (PhD) in the educational program 8D08201- «Technology of Livestock Production»

Relevance of the Research Topic

Productive horse breeding in Kazakhstan is a promising, developing, and highly efficient sector of animal husbandry. In terms of meat productivity, horses are in no way inferior to specialized beef cattle breeds. The slaughter yield of horses reaches 51-58%, with the carcass meat yield being up to 82%. Horse meat possesses high nutritional value due to its complete profile of essential amino acids and their favorable ratio, as well as the presence of high-quality dietary fat. Consequently, horse meat is recognized as a valuable dietary product.

Kazakhstan possesses favorable conditions for diversified livestock farming, including horse breeding, across all its regions. The availability of vast natural rangelands, which allow for year-round grazing, combined with abundant lush pasture grass, adequate access to watering points, and the absence of blood-sucking insects in the jailau, contributes to the development of productive horse breeding and the cost-effective production of livestock products.

The Kushum horse breed plays an exceptionally significant role in the qualitative transformation of range horse breeding in Kazakhstan, particularly as a meat and dairy breed. One of the most valuable qualities of the Kushum horse is its excellent adaptability to local environmental conditions. These horses are highly resilient to temperature extremes (both cold and heat), exhibit rapid weight recovery upon improvement of keeping conditions, demonstrate a strong ability to accumulate fat reserves (particularly during the autumn period), and show accelerated growth energy when grazing on favorable spring and autumn pastures. Furthermore, the mares are high-yielding in milk and demonstrate excellent maternal traits in rearing foals.

In this regard, the breeding of Kushum horses at the «Baiserke Agro» farm, utilizing purebred breeding strategies – specifically through the use of high-performing sires and dams capable of producing low-cost, environmentally friendly horse meat and kumis – is of particular relevance and scientific importance.

Objective of the Research

The objective of this research was to determine the meat productivity of young Kushum horses under scientifically grounded fattening and finishing practices, as well as to evaluate the milk yield of mares of different ages under standardized conditions of feeding, care, and management.

Research Tasks

The research tasks were as follows:

1. To develop rational methods for the mating and foaling of mares;

2. To investigate the grazing and fattening characteristics of 1.5- and 2.5-year-old horses;

3. To determine the nutritional requirements (feeding standards) for young horses during the finishing phase;

4. To determine the digestibility of the hay-concentrate diet;

5. To analyze the meat productivity of young horses following grazing and finishing;

6. To evaluate the milk productivity and chemical composition of the milk of Kushum mares;

7. To determine the economic efficiency of meat and milk production at the «Baiserke Agro» LLP.

Materials and Methods

The scientific and economic experiments were conducted from 2020 to 2023 at the «Baiserke Agro» LLP (Almaty Region) using Kushum horses. During the study, a breeding group of mares was formed, to which homogeneous and heterogeneous selection of Elite-class sires was applied. The grading, growth, and development of young horses were evaluated from 3 days to 30 months of age based on live weight, body measurements, and body constitution indices. The efficiency of grazing and winter finishing was studied using analog groups with regular monitoring of live weight dynamics (GOST 32225-2013) and ration nutritional value. The study of nutrient digestibility of hay-concentrate diets was carried out through balance trials on 18- and 30-month-old stallions. Meat quality and the marketability of horse meat were assessed via slaughter evaluation according to the methodology of the Russian Research Institute of Horse Breeding (VNIIK) and ST RK 1303-2004. The physico-chemical composition and caloric value of the meat, milk (ST RK 1005-98), and feed were determined using standard zootechnical methods (according to the VIZh guidelines). The study of the milk productivity of mares of different ages (4, 10, and 17 years old) under machine milking was conducted using the test milking method, with the gross milk yield calculated according to the formula by I.A. Saigin. The calculation of economic efficiency accounted for production costs, expenditures, revenue, and profitability. The experiments were performed in compliance with bioethical principles (European Convention, 1987; WOAH/OIE Code, 2017). The data were processed using methods of variance statistics.

Scientific Provisions to be Defended:

1. Techniques for grazing and finishing of Kushum horses in meat production;
2. Meat and milk productivity and the chemical composition of mare's milk;
3. Economic efficiency of meat and kumis production.

Scientific Novelty. For the first time under the conditions of the «Baiserke Agro» LLP, the feasibility of increasing output and producing environmentally friendly horse meat and kumis through the rational management of the horse breeding sector has been demonstrated using grazing and finishing practices.

Theoretical and Practical Significance. It has been established that short-term grazing and finishing of young horses increase meat productivity and enhance

meat quality. Regarding milk productivity, mature mares demonstrate high yields, reaching 1,746 liters over a 105-day lactation period.

The practical recommendations derived from the research results provide the industry with the most effective methods and technologies for grazing and finishing horses. In the production of kumis, it is recommended to prioritize the milking of mature mares over younger or older animals to ensure optimal productivity.

Key Research Findings Submitted for Defense:

Selection work at «Baiserke Agro» LLP encompasses all measures related to the selection and directed rearing of young Kushum horses in an environment conducive to the development of valuable traits in the progeny.

It was established that the sires and dams at the farm exceed the first-class standard of the Kushum breed in terms of body measurements and live weight. The breeding stallions averaged 158.4–161.2–189.5–21.0 cm and 542.6 kg, while the mares averaged 153.2–158.0–185.4–19.3 cm and 482.5 kg, respectively. The average measurements and live weight of 1.5- and 2.5-year-old young stock meet the requirements for Elite and First classes, indicating robust growth and development from an early age under pasture-tebenevka (grazing on snow-covered pastures) conditions.

The results of applying intra-breed homogeneous mating (pairing sires and dams with highly expressed desirable traits) versus heterogeneous mating showed that desired traits were more pronounced in the progeny of homogeneous mating. Linear body measurements of 2.5-year-old fillies from homogeneous mating exceeded those of their counterparts from heterogeneous mating in wither height by 0.4%, oblique body length by 1.2%, heart girth by 1.3%, cannon bone circumference by 2.8%, and live weight by 6.6% (26.3 kg).

To improve the body condition of horses, we implemented grazing for young stock. During spring grazing, yearlings, which exited the winter period with below-average body condition, achieved high average daily gains of 950–810 g during the first 10 days. In the subsequent 10 days, gains were 820 and 640 g, and by the 30th day, daily gains gradually decreased to 730 and 450 g. By the end of the grazing period, average daily gains were only 90–50 g. A similar pattern was observed during autumn grazing.

Autumn-winter finishing was conducted using on-farm feed resources, consisting of meadow hay, alfalfa hay, barley, and wheat bran. The nutritional value of the diet for 18-month-old stallions was 8.74 feed units and 920 g of digestible protein, while for 30-month-old animals, it was 11.78 feed units and 1,233 g of digestible protein. It should be noted that 30-month-old stallions exhibited higher nutrient digestibility compared to 18-month-old animals. The lowest digestibility in both groups was observed for fat and crude fiber. Higher digestibility coefficients were recorded for dry matter and organic matter (57.3–60.7% and 62.1–64.3%), protein (67.2–69.3%), and nitrogen-free extract (73.0–76.3%). The lowest indicator was observed for crude fiber digestibility (40.4–41.3%).

Young horses of different ages, kept under identical finishing conditions but fed diets with varying nutritional values, exhibited different growth rates. At the end of the finishing period, the live weight of 30-month-old stallions was 77.75 kg higher compared to the 18-month-old ones; however, 18-month-old stallions showed superior performance in terms of weight gain and average daily gain (15.6% and 20.1% higher). Both groups exhibited a sharp increase in gains during the first 30 days of finishing, followed by a gradual decline, with gains dropping to 102 g per day by the end of the period.

Control slaughter results after grazing and finishing showed that carcasses in both groups were graded as Category I in terms of condition. The carcass weight of 18-month-old stallions that underwent grazing and finishing was 199.7 kg and 195.2 kg, respectively, while for 30-month-old animals, it was 231.3 kg and 227.1 kg. The slaughter yield was 53.3–53.8% and 51.6–51.9%, respectively. Regarding morphological composition, 18-month-old stallions had a 2.3–2.9% higher meat yield compared to 30-month-olds, with a meat-to-bone ratio of 4.7–4.8 kg of meat per 1 kg of bone. Although 30-month-old stallions had heavier carcasses, they also had a higher bone content (19.8–20.1%). While 30-month-olds yielded more total meat (by 20.7 kg and 19.9 kg), their meat-to-bone ratio was lower (4.0–4.1 kg of meat per 1 kg of bone). Chemical analysis showed that the meat of 30-month-old stallions had lower moisture and higher fat content compared to 18-month-olds, but the latter excelled in protein content (by 5.4% and 5.0%). The caloric value of meat from 18-month-old stallions was 1,556–1,618 kcal/kg, compared to 1,942–1,989 kcal/kg for 30-month-olds.

The study of milk productivity in Kushum mares of different ages revealed that 10-year-old mares possess the highest productivity under pasture conditions (1,746 L), followed by 17-year-old (1,517 L) and 4-year-old mares (1,456 L). Over 105 days of lactation, the marketable milk yield was 727.6 L, 632.1 L, and 606.9 L, respectively. The yield of 10-year-old mares was 95.5 L (15.1%) higher than that of 17-year-olds and 120.7 L (19.9%) higher than that of 4-year-olds. The milk index (per 100 kg of live weight) was also highest for 10-year-old mares (342 kg) compared to 311 kg for 17-year-olds and 302 kg for 4-year-olds. The highest fat content in milk was found in 10-year-old mares (1.73%), followed by 17-year-olds (1.58%) and 4-year-olds (1.46%). A similar pattern was observed for protein, lactose, solids-non-fat (SNF), and total solids.

For kumis production, we used pure cultures of Lactobacillus bulgaricus and milk yeasts, which ferment lactose and possess antibiotic activity. The milk and starter culture mixture was agitated for 20 minutes and left to ripen for 1–1.5 hours. Once the acidity reached 65–70°T, the mixture was re-agitated for one hour, then poured into enamel containers and cooled to 17°C in a refrigerator. Cooling halts lactic acid fermentation and initiates alcoholic fermentation. After 24 hours, the kumis is ready for consumption.

Investigation of the milk productivity of Kushum mares of different ages and the chemical composition of their milk;

Determination of the economic efficiency of horse meat and kumis production.

Recommendations for Production:

1. To further increase horse meat production at «Baiserke Agro» LLP, it is necessary to improve the reproduction of Kushum horses by increasing their population and enhancing their genetic quality. This should be achieved through a series of organizational measures aimed at more rational management of the industry, the application of industrial finishing technologies, and the implementation of grazing on natural pastures.

2. To increase the production of horse meat and kumis, it is recommended to widely utilize Kushum horses as an improver breed and to perform crossbreeding with the low-productivity local horse populations currently present on the farm.

Publications.

The doctoral candidate's list of publications in the field of horse breeding includes two articles indexed in the Scopus database (*American Journal of Animal and Veterinary Sciences*) and one article indexed in the *Web of Science* database (*Animals*). In addition, five patents for breeding achievements have been granted.

The findings of the dissertation have been published in the scientific journals *"Research, Results"* (KazNARU) and *"Science and Education"* (Zhangir Khan WKATU), as well as in a scientific publication indexed in the international database Scopus (Elsevier) — *American Journal of Animal and Veterinary Sciences*. A total of 4 papers have been published on the research topic. This includes one article in the *American Journal of Animal and Veterinary Sciences*, which holds a CiteScore of 2.2 for 2024, with a percentile of 61 in Veterinary (miscellaneous) and a percentile of 55 in Animal Science and Zoology. Additionally, three articles were published in journals included in the list approved by the Committee for Quality Assurance in Science and Higher Education (CQASHE).

Structure and Scope of the Dissertation

The dissertation is presented on 122 pages, including appendices. The main body of the work comprises 114 pages of computer-processed text. The dissertation includes 32 tables, 28 figures, and 8 appendices. It consists of an introduction, four chapters, a conclusion, recommendations for production, a list of references, and appendices. The bibliography includes 151 items, 17 of which are in foreign languages.