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THE INFLUENCE OF BREED CHARACTERISTICS ON THE PHYSICOCHEMICAL PROPERTIES OF LAMB MEAT

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I. INTRODUCTION

The quality of sheep meat is significantly influenced by breed-specific characteristics [1], which determine its technological and nutritional properties. Additionally, factors such as feeding regimen can also affect lamb carcass and meat quality [2]. In recent years, the demand for high-quality lamb with desirable physicochemical traits has increased, both for direct consumption and for processing. Understanding how different breeds and crossbreeds affect parameters such as moisture content, water activity (a_w), and pH is essential for optimizing meat quality and ensuring food safety during storage. The physicochemical composition of meat plays a crucial role in its tenderness, juiciness, shelf life, and resistance to microbial spoilage. As consumer preferences shift toward healthier and more sustainable protein sources (e.g., lean red meats), the selection of optimal livestock breeds becomes increasingly important [3]. In parallel, the scientific community has explored ways to enhance meat quality through biochemical means—for instance, non-enzymatic browning (Maillard reaction) can influence meat color and flavor [6], and innovative approaches are being developed to derive bioactive compounds from meat by-products [7]. This study focuses on comparing the physicochemical properties of meat from Edilbay, Kazakh fine-wool, and Suffolk × Kazakh fine-wool crossbred rams. It aims to assess their suitability for further processing and long-term preservation, and to provide a basis for breed-focused strategies to improve meat quality.

II. MATERIALS AND METHODS

Lamb meat samples were obtained from Edilbay rams (control group), Kazakh fine-wool sheep, and Suffolk × Kazakh fine-wool crossbreeds. All animals were raised under identical feeding and housing conditions. Experiments were conducted at the laboratory of the Kazakh Research Institute of Food Processing and Food Industry (KazRIFPFI). Moisture content was determined using an MX-50 moisture analyzer in accordance with GOST 33319–2015 (Meat and meat products. Method for determining mass fraction of moisture). Water activity (a_w) was measured using an AquaLab 4TE dew-point water activity meter. The pH of the meat was assessed by the potentiometric method according to GOST R 51478–99. Samples were pre-homogenized using a STEGLER DG-360 homogenizer. A Testo 206 pH-meter (calibrated with pH 4.0, 7.0, and 10.0 buffer solutions) was used for the measurements. All measurements were performed in triplicate.

III. RESULTS AND DISCUSSION

To obtain high-quality lamb, slaughter was carried out at 8 months of age—a period during which the meat exhibits favorable taste and technological properties. Figure 1 shows carcasses of the different breeds: on the left is an Edilbay carcass with a pronounced fat tail (kurdyuk), while the center and right are Kazakh fine-wool and Suffolk × Kazakh fine-wool crossbred carcasses, characterized by uniform fat distribution and absence of a fat tail. These differences are attributable to breed-specific traits.

Table 1 - Comparative characteristics of the physicochemical properties of meat from Edilbay sheep, Kazakh fine-wool sheep, and their crossbreeds with Suffolk.

Meat samples	Moisture, %	Water activity a_w, (M±SD)	pH
Kazakh fine-wool	70.55 ± 0.57	0.9936 ± 0.0019	5.52 ± 0.017
Suffolk × Kazakh fine-wool crossbreed	70.94 ± 0.35	0.9949 ± 0.0015	5.36 ± 0.014
Edilbay	68.21 ± 4.64	0.9898 ± 0.0022	5.38 ± 0.02

The meat of crossbred animals (Suffolk × Kazakh fine-wool) is characterized by the most favorable technological properties, including higher moisture content and elevated water activity, which indicate its juiciness and suitability for processing. In contrast, the meat of Edilbay sheep exhibits a lower water activity level, which may contribute to increased microbiological stability during storage. The lower moisture content of Edilbay meat (68.21 ± 4.64%) and its reduced water activity (0.9898 ± 0.0022) suggest potentially better shelf-life and microbial stability for that breed's meat. This could be advantageous in extensive supply chains or traditional preservation

methods. Notably, the pH values across all breeds remained within the normal post-mortem range, with no signs of DFD (dark, firm, dry) meat or abnormal spoilage [4].

These results indicate that genetic background plays a critical role in determining meat quality traits, aligning with previous findings on the influence of genetics in lamb meat quality [5]. Crossbreeding strategies — particularly involving Suffolk genetics — can be effectively used to enhance moisture-related qualities of lamb meat. Further investigation into sensory attributes, fat composition, and shelf-life under various storage conditions is warranted to fully assess the commercial potential of these breeds.



Figure 1. Carcasses of Edilbay sheep, Kazakh fine-wool sheep, and Suffolk × Kazakh fine-wool crossbreeds

IV. CONCLUSION

Breed-specific characteristics have a measurable impact on the physicochemical properties of lamb meat. Crossbreeding (especially with the Suffolk × Kazakh fine-wool combination) contributed to favorable traits such as higher moisture retention and water activity, improving the meat's technological qualities. Meanwhile, meat from the indigenous Edilbay breed, with its lower water activity, may offer better microbiological stability during storage. Overall, our findings underscore the importance of genetic selection in optimizing meat quality parameters to meet consumer demands and processing requirements. In practice, this means producers can tailor breeding and production systems to achieve specific product attributes (e.g., tenderness, juiciness, or extended shelf life). Further studies are needed to evaluate additional quality indicators, including intramuscular fat content, sensory properties, and stability under varied storage conditions. Such research will help refine breed-based strategies for sustainable and high-quality lamb production.

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