Improving quality of meat and meat products subject to behaviors of crossbred rams

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Abstract. The paper presents the results of a study to explore the influence of different behaviors of rams bred by crossing the Prekos and the Edilbay breeds on the technological properties and quality of meat and meat products. It was found that the meat from rams of the first, strong, type of behavior has the best technological properties and got a high tasting rating – excellent quality. Meat processing has kept the brand, the best quality product “Pressed Boiled Lamb” is also produced from the meat of rams coming under a strong type of behavior.

1. Introduction
Food production primarily strives for promoting human health intrinsically intertwined with the quality of life and the well-being of the population. Today, the country is developing a market for domestic high-quality meat that meets consumer demands. Young lamb can be classified as one of the best types of meat yielded from animals. What is more, the quality of lamb can be largely due to breed differences, age, sex, feeding conditions and other factors. High-quality mutton is produced from young animals up to a year old. Then the fat is intensively accumulated in baggy deposits of young animals, thereby leading to the production of fatty lamb. Young sheep up to 6 months of age have the quickest muscle tissue growth rates. The age of lambs at slaughter determines the taste of mutton, the technology of preparation and the choice of dishes [1-4].

Lamb is also a source of raw materials, thus making a study into its technological properties particularly interesting. The main technological properties that characterize raw meat include water-holding capacity, meat cooking shrinkage and meat pH level [3, 5].

A modern consumer needs to know as to what taste advantages lamb and mutton has as a food. Therefore, the assessment of sheep meat should be multifaceted. A series of chemical and physical methods for researching product quality results in the nutrient composition and texture to be defined. However, it is impossible to assess the taste of meat based on these indicators alone [6-10]. In this regard, one of the indicators of product quality is taste tests that determine its suitability to meet human needs. The effectiveness of sensory evaluation is also influenced by tasters’ individual habits. Despite some subjectivity, this assessment is sometimes final and decisive in determining the quality of food [11-13].

With this in view, there was a task to assess the technological properties and taste of heat-treated meat and broth cooked from grown and fattened rams of different behaviors, as well as a resultant processed meat product.
2. Materials and methods
Data for biochemical studies was provided by Alikhanova’s farm, Michurinsk district, Tambov region, after slaughter of hybrid sheep exhibiting different behaviors. Sheep breeding strongly relies on the Belyaeva and Martynova method [5], which implies assessing individual behaviors of sheep in the flock, characterizing their nutritional, passive-defensive and position-finding reactions as soon as the customary feeding environment changes. Sheep, quickly adapting to a new environment come under type I of behavior, which is called strong steady, type II – strong unsteady, type III – weak (animals come to stock feeders with caution or do not do it at all if there is a human nearby).

To explore the profile and quality of meat, experimental rams were slaughtered over an 8 month period [6]. The longissimus muscle of the back of experimental rams was taken as an object of research. Data for research was selected from clinically healthy rams identical for each group of animals. Taste tests were based on the method proposed by VNIIMP on a 9-point scale [8]. The technological properties were evaluated through some conventional methods. Chilled and ripe lamb was used to study technological properties [3]. A “Pressed Boiled Lamb” item was produced from the meat of the experimental rams, according to TU 49 419 [10] in a meat-processing shop where its quality was further analyzed.

3. Results and Discussion
Water holding capacity (WHC) shows a firmly retained moisture fraction against the original mass that remains in the meat after centrifugation. An inversely proportional indicator of water-holding capacity is meat cooking shrinkage, which indicates the total weight loss of meat after cooking. A culinary-technological indicator of meat is a ratio of water-holding capacity to meat cooking shrinkage. Its highest values predetermine the highest yield and juiciness of processed meat products [3]. The indicators of meat technological properties produced from rams demonstrating different behaviors are shown in Table 1.

| Technological properties                  | Behavior pattern of experimental rams |
|------------------------------------------|---------------------------------------|
|                                          | I          | II          | III         |
| WHC, %                                   | 51.92±0.35** | 50.10±0.22* | 49.25±0.18  |
| Meat cooking shrinkage, %                | 42.05±0.33* | 42.95±0.26  | 43.44±0.22  |
| Culinary and technological indicator     | 1.23±0.03*  | 1.17±0.02   | 1.13±0.01   |
| Meat pH                                  | 5.51±0.02** | 5.64±0.03*  | 5.78±0.04   |

Note: the data is valid if P ≥ 0.95 *, P ≥ 0.99 **

The above data indicates that lamb from the 1st type rams differs in a rather high WHC that reliably exceeds the second type of their peers by 1.82% (P≥0.95) and the third – by 2.67%. The difference in this indicator between the samples from the second and third types was 0.85% in favor of the second type of behavior. In terms of meat cooking loss, there was a significant difference between the lamb from the first and third types – 1.39%. A similar trend persisted for the culinary and technological indicator.

A change in the pH value to a certain extent leads to some changes in physical and chemical parameters, which determines the technological and consumption advantages of meat. The major factor that affects the initial value of muscle pH is how active an animal was before slaughter, and the final pH value depends on the conditions of pasture feeding, where the animals were kept before slaughter [8]. The best pH value was found to be present in a sample of ram meat of the first type of behavior, which significantly exceeded the second type by 0.13 (P≥0.95) and the third type – by 0.27.

Taste results of meat after heat treatment are shown in Figures 2, 3 and Figures 1, 2.
The taste trials to evaluate the boiled meat showed that the meat of the first type of behavior was the most delicious, with the overall rating to be 8.8 points – excellent. The boiled meat of this type of ram in all the main indicators, including appearance, taste, smell, consistency and juiciness, received the maximum score.

### Table 2. Taste assessment of boiled sheep meat

| Index             | Type of behavior | Strong | Strong unsteady | Weak |
|-------------------|------------------|--------|-----------------|------|
| Appearance        | 9.0              | 8.5    | 8.2             |      |
| Colour            | 8.6              | 8.3    | 8.1             |      |
| Taste             | 8.8              | 8.4    | 8.0             |      |
| Smell             | 8.8              | 8.5    | 8.1             |      |
| Texture           | 8.8              | 8.7    | 8.1             |      |
| Juiciness         | 8.8              | 8.6    | 8.1             |      |
| Overall score     | 8.8-excellent    | 8.5-very good | 8.1-good      |      |

A sample of the 2nd type boiled meat was rated 8.5 points, which was 0.3 points lower than the first and was recognized as very good. The lowest score was given by the tasters to the 3rd type meat which averaged 8.1 (Fig. 1). Once boiled, the 3rd type meat was less juicy and tasty compared to the meat of the second and first types.

![Figure 1. Taste assessment of boiled sheep meat](image)

The taste trials to evaluate the fried meat quality indicated the superiority of the 1st type meat. Yet, unlike the boiled meat, the score for texture for fried meat was slightly lower than that for boiled meat, and, on the contrary, higher for color. The total taste score of the fried meat produced from these rams exceeded the same indicator for the meat of type 2 by 0.3 points, and of the third type by 0.6 points. In terms of taste, the fried lamb meat of type 2 of behavior occupied an intermediate position between the meat of the first and third types.

Simultaneously with the taste trials towards the cooked meat, the quality of the broth was also evaluated. To assess the sensory parameters of the broth, it was poured into glasses in an amount of at least 50 cm³ to determine its appearance, colour, smell (aroma), taste and richness (saturation with nitrogenous extractive substances). The results are presented in Table 4 and Figure 3.
### Table 3. Taste assessment of fried sheep meat

| Index             | Strong | Strong unsteady | Weak  |
|-------------------|--------|-----------------|-------|
| Appearance        | 9.0    | 8.5             | 8.3   |
| Colour            | 8.7    | 8.5             | 8.1   |
| Taste             | 8.8    | 8.5             | 8.2   |
| Smell             | 8.8    | 8.5             | 8.2   |
| Texture           | 8.7    | 8.3             | 8.0   |
| Juiciness         | 8.8    | 8.5             | 8.2   |
| Overall score     | 8.8-excellent | 8.5-very good  | 8.2-good |

![Diagram](image)

**Figure 2.** Taste assessment of fried sheep meat

### Table 4. Taste evaluation of sheep broth from different types of behavior

| Index          | Strong | Strong unsteady | Weak  |
|----------------|--------|-----------------|-------|
| Taste          | 8.9    | 8.7             | 8.3   |
| Smell          | 8.8    | 8.5             | 8.3   |
| Richness       | 9.0    | 8.8             | 8.4   |
| Appearance     | 8.8    | 8.4             | 8.3   |
| Overall score  | 8.8-excellent | 8.6-very good  | 8.3-good |
Table 4 and Figure 3 show that the meat of the 1st type animals also has the maximum indicators in taste, richness, appearance and colour of the broth. The total score of broth produced from the rams of this type exceeds the score of the third type by 0.5 points, and of the second type – by 0.2 points.

The raw material to produce a “Pressed Boiled Lamb” item was a hip cut without bones and cartilage. In the first technological phase, the raw material was salted. It was then rubbed with a curing mixture, adding 2.5 kg of table salt, 500 g of sugar, 100 g of black pepper and 1,000 g of crushed garlic to 100 kg of raw materials. Then the raw material was placed in molds, pre-lined with cellophane, pressed and sent for maturation in a room with a temperature of 2-4 °C for 12-24 hr. After that, the raw materials were pressed again. Then the product was heat-treated by boiling in water at 80 - 85 °C (water temperature at the time of immersion was 95-100 °C) at the rate of 55 minutes per 1 kg of product weight. After cooking, the molds were pressed, tipped over a tray, allowing the fat and broth to drain off, and cooled in a chamber to a temperature not exceeding 8 °C. The cooled mold was then immersed in hot water for several minutes, overturned over a table, thus allowing a finished product to fall out. The finished product was purified from frozen broth and fat.

The final production stage implies packaging and storage. The pressed lamb was wrapped in parchment, parchment imitation, cellophane or other film materials and stored at 0-8 °C for no more than 3 days from the end of the technological process, including at the manufacturing plant for no more than 24 hours. The resulting 3 specimens of the meat product “Pressed Boiled Lamb” were assessed to determine its taste quality.

The taste indicators for pressed boiled lamb made from the meat of different genotypes are shown in Figure 4.

The data indicate that the meat product “Pressed Boiled Lamb” produced from the 1st type sheep meat have the highest scores in almost all indicators. The difference in total score between the samples produced from the sheep meat of other types of behavior, namely types 2 and 3, was 0.2 points and 0.82 points, respectively, in favor of the above product.
4. Conclusion

Thus, the findings indicate that the mutton produced from the first-strong type of behavior has the best technological properties, while the meat and the meat product “Pressed Boiled Lamb” received a high tasting rating – excellent quality. Considering this, the behavioral characteristics can be recommended to be used as an additional test to improve the technological properties and taste of meat when selecting rams for fattening.

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