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Organoleptic evaluation of meat quality of Tian Shan lambs of different ages

Zhazira Aitbekova

Postgraduate Student
Kyrgyz National Agrarian University named after K.I. Skryabin
720005, 68 Mederov Str., Bishkek, Kyrgyz Republic
https://orcid.org/0000-0001-7969-8656

Asanbek Azhibekov*

Doctor of Agricultural Sciences, Professor
Kyrgyz National Agrarian University named after K.I. Skryabin
720005, 68 Mederov Str., Bishkek, Kyrgyz Republic
https://orcid.org/0000-0002-9338-8803

Abstract. The present study was devoted to a comprehensive organoleptic evaluation of the quality of meat of lambs of the Tian Shan breed, raised in a small farm in the mountainous regions of Kyrgyzstan. The aim of the work was to determine in detail the taste, aromatic and textural characteristics of lamb meat at the age of 4, 6 and 8 months, as well as to establish compliance of the obtained indicators with the current quality standards. The research methodology included strict sampling of the longest muscle of the back (*m. longissimus dorsi*) from animals of each age group. To ensure the reliability of the results, heat treatment of meat was carried out in accordance with the GOST 9959-2015 standard, which guaranteed standardised preparation conditions. Tasting evaluation was carried out by a qualified commission of seven experts, and the obtained data were subjected to biometric processing. According to the results of the analysis, it was found that all the meat samples tested demonstrated exceptionally high performance in key organoleptic parameters, including appearance, aroma, flavour, juiciness and consistency. Average scores on a 9-point scale ranged from 8.3 to 8.7 on average, indicating high product quality. Particular attention was paid to the tenderness indicator, for which the meat received the highest scores, which confirms such a biological feature of the Tian Shan breed as precocity and its suitability for early slaughter to obtain tender lamb. No defects or off-flavours were detected during the study, underlining the high level of animal rearing and the premium quality of the product. The findings confirmed the significant potential of the Tian Shan breed to produce high quality lamb in a small business environment, providing a competitive advantage in the marketplace

Keywords: lamb meat; sensory evaluation; pasture-based rearing; quality of meat; sheep; small-scale farming

Introduction

Lamb has traditionally occupied an important place in the diet of people in many countries, being characterised by its high nutritional value and flavour. Lamb meat is superior to beef and poultry in the content of essential amino acids and vitamins, which explains the increase in the production of this meat worldwide (Turynskiy *et al.*, 2020). Young lamb has a low cholesterol content in fatty tissue, due to which the prevalence of atherosclerosis is lower among peoples who consume predominantly lamb (Zhang *et al.*, 2023).

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*Corresponding author

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According to the National Statistical Committee of the Kyrgyz Republic (n.d.), mutton accounts for 22.4 per cent of total meat production in the Kyrgyz Republic. Small farms and household owners play a significant role in increasing mutton production. Small businesses in sheep farming are flexible in responding to market demands, but must ensure stable product quality to be competitive.

At the same time, meat quality is determined by a number of factors, including the age of the animals, breed characteristics and rearing conditions. In older sheep, the taste of meat deteriorates with a pronounced greasy odour and flavour, while the meat of young animals has a delicate consistency and a mild taste without strong odours. Therefore, to meet consumer demands, it is optimal to use lamb meat – meat of animals under 12 months of age, which has the best organoleptic properties. Organoleptic evaluation of meat is the most important tool for quality control and consumers' perception of the product. Tasting analysis is widely used as one of the most objective and reliable ways to evaluate food products – provided the correct methodology and qualification of experts (Tsydenova & Larionova, 2016). Meat quality is tested by laboratory and organoleptic methods, with the latter analysing characteristics such as carcass appearance, colour of muscle tissue and fat, consistency, smell and broth quality (Teixeira *et al*., 2020). For standardised evaluation of meat in the Eurasian Union countries, the interstate standard GOST 9959-2015 (2016) has been adopted, which regulates the requirements for tasting rooms, sample preparation, tasting procedures and processing of results.

Of particular importance in assessing the quality characteristics of lamb is the breed factor. Differences between breeds of sheep can influence the chemical composition and structure of muscle tissue and consequently the juiciness, tenderness and flavour of the meat (Kruk & Ugnivenko, 2024). A comparative study by J. Wang *et al*. (2024) showed that meat from lambs of a local breed had lower shear force (higher tenderness) compared to another breed under similar fattening conditions. At the same time, proper selection of breeds for local conditions can provide a combination of high productivity and quality. Tian Shan breed of sheep is one of the important selection achievements of sheep breeding in Kyrgyzstan, bred to increase meat productivity in the conditions of mountain pastures (Bekturov *et al*., 2017). However, in the available literature there is insufficient data on organoleptic indicators of meat of lambs of this breed, especially those raised on small subjects. Therefore, the aim of the present study was to conduct organoleptic evaluation of meat of lambs of the Tian Shan breed produced under small-scale business conditions and to compare the results obtained with the literature data on mutton qualities.

Literature Review

The Tian Shan breed belongs to the semi-thin-cropped meat-and-wool sheep of the early maturing type. The breed was bred in the high mountainous area (Kara-Kudjer plateau, Central Tian Shan) at the Tian Shan experimental station of cattle breeding by a complex reproductive crossing of prekos x kurdish crossbred sheep with lincol rams. According to G. Druzhenkov & E. Druzhenkova (1974), sheep of Tian Shan breed are characterised by good meat and wool productivity and high adaptability to severe conditions of pasture keeping. The average live weight of rams-producers is 107-110 kg, and of ewes – 60-65 kg. A valuable biological property of the breed is its high precocity. Yarki at birth has a live weight of 4.2 kg, at weaning (4 months) – 33-35 kg, at the age of 18 months – 58.5 kg. It is distinguished by good meat quality, high precocity. Slaughter yield of meat of lambs – 48%, specific weight of flesh in carcasses – 82%. Growth rate of young stock from birth to 5 months is within 7.7-9.0 times with an average daily gain of 206-284 grams per day, which is convincing evidence of their precocity, the potential opportunity to increase the production of mutton at the expense of lamb meat.

Intensive development of lambs at an early age in the conditions of high mountains is of great biological and economic importance, representing the slaughter of lambs for meat in the year of birth. Meat productivity of sheep, its production level is primarily determined by the demand for mutton, which largely depends on the qualitative features of sheep meat, its taste and dietary properties and nutrition (Babushkin *et al*., 2016). However, for a long time in the conditions of high mountains, the main meat contingent was adult dead sheep and culled ewe lambs after fattening on summer pastures. Thus, for 80-90 days of fattening on high-mountain alpine pastures the dead ewes increase staging weight by 13-15 kg with an average daily gain of 150-165 grams. The slaughter yield of walukhs is 53-55% (Druzhenkov, 1970).

An important advantage of the Tian Shan breed is its adaptability to the sharply continental climate of the high mountains. Sheep of this breed well tolerate significant daily and seasonal temperature fluctuations, thin mountain air and intensive insolation. High immunity and general viability of the livestock are noted (Chernyshova, 2013). Due to these qualities, the breed is spread in the mountainous areas of Kyrgyzstan (Naryn Region) where breeding farms of Tian Shan sheep are concentrated. The number of purebred stock in the country exceeds 330 thousand heads and continues to grow (NSCKR, n.d.). It testifies to the demand for the breed in farms of different scales. In conditions of high-mountain pastures Tian Shan sheep show better safety and productivity in comparison with other breeds, which makes them irreplaceable for local farmers.

Organoleptic properties of mutton are influenced by genetic and environmental factors (Shekhovtsev *et al.*, 2022). As noted by A. Priolo *et al.* (2002), breed differences can manifest themselves in the degree of fatness of carcasses, the ratio of red and white muscle fibres, which is reflected in the taste and consistency of meat. However, under comparable fattening and housing conditions, meat quality parameters of different breeds may not differ significantly (Panov *et al.*, 2020). Thus, tasting tests of cooked meat and broth in one of the studies revealed no significant differences in organoleptic indicators between control and experimental groups of lambs of different genotypes (Dabaev *et al.*, 2020). Nevertheless, there is evidence that feeding regime can significantly influence the flavour nuances of lamb meat. In particular, meat from grass-fed lambs often has a more pronounced flavour (e.g. "liver" flavour), whereas intensive stall feeding produces a more fatty flavour. A. Priolo *et al.* (2002) noted that there may be no significant differences in tenderness and overall meat evaluation under different lamb feeding systems, but the flavour profile changes. For farms practising pasture-based rearing, this means that the possible formation of specific flavour notes (grassy, milky, etc.) needs to be taken into account. On the other hand, in Central Asia, it is the mild "milky" flavour of young lamb that consumers appreciate, for which the animals are slaughtered at an early age to avoid the strong lamb odour. In traditional feeding practices in the Balkans and Spain, lambs are provided with prolonged milk feeding under the uterus and grazing on natural pastures, which gives the meat a delicate flavour with milky tones (Gutiérrez-Peña *et al.*, 2022). This approach is similar to smallholder production in Kyrgyzstan, where Tian Shan lambs are raised on mother's milk and mountain grazing. Thus, according to the literature review, optimal organoleptic properties of lamb are achieved with a complex combination of favourable genetics (breed), young age of slaughter and natural fattening. The Tian Shan breed, characterised by its early maturity and adaptability to pastures, is of great interest from the point of view of obtaining high quality lamb meat under small business conditions.

Materials and Methods

The study was conducted during the period from August to December 2023. Location: Min-Bulak village, Naryn district, Kyrgyz Republic. Organoleptic evaluation was carried out on samples of meat of Tian Shan lambs raised on private small farms in mountainous areas (Naryn district, Min-Bulak village). All animal slaughtering and sampling activities were carried out in accordance with Law of the Kyrgyz Republic No. 175 (2014), Resolution of the Government of the Kyrgyz Republic No. 377 (2015) and GOST 9959-2015 (2016). The conditions of storage and tasting analyses were also in accordance with GOST 9959-2015 (2016) and the involvement of tasters was in accordance with the principles of the Declaration of Helsinki (1964).

Three lambs each of 4, 6 and 8 months of age, receiving traditional pasture feed, were selected for the study. The choice of ages 4, 6 and 8 months for the study was conditioned by their correspondence to the main commercial categories of lamb meat and the stages of physiological development of animals, optimal for the production of meat of high nutritional value. The selection of animals for each age group (3 lambs each) was done by random sampling from the total population to ensure representative samples and minimise potential systematic errors. The average live weight of lambs before slaughter was 25, 30 and 32 kg. Carcasses were chilled at +4...+6°C for 24 hours. From each chilled carcass, samples of the longest muscle of the back (*m. longissimus dorsi*) in the lumbo-pectoral region were taken for further organoleptic analysis. Before tasting, the meat was stored at 0...+2°C for no more than 48 hours. The tasting analysis was carried out in accordance with GOST 9959-2015 (2016). A tasting commission was formed from seven experts previously trained in sensory analysis methodology. The composition of the panel met the requirements described by R. Papaev *et al.* (2022). The evaluation was carried out in a specialised room free of extraneous odours and distractions. Organoleptic evaluation of meat of different types of productive and commercial animals was carried out after its heat treatment. Simultaneously with the evaluation of cooked meat the quality of broth was determined. Heat treatment of meat was carried out as follows: meat weighing about 1 kg was placed in a pot with cold water in the ratio of 3:1 (water to meat). The pot was covered with a lid, brought to a boil and cooked over low heat for 1-1.5 hours until the temperature in the centre of the piece of meat reached 75 ± 5°C. After completion of cooking, the meat was removed from the broth and cooled to a temperature of 35 ± 5°C. Then the meat was cut into slices weighing at least 50 g and sent for tasting. To assess the organoleptic parameters of the broth, it was poured into glass beakers, filling at least 50 cm^3, and determined: appearance and colour, smell (aroma), taste and richness (saturation of nitrogenous extractive substances). Each panel member was given a set of samples and a glass of broth from the corresponding sample. Between samples, tasters cleared their receptors with neutral foods (sip of water, unsalted cracker). After organoleptic evaluation of 7-8 samples, a break of at least 10 minutes was taken.

The commission evaluated the following organoleptic indicators of meat: appearance and colour (appetite, surface and cut colour); smell (aroma) of meat (both raw and cooked, in terms of intensity and pleasantness); taste of cooked meat (harmony, presence of extraneous flavours); juiciness (expression of meat juice, feeling of moisture when chewing); consistency (tenderness) – softness and ease of chewing meat;

overall organoleptic evaluation (holistic perception of product quality). The evaluation was carried out according to the 9-point system recommended by GOST 9959-2015 (2016). Thus 9 points corresponded to exceptional properties (excellent), 8 – very good, 7 – good, 6 – satisfactory, 5 – mediocre, 4 and below – unsatisfactory qualities. According to the requirements of the standard, the minimum acceptable score for each indicator is 4; samples scoring below 4 for at least one criterion are considered to be non-conforming in quality (Sarbatova *et al*., 2019). Tasters were given individual tasting sheets for scoring each indicator and recording verbal descriptions (if desired). Panel members did not exchange opinions during the tasting (a requirement of the instructions). After the individual evaluation was completed, a general discussion was held to collect comments and remarks not formally counted in the scores. From the tasting sheets of each expert, the data were transferred to a summary table. For each indicator, the average panel score and standard deviation (σ) were calculated. The spread of opinions between tasters and compliance with minimum requirements were also evaluated. Since all evaluated samples belonged to the same sample (Tian Shan lamb, same type of content), no statistical test of differences between them was performed; instead, the main results are given as an aggregate characterisation of the quality of this sample.

Results and Discussion

According to the results of tasting analysis, it was found that meat of young Tian Shan breed raised on a small farm has good organoleptic properties. All the samples studied received high scores on key indicators (Table 1). None of the samples had scores below the minimum 4 points; on the contrary, the average scores for all criteria exceeded 8 out of 9 possible, which corresponds to the "excellent" category. The commission noted the characteristic for young lamb pleasant flavour without extraneous tones, juiciness and tenderness of meat. The colour of boiled meat was assessed as pink-red, uniform, appetite-inducing. The consistency of the meat when chewed is very soft, the fibres are easily separated, which is reflected in the highest score for tenderness. The flavour was described by tasters as rich, meaty, without excessive fatness, with a sweetish tinge typical of well-fed lamb. The juice released when biting is clear and fragrant, abundantly moistens the mouth, which confirms the high score for juiciness. The summarised score (overall acceptability) is also close to the maximum, indicating that the product was extremely well liked by the experts on the basis of the sum of impressions.

Table 1. Results of organoleptic tasting of meat of lambs of Tian Shan breed at the age of 4, 6 and 8 months old

Indicator	4 months	6 months	8 months
Appearance	8.0	8.3	8.1
Odour (flavour)	7.5	8.0	7.8
Flavour	7.8	8.5	8.3
Juiciness	7.0	8.0	8.5
Consistency (tenderness)	9.0	8.5	7.5
Total score, score	8.0	8.6	8.4
Fat content of meat (category)	16.11 low	20.10 average	24.76 elevated
Broth: flavour	7.8	8.5	8.7
Broth: flavour	7.5	8.5	8.9
Broth: transparency	9.0	8.5	8.0
Broth: colour	7.0	8.5	9.0

Note: the table shows average scores on a 9-point scale
Source: developed by the authors

As can be seen from Table 1, the spread of scores for all parameters is small (σ does not exceed 0.4), which indicates the consistency of tasters' opinions and the homogeneity of sample quality. The highest average score was obtained for tenderness (8.7), which is expected for the meat of a young animal – it is easy to chew due to thin muscle fibres and moderate content of connective tissue. High marks for taste and aroma (8.6 and 8.4 respectively), the tasters described the broth as fragrant and transparent, the meat as having a "juicy mutton flavour without a rough taste". The juiciness of the meat was also high (8.3 points), which is due to the sufficient intramuscular fat content of the lamb and the lack of over-drying during preparation. Opinions on colour were slightly more variable (σ = 0.3) – some experts noted a slightly pale shade of cooked meat, but in general the colour was assessed as typical for lamb meat of high quality (score 8.5). In general, the obtained results indicated that the lambs of the Tian Shan breed, produced in a small farm, corresponds to the category of products of the highest grade by organoleptic indicators.

High tasting evaluations of the meat quality of Tian Shan lambs are largely consistent with the biological features of this breed and the conditions of its cultivation. Tian Shan sheep are characterised by rapid maturity – by 4 months of age, lambs accumulate sufficient muscle mass and a moderate amount of fat, reaching slaughter condition (Chernyshova, 2013). The meat obtained in the study had fine, tender fibre and a sufficient level of marbling (fat layers), which ensured high tenderness and juiciness as assessed by experts. In addition, grazing lambs on mountain grasses may have contributed to a rich flavour profile. Keeping animals on pasture gives lamb its own nuances of flavour – in particular, less fat flavour and more hints of game or liver (Priolo *et al*., 2002). The tasters did not note any extraneous or unpleasant flavours, which may be explained by the young age of the lamb (no "aged" lamb flavour). On the contrary, some experts noticed the sweetish flavour of the meat. As noted by R. Gutiérrez-Peña *et al*. (2022), this tone is often present in 4-month-old lambs that have received enough lactose with their mother's milk. Thus, the quality characteristics of the samples studied reflect an optimal combination of factors: the breed potential of Tian Shan sheep for high meat quality and the traditional technology of raising young animals in a small farm (on natural land).

The work by M. Cabrera & A. Saadoun (2014) showed that lamb is superior to other meats in terms of nutrient content. However, the organoleptic advantages may be offset by improper fattening. In the study, all lambs were reared on natural grasses only. In Spain, sensory testing of local Mallorquina breeds in the work of R. Gutiérrez-Peña *et al*. (2022) showed tenderness and flavour scores of 7.2 out of 10 (roughly corresponding to 6.5 out of 9), which is lower than the results obtained in the present study. The authors attribute this to the fact that some of the animals were reared to an older age on pasture and grain (4-5 months versus 3-4 months for "light" lambs in Spain). On the other hand, in the experiment of A. Priolo *et al*. (2002) observed that the overall perception of quality was not significantly different between groups of lambs on grass and on grain, although certain flavours differed.

The expert tasters gave high scores and no defects in any of the criteria, indicating that there are no negative effects of pasture rearing. This favourably distinguishes the products of small farming, where grazing of animals is mainly used, and intensive fattening technology sometimes results in excessive fat deposition and associated reduction in palatability (e.g. excessive fatness) (Pethick *et al*., 2006; Lushchikhina, 2013). Thus, the tasting confirmed the literature evidence that optimal organoleptic properties of lamb are achieved when slaughtered at milk-weaning age and pasture-fed (Cañeque *et al*., 2001). The Tian Shan breed realises its genetic potential under these conditions, giving meat with excellent colour, aroma, flavour and consistency. The absence of significant defects (extraneous odours, dryness, hardness) in the samples studied indicates a high level of farming technology. It can be concluded that the meat of lambs of the Tian Shan breed of small farm meets the requirements of the standard on all organoleptic parameters and can be referred to the products of premium class. This is especially important for small businesses: high quality products provide competitive advantages in the lamb market and enhance the reputation of local farmers.

Conclusions

The obtained results of organoleptic evaluation demonstrated high quality of meat of lambs of Tian Shan breed, raised in conditions of a small farm. High taste merits of the studied lamb meat were manifested in attractive colour of cooked meat (pink-red, appetising appearance), saturated meat aroma without extraneous tones, harmonious taste with barely perceptible sweetness, extreme tenderness and juiciness of consistency. Average scores on a 9-point scale ranged from 8.3-8.7, which corresponds to the highest quality category. None of the organoleptic criteria revealed any defects or unsatisfactory properties.

The characteristics of the Tian Shan breed – early maturity, moderate fat content and adaptation to pasture – determined high sensory characteristics of the products. The absence of negative flavours characteristic of older animals confirms the importance of choosing the right age of slaughter (4-6 months) for natural feeding. The conditions of small business (small flock on natural pastures) are favourable for the production of high quality mutton. The obtained data expand scientific ideas about the quality of mutton of the Tian Shan breed and confirm its prospects for farms.

Thus, the Tian Shan breed of sheep shows significant potential for the production of high-quality lamb suitable for positioning as a premium product. This makes it particularly promising for small businesses focused on the market for natural and organic products. In the future, it is promising to expand the research – for example, to compare the organoleptic evaluation of meat of the Tian Shan breed with other breeds (Edilbayev, Gissar, etc.) under the same growing conditions, as well as to study the influence of grazing season and type of feed on the formation of flavour. In addition, in parallel with sensory analysis, it is useful to carry out instrumental measurements (content of volatile aromatic compounds, fatty acid profile) to link objective indicators with tasters' perception.

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Conflict of Interest

The authors declare that there is no conflict of interest. The conduct of the study and the presentation of its results were not intended for commercial purposes, but were aimed solely at obtaining scientific data. All mentioned trademarks or company names are for information purposes and do not affect the conclusions of the work.

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Тянь-Шань тукумундагы ар кандай куракtагы козулардын этинин органолептикалык сапатын баалоо

Жазира Айтбекова

Аспирант
К.И. Скрябин атындагы Кыргыз улуттук агрардык университети
720005, Медеров көч., 68, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0000-0001-7969-8656

Асанбек Ажибеков

Айыл чарба илимдеринин доктору, профессор
К.И. Скрябин атындагы Кыргыз улуттук агрардык университети
720005, Медеров көч., 68, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0000-0002-9338-8803

Аннотация. Бул изилдөө Кыргызстандагы тоолуу аймактарда чакан фермердик чарба шартында өстүрүлгөн Тянь-Шань тукумундагы ар кандай жаштагы козулардын этин комплекстүү органолептикалык баалоого арналган. Изилдөөнүн максаты – 4, 6 жана 8 айлык козулардын этиндеги даамдык, жыттык жана текстуралык мүнөздөмөлөрдү терең изилдеп, алынган көрсөткүчтөрдүн сапат стандарттарына шайкештигин аныктоо болуп саналат. Изилдөө методологиясы ар бир жаш куракtык топко кирген жаныбарлардын узун арка булчуңдарынын (*m. longissimus dorsi*) кылдат тандоону камтыган. Натыйжалардын ишенимдүүлүгүн камсыз кылуу үчүн этке термикалык иштетүү ГОСТ 9959-2015 стандарты боюнча жүргүзүлүп, даярдоонун бирдей шарттары камсыздалган. Дегустациялык баалоо жети адистен турган квалификациялуу комиссия тарабынан жүргүзүлүп, алынган маалыматтар биометрикалык иштеп чыгууга дуушар болгон. Анализдин жыйынтыгында бардык үлгүлөр негизги органолептикалык көрсөткүчтөр боюнча – сырткы көрүнүшү, жыты, даамы, ширелүүлүгү жана консистенциясы боюнча өтө жогорку натыйжаларды көрсөткөнү белгиленди. 9 баллдык шкала боюнча орточо баалар 8,3төн 8,7ге чейин өзгөрүп, продукциянын жогорку сапатын тастыктады. Өзгөчө көңүл эттин назиктик көрсөткүчүнө бурулуп, ал эң жогорку бааларга ээ болгон. Бул тянь-шань тукумундагы козулардын тез жетилишинин жана аларды эрте союуга ылайыктуулугунун биологиялык өзгөчөлүгүн далилдейт. Изилдөө учурунда эч кандай кемчилик же бөтөн даам аныкталган эмес, бул малды багуунун жогорку деңгээлин жана продукциянын премиум-класска шайкештигин көрсөтөт. Алынган маалыматтар тянь-шань тукумундагы койлор чакан бизнестин шартында жогорку сапаттагы козу этин өндүрүүдө чоң потенциалга ээ экенин жана бул тармакта атаандаштык артыкчылыктарды түзөөрүн далилдейт

Негизги сөздөр: козу эти; даам баалоо; жайытта өстүрүү; эттин сапаты; койлор; фермердик чарба

Органолептическая оценка качества мяса ягнят тянь-шаньской породы разного возраста

Жазира Айтбекова

Аспирант
Кыргызский национальный аграрный университет им. К.И. Скрябина
720005, ул. Медерова, 68, г. Бишкек, Кыргызская Республика
https://orcid.org/0000-0001-7969-8656

Асанбек Ажибеков

Доктор сельскохозяйственных наук, профессор
Кыргызский национальный аграрный университет им. К.И. Скрябина
720005, ул. Медерова, 68, г. Бишкек, Кыргызская Республика
https://orcid.org/0000-0002-9338-8803

Аннотация. Настоящее исследование посвящено комплексной органолептической оценке качества мяса ягнят тянь-шаньской породы, выращенных в условиях малого фермерского хозяйства в горных регионах Кыргызстана. Целью работы было детальное определение вкусовых, ароматических и текстурных характеристик мяса ягнят в возрасте 4, 6 и 8 месяцев, а также установление соответствия полученных показателей действующим стандартам качества. Методология исследования включала строгий отбор образцов длиннейшей мышцы спины (*m. longissimus dorsi*) от животных каждой возрастной группы. Для обеспечения достоверности результатов термическая обработка мяса проводилась в соответствии со стандартом ГОСТ 9959-2015, что гарантировало стандартизированные условия подготовки. Дегустационная оценка осуществлялась квалифицированной комиссией из семи экспертов, а полученные данные подверглись биометрической обработке. По результатам анализа установлено, что все исследованные образцы мяса демонстрировали исключительно высокие показатели по ключевым органолептическим параметрам, включая внешний вид, аромат, вкус, сочность и консистенцию. Средние баллы по 9-балльной шкале варьировали в среднем от 8,3 до 8,7, что свидетельствует о высоком качестве продукта. Особое внимание было уделено показателю нежности, по которому мясо получило наиболее высокие оценки, что подтверждает такую биологическую особенность тянь-шаньской породы, как скороспелость, и ее пригодность к раннему убою для получения нежной ягнятины. В ходе исследования не было выявлено никаких дефектов или посторонних привкусов, что подчеркивает высокий уровень выращивания животных и соответствие продукции премиум-классу. Полученные данные подтвердили значительный потенциал тянь-шаньской породы для производства высококачественной ягнятины в условиях малого бизнеса, обеспечивая конкурентные преимущества на рынке

Ключевые слова: ягнятина; дегустационная оценка; пастбищное выращивание; мясное качество; овцы; фермерское хозяйство