potravinárstvo®
Slovak Journal of Food Sciences

**Received:** 18.5.2022
**Revised:** 9.6.2022
**Accepted:** 21.6.2022
**Published:** 10.7.2022

*Potravinarstvo Slovak Journal of Food Sciences*
**vol. 16, 2022, p. 398-410**
**https://doi.org/10.5219/1763**
**ISSN: 1337-0960 online**
**www.potravinarstvo.com**


# The potential of goat meat as a nutrition source for schoolchildren

*Gulzhan Tokysheva, Kadyrzhan Makangali, Yasin Uzakov, Mukhtarbek Kakimov, Natalya Vostrikova, Meruert Baiysbayeva, Nurbibi Mashanova*

## ABSTRACT

The issue of rational nutrition of children is still extremely relevant and an effective factor in ensuring the preservation of the life and health of children. Pathological conditions associated with intolerance to certain components of food are increasingly common. Biologically complete products play an important role in the organization of rational nutrition of children, which can be created only in industrial production conditions. When assessing the chemical composition of experimental goat meat samples (Zaanenskaya, Alpine, Nubian), no abnormal deviations were detected, and all indicators were in the generally accepted contents of this type of animal muscle tissue. The mineral composition showed that goat meat is rich in such elements as potassium – 1693.22 – 4125.83 mg/kg; sodium – 852.27 – 1518 mg/kg, magnesium – 125.33 – 295.8 mg/kg; calcium – 79.27 – 160.79 mg/kg, iron 11.42-87.52 mg/kg. The vitamin composition of goat meat showed that the content of pantothenic acid (B5) was 0.53 – 0.62 mg / 100g, pyridoxine (B6) 0.52 – 0.64 mg/100g tocopherol 0.27 – 0.33 mg/100g. The mass fraction of goat meat proteins was 2.1 ±0.3 – 2.4 ±0.4%. The study of the dynamics of changes in the composition of protein fractions based on the results of comparative studies of the ratio of sarcoplasmic proteins showed the content of water-soluble (1.75 – 4.06%), salt-soluble (1.75 – 2.44%), alkali-soluble (11.15 – 15.10%) proteins. The salt-soluble fraction reflects the total changes in the state of protein fractions, the solubility of which was not the same for the rocks under consideration (the highest concentration was determined in the Nubian rock).

**Keywords:** goat meat, nutritional value, nutrition of schoolchildren, fractional composition of proteins, moisture binding ability

## INTRODUCTION

Meat and meat products are important nutrients for the human body. At the moment , the following types of meat are widely in demand in the republic of Kazakhstan: beef, horse meat, lamb, poultry. In recent years, the volume of meat and livestock produced has shown steady growth. Thus, it shows an increase in demand and stable growth of the meat and meat products market. Currently, in the republic of Kazakhstan, as of 2021, the indicator of the number of goats is 3 million 93 thousand heads. In 2021, more than 8 thousand tons of goat meat were sold for slaughter. It should be noted that Kazakhstan shows a leading position in the export of lamb and goat meat outside the EU countries, which is 91.9%. In particular, supplies to the EU for $ 3.4 million, to Uzbekistan for $ 1.6 million are provided, exports to Iran amounted to 112 thousand us dollars. Considering that from 2003 to the present, the development of goat breeding has almost doubled, as well as the growing interest of consumers primarily in healthy and proper nutrition, favourable conditions are emerging for the development of this market segment. With an annual increase in the number of goats in the country amounting to 7.1%, by 2050, the number will reach 6 million 278 thousand goats. With the increase in livestock, it is expected to achieve the production of goat meat of 17.1 thousand tons **[1]**.

Goat meat belongs to non-traditional raw materials. Currently, goat meat does not have a wide range of consumers in the Republic of Kazakhstan. However, active scientific research on using this type of raw meat in the industry is already underway in the world and has great prospects in the domestic market **[2]**, **[3]**, **[4]**, **[5]**, **[6]**, **[7]**, **[8]**. Regarding taste, goat meat is not inferior to mutton **[9]**. Goat meat has a moderately pronounced salty taste and is not sweet, like beef **[10]**. Young goat meat is lighter than other types of meat, and it has a pale pink color. The meat of old animals is brick-red and darkens in the air **[11]**. Goat fat is pure white **[9]**.

**Table 1** Nutritional value of different types of meat (per 100 g) **[12]**.

| Indicator | Goat Meat | Chicken | Beef | Lamb |
|---|---|---|---|---|
| Energy value, kcal | 143 | 190 | 210 | 206 |
| Proteins, g | 27 | 25 | 27 | 26 |
| Fats, g | 3.1 | 7.4 | 9.3 | 9.5 |
| Saturated fats, g | 0.9 | 2.0 | 3.5 | 3.5 |
| Cholesterol, mg | 75 | 89 | 86 | 92 |

The meat of goats aged 4-6 weeks, young animals and castrated goats are eaten. The meat of young animals aged six to ten months is considered the best. The meat of adult goats is sharper **[12]**. Nevertheless, the manual of the XIV century on home economics, "Le Ménagier de Paris" states that the best, sweet and fatty meat is obtained from six-seven-year-old castrated goats: it makes an excellent pate **[13]**. The meat of adult uncastrated goats has a pronounced specific odour **[10]**, a possible unpleasant odour in females and young animals may be due to improper processing of the carcass **[14]**.

Compared to other types of red meat, goat meat is leaner. It has less cholesterol and fat than lamb and beef **[15]**, it is less caloric than beef or chicken, and contains a lot of protein **[10]**. Goat meat is rich in unsaturated fatty acids, minerals, and amino acids **[13]**. Goat meat is well digested and digested, it is hypoallergenic and suitable for children's and dietary nutrition **[9]**. Goat meat is a source of B vitamins, pantothenic, folic, para-aminobenzoic acids and choline. Regarding the content of vitamins A, B1 and B2, goat meat significantly exceeds the meat of other farm animals **[16]**. The use of goat meat is not prohibited by any religious norms, Muslims and Jews can eat it. It positively impacts our multinational and multi-confessional society **[10]**.

**Scientific Hypothesis**

The study of the physic-chemical composition, the fractional composition of proteins allows us to obtain data on the technological properties of goat meat for use in the production of meat products.

## MATERIAL AND METHODOLOGY

**Samples**

The research objects were the meat of goats aged 9-10 months, obtained from 3 breeds: Nubian, Zaanen and Alpine (*m. L. dorsi*, shoulder blade), grown in the breeding farm "Zerenda" located in Kazhymukan auls, Tselinograd district, Akmola region, Kazakhstan. The meat was bought in a specialized meat market.

**Chemicals**

All reagents used were of U.S.P. purity or higher. All solvents, including water, were used with the LC/MS label.

**Instrument**

The content of mineral elements was determined using the Spectr AA 220 FS (VARIAN B.V, USA) atomic absorption spectrophotometer. The MOD MARS 6 (CEM Corporation, USA) microwave sample preparation system was used for sample preparation. The vitamin composition was determined using a high-performance liquid chromatograph "Agilent-1200" (Agilent Technologies, USA).

**Laboratory Methods**

Laboratory studies of meat raw materials were carried out based on the NAO "S. Seifullin KATU" (Nur-Sultan, RK) and the FGBNU "V. M. Gorbatov Food Systems Research Center" of the Russian Academy of Sciences (Moscow, RF). The following were investigated: the total chemical composition (moisture, fat, protein, ash) GOST 25011-2017, BCC (Grau-Hamm method), mineral composition (GOST R 55484-2013), vitamin composition (GOST 32307-2013), the fractional composition of the protein fraction (GOST 25011-81) **[17]**, **[18]**, **[19]**, **[20]**, **[21]**, **[22]**, **[23]**.

**Description of the Experiment**

**Sample preparation:** The objects of research were samples of goat meat of three breeds, namely the Zaanen, Alpine, and Nubian goat breed. The primary stage of the tests was grinding meat products into minced meat. Grinding was carried out using a meat grinder, the diameter of the grate is 2 mm.

**Number of samples analyzed:** we analyzed 27 samples.

**Number of repeated analyses:** All instrument measurements were performed twice.

**Number of experiment replication:** The number of repetitions of each experiment to determine one value was two times.

**Design of the experiment:** To determine magnesium, a lanthanum solution is added to an aliquot of a sample solution of a suitable volume selected with a pipette. The resulting solution is diluted with a solution of nitric acid with a mass fraction of 0.65% so that the mass concentration of magnesium is within the range of the linearity of measurements by the AAC method for this element. The typical measurement range for magnesium is from 0.05 to 0.4 mg/dm$^3$. If necessary, the lower limit of the measurement range may be smaller, depending on the mass concentration of magnesium in the sample solution. Lanthanum solution. They are added in the volume necessary to obtain a mass concentration of lanthanum in a solution for measurements by the AAC method of 10 g/dm$^3$ (for example, when diluting the sample solution after mineralization to 10 cm, 2 cm$^3$ of a lanthanum solution of a mass concentration of 50 g/dm$^3$ is added).

Calibration solutions of magnesium are prepared with mass concentrations of 0.05, 0.1, 0.2 and 0.4 mg/dm$^3$. To do this, 0.25, 0.5, 1.0 and 2.0 cm$^3$ of a standard magnesium solution are added to measuring flasks with a capacity of 50 cm$^3$, respectively. 10 cm$^3$ of a lanthanum solution of a mass concentration of 50 g/dm$^3$ is added to each flask, and the volume of contents in the flasks is brought to the mark with a solution of nitric acid. Calibration solutions are prepared on the day of the analysis.

The atomic absorption spectrometer is set up on the day of the test in accordance with the device's operating instructions. A wavelength of 285.2 nm and an optical slit width of 0.7 nm is set to determine magnesium.

**Statistical Analysis**

The statistical evaluation of the results was carried out by standard methods using statistical software Statgraphics Centurion XVII (StatPoint, USA) – multifactor analysis of variance (MANOVA), LSD test. Statistical processing was performed in Microsoft Excel 2016 in combination with XLSTAT. Values were estimated using mean and standard deviations.

## RESULTS AND DISCUSSION

**Table 2** Physico-chemical parameters of the studied goat meat samples.

| Name of the indicators to be determined | Unit of measurement | Test results | | |
|---|---|---|---|---|
| | | Zaanen breed | Alpine breed | Nubian breed |
| **Physico-chemical indicators** | | | | |
| Mass fraction of moisture | % | 79.9 ±8.0 | 79.5 ±8.0 | 77.0 ±7.7 |
| Mass fraction of fat | % | 2.1 ±0.3 | 2.1 ±0.3 | 2.4 ±0.4 |
| Mass fraction of protein | % | 17.0 ±2.6 | 17.5 ±2.6 | 19.3 ±2.9 |
| Mass fraction of ash | % | 0.92 ±0.14 | 0.80 ±0.12 | 1.21 ±0.17 |
| **Vitamins** | | | | |
| B3 | mg/100 g | 5.20 ±1.04 | 6.76 ±1.35 | 5.62 ±1.12 |
| B5 | mg/100 g | 0.62 ±0.12 | 0.53 ±0.11 | 0.59 ±0.12 |
| B6 | mg/100 g | 0.64 ±0.16 | 0.64 ±0.16 | 0.52 ±0.13 |
| D3 | mg/100 g | <1.0 | <1.0 | <1.0 |
| E | mg/100 g | 0.32 ±0.06 | 0.27 ±0.05 | 0.33 ±0.07 |
| **Minerals** | | | | |
| Potassium | mg/kg | 2470.10 ±370.52 | 1693.22 ±253.98 | 4125.83 ±618.87 |
| Sodium | mg/kg | 852.27 ±136.36 | 1005.83 ±160.93 | 1518.21 ±242.91 |
| Magnesium | mg/kg | 148.71 ±22.31 | 125.33 ±18.80 | 295.88 ±44.38 |
| Zinc | mg/kg | 37.95 ±7.43 | 25.14 ±5.13 | 15.78 ±3.44 |
| Iron | mg/kg | 27.28 ±6.18 | 87.55 ±12.83 | 11.42 ±4.00 |
| Manganese | mg/kg | 0.52 ±0.10 | 0.27 ±0.05 | 0.21 ±0.04 |
| Calcium | mg/kg | 148.32 ±25.21 | 160.79 ±27.33 | 79.27 ±19.82 |

The study of the dynamics of changes in the composition of protein fractions based on the results of comparative studies of the ratio of sarcoplasmic proteins, based on the extraction of sarcoplasmic proteins from muscle tissue with a buffer solution of low ionic strength and obtaining fractions of water-soluble, salt-soluble and alkali-soluble proteins, followed by determination of their amount by the Kjeldahl method, with the release of non-protein, peptide and residual nitrogen are presented in Table 2.

The musculature of an animal is not something given once and for all. It develops as the animal grows, changes following the current needs of the body and atrophies with ageing and decreased motor activity. The mobility of parts of the animal's body is given by the contractile ability of the muscular system, based on the delightful contractile proteins – aggregates of their molecules change their sizes when interacting. The main proteins of contractile structures are actin and myosin. Strands of these proteins form cellular structures capable of pulling together the poles of the cell to which they are attached. At the same time, the shortening of microfilaments (filamentous structures of the cytoskeleton) does not occur due to the shortening of the protein molecules (actin and myosin), but due to their mutual sliding inside the actomyosin complex and a decrease in the total length of microfilaments. Proteins of one type seem to move between proteins of another type, and the tissue contracts with some effort, ensuring that the work of shifting body parts is done. This work can be expressed by reducing the length of the muscle (dynamic work) or in tension (static work), counteracting its stretching **[24]**. The movement of the threads of the actomyosin complex requires energy expenditure and the formation of bonds between its components. In this connection, muscle tissue proteins have multifunctional properties. The study of the fractional composition of muscle tissue protein with fattening variation allows us to judge the most effective diet, achieving the maximum desired effect (Table 3).

**Table 3** Fractional composition of goat meat proteins.

| Fractional composition of protein | Unit of measurement | Zaanen | Alpine | Nubian |
|---|---|---|---|---|
| **Water-soluble proteins** | % | 4.06 | 2.81 | 1.75 |
| **Salt - soluble proteins** | % | 1.75 | 2.13 | 2.44 |
| **Alkali - soluble proteins** | % | 11.15 | 12.55 | 15.10 |
| **Moisture binding capacity** | % | 73.45 | 74.42 | 73.94 |

When analysing the results, it was revealed that the largest amount of protein was contained in the meat of the Nubian breed.

Depending on the extraction conditions, three groups of proteins are distinguished:

- water-soluble proteins consisting mainly of sarcoplasmic proteins (myogen, globulin, myoglobulin, nucleoproteins);
- salt-soluble proteins consisting mainly of myofibrillary proteins (myosin, actin, actomyosin, as well as so-called regulatory proteins: tropomyosin, troponin);
- alkali-soluble proteins consist mainly of stroma proteins, including collagen, elastin, and glycoproteins – mucin and mucoid **[25]**, **[26]**.

The salt-soluble fraction reflects the total changes in the state of protein fractions, the solubility of which was not the same for the rocks under consideration (the highest concentration was determined in the Nubian rock). It should also be noted that the salt-soluble fraction decreases significantly with an increase in the duration of cultivation. The water-soluble fraction in the maximum concentration is determined in the Zaanenskaya rock, almost more than two times than in the Nubian rock.

It should be noted that the myogen and myoglobulin proteins of the water-soluble fraction are part of the proteins extracted by saline solution. The alkali-soluble fraction includes collagen and elastin, a significant part of water-soluble and salt-soluble proteins. Consequently, the content of water-soluble, salt-soluble, and alkali-soluble proteins cannot definitively judge the percentage of these fractions in meat during cultivation.

When assessing the chemical composition of experimental goat meat samples, no abnormalities were detected, and all indicators were in the generally accepted contents of this animal muscle tissue.

The content of the vitamin composition was also within the same limits for all breeds. To assess the nutritional value of this type of meat, it is recommended to conduct a comparative analysis with similar samples of lamb meat.

It should be noted that significant differences were found when studying the mineral composition of different breeds of goat meat. Particular attention should be paid to the content of minerals such as potassium and sodium in the Nubian rock, which was found to be significantly higher than in the other two. At the same time, significant iron content was determined in the Alpine rock, more than 2 – 3 times relative to other rocks. To test the hypothesis

of increased iron content in the meat of this breed or the presence of this artifact due to the animal's characteristics (or poor exsanguination), it is necessary to conduct a more detailed study with a larger sample.

It should also be noted that the calcium content in the meat of all three breeds is determined above industrially kept animals, such as beef and lamb, which is also possibly due to the best conditions for keeping animals that participated in this experiment.

As a result of the conducted studies on the mineral composition of goat meat, it is possible to draw a general conclusion that, according to this indicator, meat can be classified as high-containing concerning the main essential elements. Moreover, recommend this raw material to produce baby food products, which have increased requirements for the composition of vitamins and minerals.

There were no significant differences in moisture-binding capacity (WCC). In general, it is essential to note that WCC, regardless of the feeding diet, gives significantly better values with proper maintenance and slaughter of animals. It can be concluded that the selected fattening technologies in the experiment and the absence of stress (the WCC indicator under stress will be less than 65%) gives such results.

Goat meat, which has a better ability to concentrate meat juice inside the muscle fiber, is more valuable because of its technological characteristics. Therefore, it can also be recommended for the preparation of delicatessen products and dried products.

Karami M. et al. determined the effect of the goat diet on the fatty acid profile and the resulting meat quality. Twenty-four young goats of the Kachagan breed with an average live weight of 14.2 ±1.46 kg were selected for the study. Palm oil in the amount of 3% was added to the diet of one group, and rapeseed oil in similar concentrations was added to the feed of the second group of animals. Blood sampling and weighing of animals were performed before the experiment and after 33, 66 and 102 days. At the end of the experiment, it was shown that adding 3% rapeseed oil to the diet of goats improves the fatty acid profile of meat by increasing the concentration of omega-3 fatty acids, thereby making it more beneficial to health. At the same time, no such effect was observed from palm oil **[27]**. Lushnikov V. V. Yusova O.V. conducted studies of subcutaneous fat of young goats aged 4, 6, and 8 months of Russian and Zaanen breeds. The study found a significant amount of valuable polyunsaturated fatty acids. The optimal value was noted in goats aged 6 months **[28]**. Uzakov Ya. M. et al. conducted a comparative analysis between mutton and goat meat. According to the data obtained, mutton contains more dry matter (1.5-2%), which is explained by the high-fat content in mutton. According to amino acids, goat meat contains more arginine (1.88 ±0.05 and 1.62 ±0.04), lysine (1.84 ±0.04 and 1.65 ±0.03), histidine (2.01 ±0.06 and 1.71 ±0.03), methionine (1.40 ±0.04 and 1.23 ±0.04) and aspartic acid (1.20 ±0.04 and 1.06 ±0.03), but at the same time, a lower content of the following amino acids was noted: leucine (1.36 ±0.04 and 1.64 ±0.06), glycine (0.81 ±0.04 and 0.99 ±0.06) **[29]**. At the moment, Kazakhstan has 180 million hectares of pasture lands. Of these, 18.7 million hectares. foothill and 8,9 million hectares of mountain pastures. At the same time, it is worth noting the low use of pastures (about 10-15%). Optimal pastures for goats are foothills and low mountains. The low use of pastures opens up the possibility of breeding goats in industrial quantities. Goats are spread throughout the world. They live in small or large herds and in different areas and environments. Because of its distinctive taste and desired chemical composition, goat meat is increasingly consumed in Serbia. Animal foods are rich in protein, vitamins and minerals, but contain very little fat, especially cholesterol. This review paper aims to highlight some health benefits, nutritional values and potential use of goat meat. The chemical composition of goat meat affects race, gender, productivity and adaptability to stress, environment, management, diet, weight at slaughter, health condition, and slaughter and procedures with the carcasses after slaughter. The average chemical composition of lean goat meat contains about 75.42% water, 3.55% fat, 19.95% protein and 1.06% mineral matter. The energy value is about 580 kJ per 100 g. Goat meat has about the same nutritional value as well as sheep meat. Due to the low content of saturated fatty acids and cholesterol, goat meat in the human diet is a healthier alternative than other red meat. Polyunsaturated fatty acids are prevalent in goatmeat, and a diet rich in unsaturated fatty acids is correlated with a reduced risk of stroke and coronary disease. In addition, essential amino acids such as lysine, threonine and tryptophan are present in goat meat. Regardless of the nutritional value, goat meat is still less appreciated due to its specific smell and taste, even if the animal is older **[30]**. In general, goat meat is not inferior to other meat types regarding nutritional and biological value–it has a high protein content (up to 29%), and it is a good source of minerals, vitamin B-complex, and essential amino acids. However, the meat of older and culled goats is less juicy, less tender, has a characteristically different odour and taste compared to kids' goat meat (and meat of other animals), and thus tends to be less desirable. Different meat products could be produced using goat meat (including culled goat meat): dry-fermented sausages (e.g., sucuk), dry-cured meats (Violino di capra–goat prosciutto), frankfurters, mortadella, etc. without adverse effects on products' technological properties. The negative impact of goat meat on the properties of meat products is mainly associated with using goat fatty tissue. However, this could be overcome by using fatty tissue of other animals (e.g., pork back fat or beef fatty tissue) **[31]**. Herzegovinian dry smoked goat meat is a traditional cured

meat product made of the whole carcass of adult castrated bucks, dry salted and cold smoked. It has been traditionally produced in Herzegovina for centuries, especially in the wider area of the Stolac municipality. This study aimed to determine the quality parameters of Herzegovinian dry smoked goat meat. For the research, the samples were made into eight separate anatomical units (neck, sirloin, leg, loin, flank, breast, shoulder, hindshank), on which the tests were performed. Sensory, physical, and chemical tests were performed on the examined samples. Also, its hydrolytic and oxidative changes (acid and peroxide number, TBARS value) were determined to monitor changes in fats. The sensory evaluation determined that a "pleasant" aroma characterized the examined samples. Chemical tests revealed significant differences in the values of the examined parameters between samples from different anatomical regions. The least hydrolytic and oxidative changes were found in the breast samples with the highest fat content. PCA analysis revealed a positive correlation between moisture content and pH value and a negative correlation of these parameters with fat content. Furthermore, a significant positive correlation was found between NaCl content, ash, peroxide number, and TBARS values. Fat content was characteristic in the breast samples, moisture in the shoulder samples, and protein in the hindshank samples, while NaCl and ash content were characteristic in the neck samples **[32]**. Two variants of sucuk were made: one of beef meat and beef tail fat and another of goat meat and goat tail fat with meat/fat ratio of 75/25 and the same ingredients. After filling, the sausages were hung to dry in a traditional smoking house (without possibly controlling the temperature or humidity). Weight loss, pH, non-protein nitrogen content, basic chemical composition, instrumental colour measurement and sensory evaluation were made for both variants. Both variants had an almost identical weight loss (36.98 beef sucuk and 36.25 goat sucuk). Changes in pH value and non-protein nitrogen content had the same tendency, and end values did not differ. The basic chemical composition at the end of production indicates that both variants were of excellent quality. L* and b* values did not differ, but there was a significant difference in a* value (11.72 beef and 14.15 goat). In terms of appearance, texture and taste, assessors gave poorer grades to goat sucuk, but these grades do not indicate that the product is unacceptable (they were more than 5). It is possible to replace goat tail fat with beef fat to appease the specific flavour of the product and to make it more acceptable to consumers who may not be used to such flavour **[33]**. The quality of fresh goat meat can be defined strictly in terms of physical and chemical properties or consumer perception. In Serbia, there is not enough information about the quality of goat meat and goat meat products, such as smoked ham. This study aimed to determine differences in the basic chemical composition, colour, fatty acids composition, and volatile compounds in fresh meat and smoked ham (*musculus gluteus superficialis*). The meat was obtained from the population of White Serbian goat, five or six years old. ISO methods were implemented to determine the quality of these parameters. A statistically significant difference ($p$ <0.05) was determined between values of protein, fat, moisture, ash, pH value, fatty acids and volatile compounds determined in fresh meat and finished product (smoked ham). It is assumed that the complex chemical and biochemical processes occurring during production (growing, curing, smoking, drying) resulted in statistically significant differences between the quality parameters in fresh meat and smoked ham. There was a statistically significant difference ($p$ <0.05) between the values of capric acid, lauric acid, myristic acid, pentadecanoic acid, pentadecenoic acid, palmitic acid, palmitoleic acid, hep tadeca-noic acid, stearic acid, oleic acid, linoleic acid, linolenic acid, arachidic acid and gadoleic acid identified in the thigh meat prepared for curing and smoking in compared to the value of the fatty acids identified in the final product (smoked ham) **[34]**. The potential of goats to produce high-quality meat is mainly reflected in their healthy fats, low-calorie intramuscular fats, saturated fats, and, especially, their high ratios of unsaturated (UFA) and saturated (SFA) fatty acids, as well as hypocholesterolemic and hypercholesterolemic fatty acids. This study aimed to collect and compare meat quality parameters for domestic Balkan, Alpine and Saanen goats of the same age. Samples for all tests were taken from musculus gluteus superficialis. Chemical composition, pH value, fatty acid composition, the content of volatile compounds, colour, and overall sensory quality (appearance, texture and smell) were determined. In chemical composition, moisture, fat, protein, and ash varied significantly between the examined groups as opposed to pH values. Furthermore, among all the examined groups, a significant difference was found between fatty acids and volatile compounds. The determined ratio of polyunsaturated fatty acids (PUFAs) to SFAs was 0.089, 0.085 and 0.071 for Balkan, Alpine and Saanen goat meats, respectively. Regarding that ratio, Saanen goat meat had the most favourable characteristics. Saanen goat meat showed the highest nutritional value. On the other hand, Balkan goat meat had the lowest intramuscular fat content. Measurements of the meat colour from all three groups and overall acceptability showed significant differences between breeds. Obtained results point to the impact of breed on goat meat's chemical composition and fatty acid profile **[35]**. Goats provide valuable products that are appreciated by consumers looking for food that is not only tasty but also healthy, and probably, one of them is goat meat. Breeding of local breeds such as the native Carpathian goat has been gaining importance in recent years, which creates an opportunity for the development of the goat meat market. This study aimed to investigate the influence of goat breed on the basic chemical, fatty and amino acid composition, colour and sensory evaluation of meat. The research material consisted of Carpathian goats from the

NRIAP experimental plant in the southern part of Poland and goats from a farm keeping Saanen goats in south-eastern Poland. Ten male goat kids from each breed were taken to the NRIAP farm. The meat quality obtained from the leg (m. *biceps femoris*) of male goat kids about 150 days old at slaughter was analysed. The meat of the Carpathian goat was characterized by a lower content of protein and cholesterol ($p$ <0.01), and a higher content of fat and general collagen compared to the meat from Saanen goats ($p$ <0.05). Cholesterol content in goat meat of both breeds was similar and ranged from 55.08 mg/100g (Carpathian) to 56.79 mg/100g (Saanen). Despite the higher collagen content, the goat meat of Carpathian breeds was characterized by lower shear force, less hardness ($p$ <0.05) and chewiness, which was more delicate. A higher content of monounsaturated acids characterized the fat of Carpathian goat breeds, mainly C 18:1n:9, and a more favourable (lower) saturation index, S/P ($p$ <0.05) **[36]**. This study aimed to evaluate the effect of the production system on growth performances and meat quality of suckling Messinese goat kids. At birth, 102 suckling kids were divided into two homogeneous groups for sex and body weight (3.4 kg); animals of the SES group were fed exclusively with spontaneous pasture and kept in the stable during the evening; animals of the ES group were fed exclusively with spontaneous pasture, characterized by the presence of *Quercus suber*, and kept exclusively outdoors. From birth to weaning, kids were weighed every 10 days. Carcase yields and meat quality traits on the *Longissimus dorsi* muscle were studied at slaughter. Data were subjected to ANOVA. ES group showed the highest final body weight (10.53 kg vs. 9.40 kg) **[37]**. Dietary fats are fatty acids that may play positive or negative roles in preventing and treating diseases. In nature, fatty acids occur in the form of mixtures of saturated fatty acid (SFA), monounsaturated fatty acid (MUFA), and polyunsaturated fatty acid (PUFA), so their nutritional and/or medicinal values must be determined. Herein, we do not consider the classic indices, such as ∑SFA, ∑MUFA, ∑PUFA, ∑n-6 PUFA, ∑n-3 PUFA, and n-6 PUFA/n-3 PUFA; instead, we summarize and review the definitions, implications, and applications of indices used in recent years, including the PUFA/SFA, index of atherogenicity (IA), the index of thrombogenicity (IT), the hypocholesterolemic/hypercholesterolemic ratio (HH), the health-promoting index (HPI), the unsaturation index (UI), the sum of eicosapentaenoic acid and docosahexaenoic acid (EPA + DHA), fish lipid quality/flesh lipid quality (FLQ), the linoleic acid/α-linolenic acid (LA/ALA) ratio, and trans fatty acid (TFA). Of these nutritional indices, IA and IT are the most commonly used to assess the composition of fatty acids as they outline significant implications and provide clear evidence. EPA + DHA is commonly used to assess the nutritional quality of marine animal products. All indices have their advantages and disadvantages; hence, a rational choice of which to use is critical **[38]**. This study investigated the relationship between muscle fiber characteristics and fatty acid composition of four major muscles in Korean native black goat (KNBG). *Longissimus lumborum* (LL), *psoas major* (PM), *semimembranosus* (SM), and *gluteus medius* (GM) were obtained from five male KNBGs of 36 months of age and subjected to histochemical analysis to determine fatty acid composition and meat quality traits. There were significant ($p$ <0.05) differences in fiber number percentage (FNP) and fiber area percentage (FAP) of fiber types among these four muscles. PM had the highest FNP of type I and the lowest FNP of type IIB, while SM had the highest FNP of type IIB. The highest fat content was observed in LL, while SM had the lowest fat content. The proportions of SFA and MUFA were significantly ($p$ <0.05) different among four muscles due to differences in the majority of fatty acids, such as oleic (C18:1) and palmitic (C16:0) acids. The PUFA/SFA ratio differed significantly ($p$ <0.05) among four muscles, and the highest PUFA/SFA ratio was observed in PM. Results suggested that LL and PM might be healthful because of the higher desirable fatty acid value and PUFA/SFA ratio. Also, data showed that correlations between muscle fiber types and fatty acids proportion of goat muscles were reversed with those of cattle muscles **[39]**. The arguments included in the article were based on a small number of information preserved in the sources, which concern a seasonal presence of the Wallachian shepherds in the areas situated north of the line designating the scope of permanent (year-round) rural settlements founded on the Wallachian law. It was practised in forests belonging to the king and in private estates throughout all seasons. This research resulted in the thesis statement that groups of the Wallachian shepherds led seasonal grazing of their herds in the submontane areas in the 15th century. Various factors, primarily of an economic nature, made these pastoral activities disappear or, at least, made them significantly limited at the turn of the 16th and 17th centuries. Pastoralism of a transhumance type existed throughout the period under discussion, in modern sources referred to as koszarnictwo (transhumance herding), consisting of the period under discussion, in modern sources referred to as koszarnictwo (transhumance herding), consisting of periodic migrations of pastoral groups from permanent villages. Similarly to what I have claimed in my previously published research on the Wallachian pastoralism in the Carpathian areas, there are no indications in the sources which would justify a thesis for a long time widespread in historical studies on the presence of a nomadic phase in the history of the Wallachian colonization in the Polish areas. Also, in the case of the studied areas, its existence can be given no confirmation **[40]**. To assess the development of kid's bodies during birth – 6 months kids were ed at birth, at 28 days, at weaning (60 days) and 6 months, registering total weight gain and average daily gain achieved by them in stages throughout the period monitored. The research considered two farms of goats from the Carpathian breed

differentiated by the technology of rearing and exploitation practised, which were situated in the South Muntenia Region (Giurgiu and Prahova counties). Prahova County exploits animals belonging to Carpathian breed Prahova County farm exploits Carpathian breed animals and practicing an extensive operating system or pastoral, and the farm from Giurgiu County exploits the same breed using the same breed semi-intensive operating system. The best result in terms of quantitative parameters of meat production (average daily gain, average total gain) was achieved by practising semi-intensive operating systems **[41]**. Five types of meat were produced: traditional milk capretto (MC), heavy summer capretto (HSC), summering (SCh), fall (FCh) and late fall chevon (LFCh). HSC was the most tender meat, having fewer cooking losses than MC and redder chevon types. The instrumental profile corresponded with the appearance and texture attributes perceived by panellists. With kids' ageing, meat lost its milk aroma (MC) and sweet taste (HSC). It acquired an increasing intensity of goat flavour and livery notes, partially related to the feeding regime and fatty acid profile. A niche market preferred chevon over capretto; while the cluster of consumers unfamiliar with chevon showed a decrease in pleasantness when tasting chevon, the familiar group reduced their ratings only for meat from the oldest kids **[42]**. Collagen constitutes 20-30% of proteins in the organism of mammals and birds, and it is a major component of the intramuscular connective tissue. In the muscles, collagen is mainly stored in epimysium, perimysium, and endomysium. There are more than 20 genetic types of collagens in the skeletal muscles; among them, collagen type I and type III are a significant portion. The morphology, composition, and quantity of the connective tissue in the muscles depend predominantly on their type and the animal's species, breed, and age. Owing to differences in the methods of determining collagen, the content of this protein can differ in individual muscles. High content of this incomplete protein in the muscles' connective tissue significantly impacts the meat's tenderness and decreases its quality. The cross-linking of collagen in the muscles that are highly active in live animals increases with the age of animals and causes the meat to become hard. Lower content of collagen was found in the muscles with longer sarcomeres and in the meat from late maturing and castrated animals **[43]**. The possibility for improvement of carcass traits and quality of kid meat of the autochthonous Balkan goat breed by crossing with the Saanen breed was investigated in this study. The trial was carried out on one group of Balkan goat kids and three groups of kids cross of Balkan and Saanen goats with different proportions of Saanen genes: 25, 50 and 75%. Each group had 16 male kids, slaughtered at an average body weight of 18 kg. With the increase in the proportion of Saanen genes, the age of kids that reached preslaughter weight decreased, the chilling loss increased, and the proportion of fat tissue (kidney and pelvic fat) in the carcass side decreased ($P \leq 0.05$). The crossing also increased the proportion of carcass parts of the first category (leg and loin section) and muscle tissue in those parts. The highest proportion of muscle tissue in the thigh (74.91%) and loin section (75.66%) was determined in kids from the group with 75% of Saanen genes, and kids from this group also had the highest proportion of intramuscular fat (2.48%) in samples of m. longissimus dorsi. Slight differences between kid groups were established in indicators of technological meat properties, such as water binding capacity and tenderness, with the increase in the proportion of Saanen genes in the genotype. The sensory score for roasted meat was high, and scores for tenderness and juiciness were slightly higher in kid crosses with 50% and 75% of Saanen genes ($p \leq 0.05$). Results presented in this study confirm the positive effect of crossing the Saanen breed with the Balkan breed on carcass traits and for obtaining meat of more desirable quality **[44]**. Little is known about the fatty acid composition of the major muscles in goats from different breeds. Forty male suckling kids, 20 Criollo Cordobes and 20 Anglo Nubian, were slaughtered at 75 days of age and their longissimus thoracis (LT) fatty acid composition (semitendinosus (ST) muscles were analysed to clarify the effects of genotype and muscle type on goat kid meat. Genotype greatly influenced the fatty acid composition of goat kid meat **[45]**. Forty suckling kids, 20 intact males and 20 females were randomly assigned to two groups: I (60 ±2 days old and live weight ≤11 kg) and II (90 ±3 days old and live weight >11 kg). Sex significantly influenced meat colour, WarnerBratzler shear force, cooking losses, water holding capacity and intramuscular fat content, while the age/weight significantly influenced cholesterol and tenderness. The main fatty acids identified from the intramuscular fat were oleic (30.1-32.6%), palmitic (19.6-21.0%) and stearic (13.5-16.3%). Levels of saturated and unsaturated fatty acids ranged from 40.1% to 41.9% and from 57.6% to 59.1%, respectively. Meat from CC kids is pale red, tender, and juicy, and the intensity of flavour and aroma were medium-high **[46]**. Thirty-two male goats were divided into four racial groups: eight pure Boer breeds, eight 3/4 Boer + 1/4 SPRD crossbred, eight 1/2 Boer + 1/2 SPRD crossbred and eight 1/2 Anglo Nubian + 1/2 SPRD crossbred. All goats were reared under the feedlot system and slaughtered at the average age and live weight of 223 days and 29 kg, respectively. The chemical composition was determined, including moisture, protein, ash, fat, cholesterol, phospholipids, and fatty acids. The breed types had no significant effect on moisture, protein, ash, fat, cholesterol, and phospholipids contents. However, the percentages of oleic and stearic acids and the MUFA/SFA ratio showed significant differences between the four breed groups, ranging from 0.72 for 3/4 Boer + 1/4 SPRD crossbred to 0.95 for 1/2 Boer + 1/2 SPRD crossbred. The oleic acid (C18:1) was found in the highest percentage in the fatty acid profile in goat meat, particularly for 1/2 Boer + 1/2 SPRD and 1/2 Anglo + 1/2 SPRD

genotypes. The crossing of exotic Boer and Anglo Nubian breeds with the natives SPRD resulted in goat meat of high quality, even at a ratio of 50%, since the goat meat showed low cholesterol percentage and high protein and unsaturated fatty acids contents **[47]**. Some quality traits of meat from purebred French Alpine kids and Boer crossbreeds aged 50 days were evaluated in the study. Samples of m. quadriceps femoris were taken to determine the chemical composition and physicochemical properties of meat, as well as a water-to-protein ratio, energy value, levels of cholesterol and amino acids in a protein, and fatty acid concentration in intramuscular fat. It was found that meat from crossbred kids, compared to meat from purebred kids, contained more intramuscular fat, cholesterol and vitamin A, had a higher calorific value, a brighter colour, a lower water-holding capacity, a higher level of physiological maturity (measured as the value of a water-to-protein ratio), and got higher scores for tenderness and juiciness. The meat protein from crossbred kids had a more desirable essential amino acid/non-essential amino acid (EAA/NEAA) ratio. At the same time, intramuscular fat contained less OFAs and had more desirable unsaturated fatty acid/ saturated fatty acid (UFA/SFA) and DFA/OFA (UFA+C 18:0 /SFA-C 18:0) ratios. Due to a high protein content (19.44 and 19.74%), low levels of fat (1.67 and 1.96%) and cholesterol (48.76 and 56.63 mg/100g), a low energy value (96.36 and 101.47 kcal/100g), a high concentration of essential amino acids, a desirable fatty acid profile and high scores for sensory properties, meat from purebred French Alpine kids and (especially) Boer crossbreds may be recommended as a valuable component of a low-fat diet **[48]**. The effect of two different rearing systems of goats, such as grown under confinement and raised on the field, was evaluated on the muscles of an intact male goat. The physicochemical properties such as pH, water activity (Aw), and chemical composition, including moisture, protein, ash, calcium, iron, phosphorus, cholesterol, phospholipids and fatty acids, were determined. The rearing system had no significant effect on protein content and water activity. Concentrations of ash and fat were significantly ($p$ <0.05) different, being higher in goats raised under confinement, while goats raised in the field had a higher percentage of moisture and phospholipids. However, pH, iron, phosphorus, and cholesterol contents were significantly higher for animals raised under confinement. The predominant fatty acid in goat meat in both rearing systems was oleic (C18:1), ranging from 36.23 to 43.56%. Higher contents of saturated fatty acids (SFA) and lower contents of monounsaturated fatty acids (MUFA) were found to be significantly ($p \leq 0.05$) different in goats raised in field. This resulted in a greater ratio of unsaturated fatty acids (UFA) and SFA, and that of MUFA and SFA in goat meat of animals raised under confinement compared to that of the goats raised on the field **[49]**. The weight at slaughter (LWS) for kid goats in Mediterranean countries is lower than in Arabian or African countries. Logically, increasing LWS could increase a farmer's profit margin. Forty-five twin male kids from the Canary Caprine Group breed were used to compare carcass and meat quality at 6, 10 and 25 kg LWS. Dressing percentage based on full weight was lower for 25 kg LWS compared with LWS of 6 and 10 kg, although based on empty body weight, dressing percentage for 25 kg LWS was similar to that with 6 and 10 kg LWS. However, the dressing percentage based on empty body weight was lower for 6 vs. 10 kg LWS. There were no significant differences among LWS in percentage contributions to the whole carcass of primal cuts, excluding the neck (lower proportion in 25 kg LWS kids). LWS did not affect tissue distribution in the carcass except for intermuscular fat (higher for 25 vs. 6 kg LWS). Few differences between LWS were observed concerning meat quality parameters. Results suggest that increasing LWT from 6 to 10 and 25 kg for kids artificially reared does not negatively affect carcass or meat quality yet would result in more edible meat (pounds) to be marketed **[50]**. The effect of castration and slaughter age on fat, cholesterol, phospholipids and fatty acid contents was determined for native Brazilian goat meat muscles. Groups of castrated and intact "Mestiço" goats were slaughtered at 175, 220, 265 and 310 days of age. Castration and slaughter age significantly affected total cholesterol and fatty acids contents. The cholesterol content increased with the advance in slaughter age. Meat from castrated goats had a higher cholesterol content than that from intact. Goat muscle contained mostly C18:1 (38-44%), C18:0 (23-25%), C16:0 (18-21%), and C18:2 (4-6%) fatty acids. There were no differences in saturated, unsaturated and polyunsaturated fatty acids levels among the four groups slaughtered at different intervals. Castrated goat meat contained significantly greater unsaturated and polyunsaturated fatty acids than that of intact. Total fat and phospholipids percentages ranged from 3.0 to 3.4 g/100g and 10.6 to 11.1 mg/100g, respectively, for intact and castrated goats **[51]**. Twenty Boer x Spanish goats, in the age range of 90-118 days, were assigned to two dietary treatments, with 10 animals fed a grain ration (G) and 10 grazed in rangeland. The grain ration contained sorghum grain (67.5%), cottonseed hulls, dehydrated alfalfa meal, cottonseed meal, soybean meal, molasses, and mineral and vitamin supplements. Animals were slaughtered at the age range of 206-234 days. Intramuscular fat (IF) and the diet specimens - representative samples of G and the parts of range plants (RPs) that goats were expected to have consumed - were analysed for fatty acid composition. The percentage of 16:0 was higher in RPs than in G, but not different between IF from range goats and that from grain-fed goats. Total unsaturated fatty acid (UFA) percentage was higher in G than in RPs. The major UFAs were 18:2 and 18:3 in RPs, and 18:1 and 18:2 in G. In IF, 18:1 constituted more than two-thirds of UFAs, regardless of diet type **[52]**.

## CONCLUSION

When assessing the chemical composition of experimental goat meat samples (Zaanenskaya, Alpine, Nubian), no abnormal deviations were detected, and all indicators were in the generally accepted contents of this type of animal muscle tissue. The mass fraction of goat meat proteins was 2.1 ±0.3-2.4 ±0.4%. The study of the dynamics of changes in the composition of protein fractions based on the results of comparative studies of the ratio of sarcoplasmic proteins showed the content of water-soluble (1.75 – 4.06%), salt-soluble (1.75 – 2.44%), alkali-soluble (11.15 – 15.10%) proteins. The salt-soluble fraction reflects the total changes in the state of protein fractions, the solubility of which was not the same for the rocks under consideration (the highest concentration was determined in the Nubian rock). There were no significant differences in moisture-binding capacity (WCC) (73.45; 74.42; 73.94%). Generally, it is important to note that goat meat, which has a better ability to concentrate meat juice inside the muscle fiber, is more valuable in terms of its technological characteristics. Therefore, it can also be recommended to produce food for schoolchildren.

## REFERENCES


1. Masanov, Y. (2021). To which markets outside the EAEU does Kazakhstan supply meat? In Kz. Kursiv.Media (pp. 1). Available at: https://kz.kursiv.media/2021-03-04/na-kakie-rynki-za-predely-eaes-kazakhstan-postavlyaet-myaso/. (in Russian)
2. Chauhan, P., Kumar, R. R., Mendiratta, S. K., Talukder, S., Gangwar, M., Sakunde, D. T., & Meshram, S. K. (2021). In-vitro functional efficacy of extracts from Phyllanthus emblica, Eucalyptus globulus, Tinospora cordifolia as pancreatic lipase inhibitor and source of anti-oxidant in goat meat nuggets. In Food Chemistry (Vol. 348, p. 129087). Elsevier BV. https://doi.org/10.1016/j.foodchem.2021.129087
3. Teixeira, A., Silva, S., Guedes, C., & Rodrigues, S. (2020). Sheep and Goat Meat Processed Products Quality: A Review. In Foods (Vol. 9, Issue 7, p. 960). MDPI AG. https://doi.org/10.3390/foods9070960
4. Sujarwanta, R. O., Beya, M. M., Utami, D., Jamhari, J., Suryanto, E., Agus, A., Smyth, H. E., & Hoffman, L. C. (2021). Rice Bran Makes a Healthy and Tasty Traditional Indonesian Goat Meatball, 'Bakso.' In Foods (Vol. 10, Issue 8, p. 1940). MDPI AG. https://doi.org/10.3390/foods10081940
5. Teixeira, A., Ferreira, I., Pereira, E., Vasconcelos, L., Leite, A., & Rodrigues, S. (2021). Physicochemical Composition and Sensory Quality of Goat Meat Burgers. Effect of Fat Source. In Foods (Vol. 10, Issue 8, p. 1824). MDPI AG. https://doi.org/10.3390/foods10081824
6. Mahachi, L. N., Rudman, M., Arnaud, E., Muchenje, V., & Hoffman, L. C. (2020). Application of Fat-Tailed Sheep Tail and Backfat to Develop Novel Warthog Cabanossi with Distinct Sensory Attributes. In Foods (Vol. 9, Issue 12, p. 1822). MDPI AG. https://doi.org/10.3390/foods9121822
7. Li, S., Xiang, C., Ge, Y., Liu, H., Zhang, D., & Wang, Z. (2022). Differences in eating quality and electronic sense of meat samples as a function of goat breed and postmortem rigor state. In Food Research International (Vol. 152, p. 110923). Elsevier BV. https://doi.org/10.1016/j.foodres.2021.110923
8. Jia, W., Fan, Z., Shi, Q., Zhang, R., Wang, X., & Shi, L. (2021). LC-MS-based metabolomics reveals metabolite dynamic changes during irradiation of goat meat. In Food Research International (Vol. 150, p. 110721). Elsevier BV. https://doi.org/10.1016/j.foodres.2021.110721
9. Zabelina, M. V., Belova, M. V., Rysmukhambetova, G. E., & Gerilovich, V. V. (2016). Kozlyatina — an important source of full-fledged food products. In Sheep, goats, wool business journal (Vol. 4, pp. 22–24).
10. Weinstein, B., & Scarbrough, M. (2011). Goat meat, the final frontier. In The Washington Post (pp. 1). Newsweek Interactive. Available at: https://www.washingtonpost.com/lifestyle/food/goat-meat-the-final-frontier/2011/03/28/AF0p2OjC_story.html.
11. Lukyanenko, I. V. (2014). Classification of meat. Juicy pork and bones. Kharkiv: Family Leisure Club.
12. Weinstein B., Scarbrough M., & Nilsson, M. (2011). Goat: Meat, Milk, Cheese. Stewart, Tabory & Chang. 256 p.
13. Weaver, S. (2006). Goats: Small-scale Herding for Pleasure And Profit. BowTie Press. 160 p.
14. Davidson, A. (2014). The Oxford Companion to Food (T. Jaine, Ed.). Oxford University Press. https://doi.org/10.1093/acref/9780199677337.001.0001
15. Long an Ethnic Delicacy, Goat Goes Mainstream, The Washington Post (November 13, 2004). Accessed November 13, 2021.
16. Chikalev, A. I. (2012). Characteristics of goat meat. Goat breeding: textbook.
17. GOST 25011-2017. Meat and meat products. Methods of protein determination
18. GOST R 55573-2013. Meat and meat products. Determination of calcium by atomic absorption and titrimetric methods.
19. GOST R 55484-2013. Meat and meat products. Determination of the content of sodium, potassium, magnesium and manganese by the method of flame atomic absorption.

**20.** GOST 33424-2015. Meat and meat products. Determination of magnesium by flame atomic absorption spectrometry.

**21.** GOST R 55482-2013. Meat and meat products. Method for determining the content of water-soluble vitamins.

**22.** GOST 32307-2013. Meat and meat products. Determination of the content of fat-soluble vitamins by high-performance liquid chromatography.

**23.** Grau, R., & Hamm, R. (1953). Eine einfache Methode zur Bestimmung der Wasserbindung im Muskel. In Die Naturwissenschaften (Vol. 40, Issue 1, pp. 29–30). Springer Science and Business Media LLC. https://doi.org/10.1007/bf00595734

**24.** Gudilin, I. I. (1989). Genetic foundations of animal breeding. Moscow.

**25.** White, A., Handler, F., Smith, E., Hall, R., & Lehman, I. (1981). Fundamentals of Biochemistry. In Mir ( Volume 2, pp. 730–813).

**26.** Ivankin, A. N., Vostrikova, N. L., Kulikovskii, A. V., & Oliferenko, G. L. (2018). MICROCOMPONENTS OF FOOD SYSTEMS BASED ON ANIMAL AND OTHER RAW MATERIALS. REVIEW. In Theory and practice of meat processing (Vol. 3, Issue 1, pp. 16–28). The Gorbatov's All-Russian Meat Research Institute. https://doi.org/10.21323/2414-438x-2018-3-1-16-28

**27.** Karami, M., Ponnampalam, E. N., & Hopkins, D. L. (2013). The effect of palm oil or canola oil on feedlot performance, plasma and tissue fatty acid profile and meat quality in goats. In Meat Science (Vol. 94, Issue 2, pp. 165–169). Elsevier BV. https://doi.org/10.1016/j.meatsci.2013.02.004

**28.** Lushnikov, V. V. (2016). Fatty acid composition of intramuscular fat as an indicator of the nutritional value of dairy goat mea. In V. V., & Yusova, O. V. Meat industry.

**29.** Uzakov, Ya. M. (2016). Determination of the amino acid composition of mutton and goat meat. In Uzakov, Ya. M., Kozhakhieva, M. O., Nurmukhambetova, D. E., & Shukeshova, S. E. Proceedings of the XIII International Scientific and Practical Conference (pp. 342–346).

**30.** Ivanovic, S., Pavlovic, I., & Pisinov, B. (2016). The quality of goat meat and it's impact on human health. In Biotehnologija u stocarstvu (Vol. 32, Issue 2, pp. 111–122). National Library of Serbia. https://doi.org/10.2298/bah1602111i

**31.** Stajic, S., & Pisinov, B. (2021). Goat meat products. In IOP Conference Series: Earth and Environmental Science (Vol. 854, Issue 1, p. 012092). IOP Publishing. https://doi.org/10.1088/1755-1315/854/1/012092

**32.** Ganic, A., Begic, M., Forto, A., & Krvavica, M. (2022). Determination Of Quality Parameters Of Herzegovinian Dry Smoked Goat Meat. In The Journal "Agriculture and Forestry" (Vol. 68, Issue 4). Journal Agriculture and Forestry. https://doi.org/10.17707/agricultforest.68.1.06

**33.** Stajic, S., Stanisic, N., Perunovic, M., Zivkovic, D., & Zujovic, M. (2011). Possibilities for the use of goat meat in the production of traditional sucuk. In Biotehnologija u stocarstvu (Vol. 27, Issue 4, pp. 1489–1497). National Library of Serbia. https://doi.org/10.2298/bah1104489s

**34.** Ivanovic, S., Pisinov, B., Boskovic, M., Ivanovic, J., Markovic, R., Baltic, M., Z., & Nesic, K. (2014). Changes in the quality of goat meat in the production of smoked ham. In Tehnologija mesa (Vol. 55, Issue 2, pp. 148–155). Centre for Evaluation in Education and Science (CEON/CEES). https://doi.org/10.5937/tehmesa1402148i

**35.** Ivanović, S., Pavlović, M., Pavlović, I., Tasić, A., Janjić, J., & Baltić, M. Ž. (2020). Influence of breed on selected quality parameters of fresh goat meat. In Archives Animal Breeding (Vol. 63, Issue 2, pp. 219–229). Copernicus GmbH. https://doi.org/10.5194/aab-63-219-2020

**36.** Migdał, W., Kawęcka, A., Sikora, J., & Migdał, Ł. (2021). Meat Quality of the Native Carpathian Goat Breed in Comparison with the Saanen Breed. In Animals (Vol. 11, Issue 8, p. 2220). MDPI AG. https://doi.org/10.3390/ani11082220

**37.** Liotta, L., Chiofalo, V., Lo Presti, V., & Chiofalo, B. (2020). Effect of production system on growth performances and meat traits of suckling Messinese goat kids. In Italian Journal of Animal Science (Vol. 19, Issue 1, pp. 245–252). Informa UK Limited. https://doi.org/10.1080/1828051x.2020.1726832

**38.** Chen, J., & Liu, H. (2020). Nutritional Indices for Assessing Fatty Acids: A Mini-Review. In International Journal of Molecular Sciences (Vol. 21, Issue 16, p. 5695). MDPI AG. https://doi.org/10.3390/ijms21165695

**39.** Hwang, Y. H., Joo, S. H., Bakhsh, A., Ismail, I., Joo, S. T. (2017). Muscle Fiber Characteristics and Fatty Acid Compositions of the Four Major Muscles in Korean Native Black Goat. In Korean J Food Sci Anim Resour (Vol. 37, Issue 6, pp. 948–954). Korean Society for Food Science of Animal Resources. https://doi.org/10.5851/kosfa.2017.37.6.948

**40.** Jawor, G. (2016). Seasonal pastoral exploitation of forests in the area of Subcarpathia in the 15th and 16th century. In Balcanica Posnaniensia Acta et studia (Vol. 23, p. 175). Adam Mickiewicz University Poznan. https://doi.org/10.14746/bp.2016.23.12

**41.** Călin, I., Răducuță, I., Dărăban, S., Vlad, I., Priseceanu, H. I., Pascal, C., & Pădeanu, I. (2015). Research on Quantitative Skills in Meat Production Direction at Youth Goats from Carpathian Breed in Relation with the Rearing System. In Agriculture and Agricultural Science Procedia (Vol. 6, pp. 191–196). Elsevier BV. https://doi.org/10.1016/j.aaspro.2015.08.058

**42.** Borgogno, M., Corazzin, M., Saccà, E., Bovolenta, S., & Piasentier, E. (2015). Influence of familiarity with goat meat on liking and preference for capretto and chevon. In Meat Science (Vol. 106, pp. 69–77). Elsevier BV. https://doi.org/10.1016/j.meatsci.2015.04.001

**43.** Janicki, B., & Buzała, M. (2013). EFFECT OF COLLAGEN ON TECHNOLOGICAL QUALITY OF MEAT. In Zywnosc.Nauka.Technologia.Jakosc/Food.Science.Technology.Quality. Polskie Towarzystwo Technologow Zywnosci Wydawnictwo Naukowe PTTZ. https://doi.org/10.15193/zntj/2013/87/019-029

**44.** Stanišić, N., Žujović, M., Tomić, Z., Maksimović, N., Bijelić, Z., Ivanović, S., & Memiši, N. (2012). The Effects of Crossing Balkan and Saanen Goat Breeds on Carcass Traits and Certain Quality Parameters of Kid Meat. In Annals of Animal Science (Vol. 12, Issue 1, pp. 53–62). Walter de Gruyter GmbH. https://doi.org/10.2478/v10220-012-0004-8

**45.** Peña, F., Juárez, M., Bonvillani, A., García, P., Polvillo, O., & Domenech, V. (2011). Muscle and genotype effects on fatty acid composition of goat kid intramuscular fat. In Italian Journal of Animal Science (Vol. 10, Issue 3, p. e40). Informa UK Limited. https://doi.org/10.4081/ijas.2011.e40

**46.** Bonvillani, A., Peña, F., Domenech, V., Polvillo, O., García, P. T., & Casal, J. J. (2010). Meat quality of Criollo Cordobes goat kids produced under extensive feeding conditions. Effects of sex and age/weight at slaughter. In Spanish Journal of Agricultural Research (Vol. 8, Issue 1, p. 116). Instituto Nacional de Investigacion y Tecnologia Agraria y Alimentaria (INIA). https://doi.org/10.5424/sjar/2010081-1150

**47.** Madruga, M. S., Medeiros, E. J. L. de, Sousa, W. H. de, Cunha, M. das G. G., Pereira Filho, J. M., & Queiroga, R. de C. R. do E. (2009). Chemical composition and fat profile of meat from crossbred goats reared under feedlot systems. In Revista Brasileira de Zootecnia (Vol. 38, Issue 3, pp. 547–552). FapUNIFESP (SciELO). https://doi.org/10.1590/s1516-35982009000300021

**48.** Brzostowski, H., Niżnikowski, R., & Tański, Z. (2008). Quality of goat meat from purebred French Alpine kids and Boer crossbreeds. In Archives Animal Breeding (Vol. 51, Issue 4, pp. 381–388). Copernicus GmbH. https://doi.org/10.5194/aab-51-381-2008

**49.** Madruga, M. S., Resosemito, F. S., Narain, N., Souza, W. H., Cunha, M. G. G., & Ramos, J. L. F. (2006). Effect Of Raising Conditions Of Goats On Physico-Chemical And Chemical Quality Of Its Meat Efecto De Las Condiciones De Crecimiento De Cabras En La Calidad Fisico-Química Y Química De Su Carne. In Ciencia y Tecnologia Alimentaria (Vol. 5, Issue 2, pp. 100–104). Informa UK Limited. https://doi.org/10.1080/11358120609487678

**50.** Marichal, A., Castro, N., Capote, J., Zamorano, M. J., & Argüello, A. (2003). Effects of live weight at slaughter (6, 10 and 25 kg) on kid carcass and meat quality. In Livestock Production Science (Vol. 83, Issues 2–3, pp. 247–256). Elsevier BV. https://doi.org/10.1016/s0301-6226(03)00113-1

**51.** Madruga, M. S., Narain, N., Souza, J. G., & Costa, R. G. (2001). Castration and slaughter age effects on fat components of "Mestiço" goat meat. In Small Ruminant Research (Vol. 42, Issue 1, pp. 75–80). Elsevier BV. https://doi.org/10.1016/s0921-4488(01)00224-3

**52.** Rhee, K. S., Waldron, D. F., Ziprin, Y. A., & Rhee, K. C. (2000). Fatty acid composition of goat diets vs intramuscular fat. In Meat Science (Vol. 54, Issue 4, pp. 313–318). Elsevier BV. https://doi.org/10.1016/s0309-1740(99)00094-7



**Funds:**

This research is funded by the Science Committee of the Ministry of Education and Science of the Republic of Kazakhstan (Grant no. AP09058213).

**Acknowledgments:-**


**Conflict of Interest:**

The authors declare no conflict of interest.

**Ethical Statement:**

This article does not contain any studies that would require an ethical statement.


**Contact Address:**

Gulzhan Tokysheva, S. Seifullin Kazakh Agrotechnical University, Department of Food Technology and Processing Products, Zhenis Str., 62, Nur-Sultan, 010000, Kazakhstan,
Tel.: +77026600238,
E-mail: tokisheva_g@mail.ru
ORCID: https://orcid.org/0000-0003-3818-7635

*Kadyrzhan Makangali, S. Seifullin Kazakh Agrotechnical University, Department of Food Technology and Processing Products, Zhenis Str., 62, Nur-Sultan, 010000, Kazakhstan,
Tel.: +77079822448,
E-mail: kmakangali@mail.ru
ORCID: https://orcid.org/0000-0003-4128-6482
Yasin Uzakov, Almaty Technological University, Department of Technology of Food products, Tole Bi Str., 100, 050000, Almaty, Republic of Kazakhstan,
Tel.: +7727396733,
E-mail: yuzakov@internet.ru
ORCID: https://orcid.org/0000-0003-4626-2471
Mukhtarbek Kakimov, S. Seifullin Kazakh Agrotechnical University, Department of Food Technology and Processing Products, Zhenis Str., 62, Nur-Sultan, 010000, Kazakhstan,
Tel.: +77172317547,
E-mail: kakimov.mukhtarbek@bk.ru
ORCID: https://orcid.org/0000-0002-1190-2195
Natalya Vostrikova, V. M. Gorbatov Federal Research Center for Food Systems of RAS, Laboratory Center for food and feed testing, Talalikhina st., 26, Moscow, 109316, Russian Federation,
Tel.: +77172317547,
E-mail: nvstrk@bk.ru
ORCID: https://orcid.org/0000-0002-9395-705X
Meruert Baiysbayeva, Almaty Technological University, Department of technology of bread products and processing industries, Tole Bi Str., 100, 050000, Almaty, Republic of Kazakhstan,
Tel.: +7727396733,
E-mail: baiyasbaeva@bk.ru
ORCID: https://orcid.org/0000-0002-1172-9281
Nurbibi Mashanova, S. Seifullin Kazakh Agrotechnical University, Department of Food Technology and Processing Products, Zhenis Str., 62, Nur-Sultan, 010000, Kazakhstan,
Tel.: +77172317547,
E-mail: nurbibi.mashanova@bk.ru
ORCID: https://orcid.org/0000-0001-8664-5173

Corresponding author: *