

# Study of physical and chemical parameters of goat meat for use in the production of children's food

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**Abstract.** The issue of rational nutrition of children is still extremely relevant and an effective factor ensuring the preservation of life and health of children. Pathological conditions associated with intolerance to certain components of food are increasingly common. When assessing the chemical composition of experimental samples of goat meat (Zaanen, Alpine, Nubian), no abnormal deviations were detected, and all indicators were in the generally accepted contents of this type of animal muscle tissue. Comparative analysis of goat meat samples shows that the fat content is more than 3 times less than that of lamb. The mass fraction of moisture is higher than mutton by 3 - 5%. Thus, it confirms that goat meat is a more dietary meat raw material in comparison with lamb. The potassium content among the experimental samples is distinguished by the goat meat of the Nubian breed ( $4125.83 \pm 618.87$  mg/kg), which in comparison with the Zaanen ( $2470.10 \pm 370.52$  mg/kg) is more than 1.5 times greater, and the Alpine breed ( $1693.22 \pm 253.98$  mg/kg) is more than 2 times. The concentration of such essential amino acids as tryptophan, leucine, isoleucine, phenylalanine, methionine allows you to cover from 14% to 30.5% of the daily norm.

## 1 Introduction

Meat and meat products are an important source of 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 indicators of the number of goats are 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 EAEU countries, which is 91.9%. In particular, supplies to the UAE for \$3.4 million, to Uzbekistan for \$1.6 million are provided, exports to Iran amounted to 112 thousand US dollars [1].

Considering that from 2003 to the present, the indicators of the development of goat breeding have almost doubled, as well as the growing interest of consumers primarily in healthy and proper nutrition, favorable 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.

In terms of taste, goat meat is not inferior to lamb. Goat meat has a moderately pronounced salty taste, and not sweet, like beef [2]. Young goat meat is lighter than

other types of meat, it has a pale pink color. The meat of old animals is brick-red and darkens in the air [3]. Goat fat is pure white [4].

Goats, along with sheep, are one of the first farm animals domesticated by man. According to archaeological data, the first evidence of the domestication of goats is about 10 thousand years old.

Goat products are widely used all over the world. As a rule, in the dairy industries. However, in recent years, meat goat breeding has also been gaining momentum. There are objective reasons for this, first of all, goat meat is a dietary meat with low cholesterol. It also has a rich amino acid composition.

To date, the goat meat market is developed asymmetrically. If in the countries of Asia and Africa it is quite a traditional meat raw material, in many other continents the status of goat meat is rather as a promising direction. However, in recent years, goat meat has been strengthening its position in the meat products market. Since the features of the composition allow you to consume this type of meat as part of a dietary or therapeutic and preventive nutrition.

According to FAO, about 6.3 million tons were produced worldwide in 2019. Of these, (4.53 million tons) are in Asia, (1.47 million tons) in Africa,

for America (137.41 thousand tons), for Europe (96.3 thousand tons) and for Oceania (22.6 thousand tons). Data on the shares of goat meat produced on different continents are shown in Fig. 1 [5].

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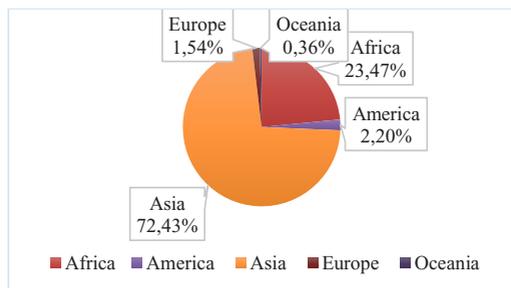


Fig. 1. Goat meat production

Based on FAO statistics, it can be noted that the volume of goat meat produced shows a constant increase in 1991, 2.7 million tons were produced worldwide. By 2019, this indicator has grown more than 2 times and amounted to 6.3 million tons. The detailed dynamics of the growth of goat meat produced worldwide is shown in Fig. 2 [5].

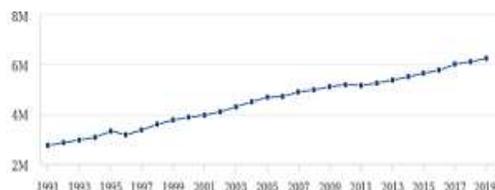


Fig. 2. Schedule of goat meat produced by year

As of 2019, the number of goats worldwide is 1.1 billion heads. The main goat population is located in Africa (23.47%) and Asia (72.43%). Thus, more than 95% of the world's goat population is concentrated in these two regions. Over the period from 2000 to 2019, the growth of livestock amounted to more than 300 million. Data on the dynamics of the number of goats are shown in the diagram in Fig. 3.

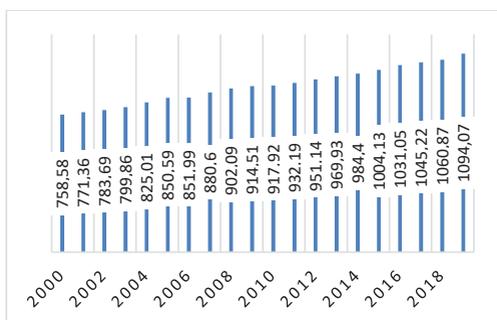


Fig. 3. The number of goats thousand heads 2000-2019

As you can see for the presented period of about 20 years, the total number of goats has grown by almost a third. And exceeded 1 billion heads worldwide. The leaders in total livestock at the moment are such countries as India (148.8 million), China (137.2 million), Nigeria (81.88 million) and Bangladesh.

Table 1. Nutritional value of different types of meat (per 100 g) [6]

Indicator	Goat Meat	Chicken	Beef	Lamb
Energy value, kcal	143	190	210	206
Proteins, g [5]	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, yale goats and castrated goats are eaten. The meat of young animals aged from six to ten months is considered the best. The meat of adult goats is sharper [6]. 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 [7]. The meat of adult uncastrated goats has a pronounced specific odor [8], a possible unpleasant odor in females and young animals may be due to improper processing of the carcass [9]. Compared to other types of red meat, goat meat is leaner. It has less cholesterol and fat than lamb and beef [10], it is less caloric than beef or chicken, and contains a lot of protein [8]. Goat meat is rich in unsaturated fatty acids, minerals, amino acids [7]. 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, paraaminobenzoic acids and choline. In terms of the content of vitamins A, B1 and B2, goat meat significantly exceeds the meat of other farm animals [11]. The use of goat meat is not prohibited by any religious norms, Muslims and Jews can eat it, it has a positive impact in our multinational and multi-confessional society [8].

The aim of the study was to substantiate goat meat for use in children's food products based on the study of the physico-chemical composition.

## 2 Materials and methods

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

Laboratory studies of meat raw materials were carried out on the basis of NAO "S. Seifullin KATU" (Nur-Sultan, RK). The following were studied: total chemical composition (moisture, fat, protein, ash), moisture binding capacity, mineral composition (7 pcs), vitamin composition (5 pcs), fractional composition of protein fraction [12 - 18].

## 3 Results and discussion

Laboratory studies of various indicators of goat meat allows us to give an objective assessment of the biological and nutritional value of meat raw materials.

First of all, it is important to evaluate the physico-chemical parameters. It is worth noting that meat products

are mostly considered as a natural source of proteins and fats. There were such basic indicators as the mass fraction of moisture, fat, protein and ash. The results of the physicochemical parameters are given in Table 2.

**Table 2.** Physicochemical indicators

Indicators	Goat meat "Zaanen"	Goat meat "Alpine"	Goat meat "Nubian"	Lamb
Mass fraction of moisture, %	79.5±8.0	79.9±8.0	77.7±0.77	74.2
Mass fraction of fat, %	2.1±0.3	2.1±0.3	2.4±0.4	7.6
Mass fraction of protein, %	17.5±2.6	17.0±2.6	19.3±2.9	16.3
Mass fraction of ash, %	0.80±0.12	0.92±0.14	1.21±0.17	1.2

As a control sample for comparative analysis, mutton was selected as the type of meat raw material closest in morphology. Comparative analysis of goat meat samples shows that the fat content is more than 3 times less than that of lamb. At the same time, the mass fraction of moisture is higher than mutton by 3 - 5%. In parallel with this, the differences in the mass fraction of protein are about 1 - 3%. In total, this indicates goat meat as a more dietary meat raw material in comparison with lamb. This allows us to consider this type of meat raw materials as potential raw materials for functional products.

At the same time, one of the indicators of the nutritional value of meat raw materials is the presence of such essential substances for the human body as vitamins. During the studies, concentrations of both water-soluble (B3, B5, B6) and fat-soluble (E, D) were determined. Data on the results of the study are shown in Table 3.

**Table 3.** Vitamin composition of goat meat

Indicators	Goat meat "Zaanen"	Goat meat "Alpine"	Goat meat "Nubian"
B <sub>3</sub> , mg/100g	5.20±1.04	6.76±1.35	5.62±1.12
B <sub>5</sub> , mg/100g	0.62±0.12	0.53±0.11	0.59±0.12
B <sub>6</sub> , mg/100g	0.64±0.16	0.64±0.16	0.52±0.13
D <sub>3</sub> , mg/100g	>0.1	>0.1	>0.1
E, mg/100g	0.32±0.06	0.27±0.05	0.33±0.07

The mineral composition of goat meat from different breeds was investigated. Minerals are an important component of meat products. In the composition of goat meat, a number of minerals necessary for the human body have been identified. In the course of studies of goat meat, a number of mineral substances were found, the results of the study are shown in Table 4.

The composition of goat meat is saturated with minerals. It is especially possible to answer such mineral substances of potassium and sodium. According to the potassium index, the goat meat of the Nubian breed (4125.83 ± 618.87 mg/kg) is distinguished among the experimental samples, which is more than 1.5 times more than the Zaanen breed (2470.10 ± 370.52 mg/kg), and the Alpine breed (1693.22 ± 253.98 mg/kg) more than 2 times. In terms of the amount of sodium, similarly, the goat meat of the Nubian (1518.21 ± 242.91 mg/kg) breed is saturated to a greater extent in comparison with the

Zaanen breed (852.27 ± 136.36 mg/kg) and Alpine (1005.83 ± 160.93 mg/kg).

**Table 4.** Mineral composition

Indicators	Goat meat "Zaanen"	Goat meat "Alpine"	Goat meat "Nubian"
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 presence of magnesium is similar to the superiority of Nubian (2955.88 ± 44.38 mg/kg) goat meat with a preponderance. The composition of the amino acids of the

**Table 5.** Amino acid composition

Indicators	Goat meat "Zaanen"	Goat meat "Alpine"	Goat meat "Nubian"
Interchangeable amino acids			
Aspartic acid, g/100 g	1.13±0.17	0.87±0.27	2.32±0.35
Glutamic acid, g/100 g	2.02±0.30	1.87±0.11	4.22±0.63
Serine, g/100 g	0.73±0.11	0.74±0.06	0.34±0.05
Glycine, g/100 g	1.58±0.24	1.43±0.13	1.03±0.15
Alanine, g/100 g	1.21±0.18	1.26±0.17	1.22±0.18
Tyrosine, g/100 g	1.17±0.18	1.1±0.05	0.95±0.14
Cystine, g/100 g	0.25±0.04	0.33±0.19	0.23±0.03
Proline, g/100 g	0.50±0.08	0.57±0.28	0.50±0.08
Conditionally interchangeable amino acids			
Histidine, g/100 g	0.30±0.05	0.43±0.21	0.37±0.06
Arginine, g/100 g	1.38±0.21	1.36±0.19	1.19±0.18
Oxyproline, g/100 g	0.313±0.025	0.457±0.037	0.420±0.034
Essential Amino acids			
Threonine, g/100 g	0.64±0.10	0.87±0.20	0.83±0.12
Valine, g/100 g	1.24±0.19	1.24±0.10	1.32±0.20
Methionine, g/100 g	0.50±0.08	0.67±0.12	0.50±0.08
Phenylalanine, g/100 g	0.57±0.09	0.77±0.12	0.65±0.10
Isoleucine, g/100 g	0.64±0.10	0.83±0.13	0.73±0.11
Leucine, g/100 g	0.84±0.13	0.88±0.24	0.80±0.12
Lysine, g/100 g	1.78±0.27	1.61±0.09	1.40±0.21
Tryptophan, g/100 g	0.204±0.040	0.193±0.038	0.268±0.054
Total, g/100 g	17.00±2.55	17.5±2.63	19.30±2.89

The presence of magnesium is similar to the superiority of Nubian ( $2955.88 \pm 44.38$  mg/kg) goat meat with a preponderance. The composition of the amino acids of the product is one of the key indicators that determine the biological value. As you know, meat and meat products are one of the main sources of protein. Of particular importance is the ratio of interchangeable and essential amino acids. During laboratory tests, the amino acid composition of goat meat was analyzed. The data obtained during the study are shown in Table 5.

The amino acid score indicator allows you to give an objective assessment of the extent to which the composition of essential amino acids is able to compensate for human needs. The comparison is made with respect to the ideal protein, essential amino acids, in which they are fully capable of replacing the need. Data on the amino acid score are given in Table 6.

**Table 6.** Amino acid score

Essential amino acids	The perfect protein	Goat meat "Zaanen"	Amino Acid score %	Goat meat "Alpine"	Amino Acid score, %	Goat meat "Nubian"	Amino Acid score, %
Threonine	2.3	0.64±0.10	27.8	0.87±0.20	33.7	0.83±0.12	36.1
Valine	3.9	1.24±0.19	25.6	1.24±0.10	25.6	1.32±0.20	33.8
Methionine	2.2	0.50±0.08	22.7	0.67±0.12	30.5	0.50±0.08	22.7
Phenylalanine	3.8	0.57±0.09	15	0.77±0.12	20.3	0.65±0.10	17.1
Isoleucine	3.0	0.64±0.10	21.3	0.83±0.13	27.7	0.73±0.11	24.3
Leucine	5.9	0.84±0.13	14.2	0.88±0.24	14.9	0.80±0.12	13.6
Lysine	4.5	1.78±0.27	39.5	1.61±0.09	35.8	1.40±0.21	31.1
Tryptophan	1.1	0.204±0.040	18.5	0.193±0.038	17.5	0.268±0.054	24.4

As can be seen from Table 6 of the study, the samples are rich in essential acids. For example, 100 g of Nubian goat meat is able to cover 36.1% of the daily norm of threonine, in turn, Alpine and Zaanen goat meat covers 27.8% and 33.7%, respectively. The valine contained in the studied samples makes it possible to cover 25.6% (Zaanen, Alpine) to 33.8% (Nubian) of the daily needs of the human body. On average, the concentration of such essential amino acids as tryptophan, leucine, isoleucine, phenylalanine, methionine allows you to cover from 14% to 30.5%. In particular, it is worth noting that all the samples presented are very rich in lysine. The leader among which was the goat of the Zaanen breed 39.5%, samples from Alpine and Nubian breeds allow covering 35.8% and 31.1%, respectively.

## 4 Conclusion

When assessing the chemical composition of experimental samples of goat meat (Zaanenskaya, Alpine,

Nubian), no abnormal deviations were detected, and all indicators were in the generally accepted contents of this type of animal muscle tissue.

Comparative analysis of goat meat samples shows that the fat content is more than 3 times less than that of lamb. The mass fraction of moisture is higher than mutton by 3-5%. Thus, it confirms that goat meat is a more dietary meat raw material in comparison with lamb. The potassium content among the experimental samples is distinguished by the goat meat of the Nubian breed ( $4125.83 \pm 618.87$  mg/kg), which in comparison with the Zaanen ( $2470.10 \pm 370.52$  mg/kg) is more than 1.5 times greater, and the Alpine breed ( $1693.22 \pm 253.98$  mg/kg) is more than 2 times. The concentration of such essential amino acids as tryptophan, leucine, isoleucine, phenylalanine, methionine allows you to cover from 14% to 30.5% of the daily norm. There were no significant differences in moisture binding capacity (WCC) (73.45; 74.42; 73.94%). In general, 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, and therefore it can also be recommended for the production of children's food.

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