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Dependence of the Physicochemical Composition and Biological Value of the Meat of Tuvinian Short-Fattailed Sheep on the Type of Feeding Behavior

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***Abstract*: Studying the biological and nutritional value of the meat of Tuvinian short-fattailed sheep is a relevant task. Tuvinian sheep combine good meat qualities. The article presents the data about the biological and nutritive value of the meat of Tuvinian short-fattailed rams with various types of feeding behavior. For its taste, due to the low content of cholesterol in the fat, lamb meat belongs to dietary products. The highest gain in the muscle tissue is observed in calves of 4 – 6 months of age. When compared to veal, by the content of protein in boneless meat, lamb meat is slightly inferior, but in fat and energy content is superior. Lamb meat protein contains more essential amino acids, such as arginine, tryptophan, threonine than veal. Types of sheep feeding behavior are inheritable. The first behavior type is called strong fast-growing balanced (group I), the second – strong fast-growing unbalanced (group II), the third – weak slow-growing (group III). Sheep of the calm type eat the fodder and assimilate nutrients better, and their consumption of feed per unit of product is lower, and feed efficiency is higher by 28 – 33 %. In the meat of the rams of the behavior type III, the moisture content is 63.8 %, while in group I, it is lower by 2.3 %; in group I, the highest fat content is observed – 17.0 %, which is higher by 1.2 % and 1.6 % than in the behavior groups II and III. By the mass fraction of protein and ash, no significant differences are found. In the studied types of behavior, the relation between the content of fat and protein is not so obvious; however, an increased fat content results in a decreased protein content. The energy value of 100 g of minced lamb meat in feeding behavior group I is 227 kcal, or 949.85 kJ, which is higher by 12 kcal, or 50.25 kJ than in type II, and higher by 15.2 kcal, or 63.66 kJ than in type III, respectively. The amino acids ratio is one of the criteria of meat nutritional value. The protein quality indicator of the muscle tissues (PQI) in seven-months old rams of type II is higher than in the groups of feeding behavior types I and III. A specific and quite clear correlation has been found between the amino acid composition of lamb meat and its organoleptic properties, depending on the type of rams feeding behavior.*

***Index Terms*: Amino Acid and Physicochemical Composition of Meat, Feeding Behavior Type, Protein Quality Indicator, Tuvinian Sheep.**

I. INTRODUCTION

Sheep breeding in Russia has historically formed as an integral part of the national economy. The problem of stabilizing sheep breeding and increasing production in the industry is a major challenge in maintaining the food and raw materials security of Russia [1].

One of the solutions to this problem is the phenomenon of fast-growing, which is of great economic significance due to the fact that fast-growing animals have high growth vigor, the peak amount of the most valuable muscle tissues is accumulated in them during the first year of life, and this period virtually ends with the formation of meat productivity [2]-[5].

Young lamb meat belongs to the best types of meat by its taste qualities due to the low content of cholesterol in the fat. The sheep meat slaughtering age shows the specificity of consumer demand and traditions of the population. The highest gain of muscle tissues in young animals occurs after weaning, especially during the following 4 – 6 months of life [6]-[8].

Nutritional value of the meat depends on the ratio of the various tissues in its composition, the most valuable of which are muscle and fat tissues [9], [10]. By the content of protein in boneless meat, lamb meat is only slightly inferior to beef and veal and is superior to them in fat and energy content. Compared to beef, protein in lamb meat contains more essential amino acids, such as arginine, tryptophan, threonine, which are required by the organism and not synthesized in it [11]-[13]

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The biological and nutritional value of meat is, first of all, characterized by the content of proteins in the muscle tissues. The biological value of meat is determined by the degree of amino acids balance. The higher the content of full-fledged proteins is, the higher this value is [14], [15].

Proteins perform vital functions in the organism, which characterizes their biological importance. Proteins that do not contain at least one essential acid cannot ensure normal functioning of the organism [16]-[18].

According to L. A. Gorozhankina, the amount of some amino acids in lamb meat depends on the animal fatness: fatty meat contains more lysine and less methionine. Animal proteins are better absorbed by the organism because they contain all amino acids needed by the organism in an optimum ratio [19]-[21].

In animal breeding, many researchers pay special attention to the necessity of considering the type of animal behavior. In the modern ethology, animals behavior by the nature of nervous excitability has been systematized and classified into six major systems: productive behavior, sexual, adaptive, population, locomotor, and feeding behavior. In equal feeding and keeping conditions, sheep of the calm type eat the fodder and assimilate nutrients better, their consumption of feed per unit of product is lower, and feed efficiency is higher by 28 – 33 %.

Types of sheep feeding behavior are inheritable, and such traits as meatiness, fast-growing, high wool yield, etc. are passed to the offspring. [22]-[24].

Studying the biological and nutritional value of the meat of Tuvinian short-fattailed sheep is a relevant task and is of both scientific and practical interest. Tuvinian sheep combine good meat qualities and high adaptability to the conditions of sharply continental climate [25]-[28].

The study was aimed at determining the effect of the type of feeding behavior on the physical and chemical composition, and amino acid and protein quality indicator of the meat of the Tuvinian short-fattailed sheep.

II. METHODS

A. General description

Animals were classified into ethological types according to the method of locomotor and feeding reactions of D. K. Belyaeva, V. N. Martynova improved by V. S. Saratovsky, M. I. Liev, et al., which consisted in assessing the individual behavior of sheep in the herd, characterizing their feeding, passive-defensive and indicative reactions on changes in the stereotypical feeding situation.

The experimental work for studying the feeding behavior of Tuvinian sheep was performed at the agricultural production co-operative breed livestock farm Bai-Khol in the Erzin district of the Tuva Republic, which is a breeding farm for preservation and breeding Tuvinian short-fattailed sheep.

B. Algorithm

For the experiment, three groups of ewes (n = 150) were selected, and their behavior types were determined; the ewes were artificially inseminated with the semen from a Tuvinian stud ram, and offspring were obtained. In the offspring, the strength of reaction to supplementary feeding was also determined, and three groups of rams were formed by the results of the tests. The first behavior type was called strong fast-growing balanced (group I), the second – strong fast-growing unbalanced (group II), and the third – weak slow-growing (group III).

Upon reaching the age of seven months, three rams from each group were slaughtered in accordance with the method of the All-Russia Institute of Animal Breeding (1978).

In the conditions of the test center FSC of food systems n.a. V. M. Gorbatov of RAS, the physicochemical and amino acid composition of lamb meat was determined.

The physicochemical composition of minced lamb meat was determined by the average sample from the meat part of the carcass (0.3 kg for three samples from each group). The content of protein, fat, moisture, and ash was determined according to the regulatory documents GOST 33319-2015, 23042-2015 GOST, GOST 25011-2017, and GOST 31727-2012.

To determine the amino acid composition, 0.3 kg of minced lamb neat were taken from the three groups. The studies were performed in compliance with normative documents for test method MI 103.5-105-2011, GOST 23041-2015, and MVI-02-2002.

III. RESULTS

Tuvinian short-fattailed sheep combine good meat quality and high adaptability to the conditions of the sharply continental climate, resistance to low temperatures, unpretentiousness to the feed resources, the capability of winter grazing, and endurance to drifts over long distances.

According to the research of the authors, sheep of this breed have medium dimensions, are well adapted for winter grazing, in most sheep, the fat tail has the length of 13 – 15 cm and the width of 14 – 17 cm. Usually, the tail consists of the fat and the skinny part, which is curved in most cases.

The live weight of the ewes in the autumn is 43 – 50 kg, of rams – 75 – 90 kg. The animals quickly gain weight and have good slaughter qualities. Upon slaughtering of wedders, the average live weight is 50 kg, the slaughter yield is 48 – 52 %. Fecundity of the ewes is low – 104 – 110 % [29]-[31].

The nutritional value of meat is characterized by proteins. The averaged samples of meat from rams in all groups were subjected to physicochemical analysis, the data of which are shown in Table I. According to the authors, in the meat of the rams of feeding behavior type III, the moisture content is 63.8 %, while in the group of feeding behavior type I, it is lower by 2.3 %; in the group of feeding behavior type I, the highest fat content is observed – 17.0 %, which is higher by 1.2 % and 1.6 % than in the groups of feeding behavior types II and III. The content of the mass fraction of dry matter in the meat from the first group is higher than in the second and the third group by 1.49 and 1.73 %. At the same time, no significant differences were found by the mass fraction of protein and ash. As one can see from the data about the studied types of the feeding behavior, the relation between the content of fat and protein is not so obvious; however, an increased fat content results in decreased protein content.

A valuable meat indicator is its nutritional value. It mainly depends on the content of fat, animals fatness. The energy value of 100 g of minced lamb meat in the group of feeding behavior type I is 227 kcal or 949.85 kJ, which is higher by 12 kcal or 50.25 kJ than in the group of feeding behavior type II, and higher by 15.2 kcal or 63,66 kJ than in the group of feeding behavior type III, respectively.

The water-protein ratio of the meat is an index of meat chemical maturity. In the rams of the studied breed, the water-protein ratio almost does not change by the type of feeding behavior, but in the group of feeding behavior type I, this indicator is slightly higher (0.31 %) than in the groups of feeding behavior types II and III by 0.04 and 0.02 %, indicating chemical maturity of lamb meat as early as at the age of seven months.

Table I. Physicochemical composition of average samples of minced meat from carcasses of experimental animals (7 months old) (n = 3)

Characteristic		Group		
		I	II	III
Mass fraction content	moisture	61.5 ± 4.5	62.8 ± 5.0	63.8 ± 5.0
	dry matter	36.5 ± 0.92	35.01 ± 0.65	34.77 ± 0.60
	protein	18.5 ± 0.2	18.2 ± 0.2	18.3 ± 0.1
	fat	17.0 ± 1.7	15.8 ± 1.5	15.4 ± 1.6
	ash	1.00 ± 0.10	1.01 ± 0.09	1.07 ± 0.12
Ratio	moisture-protein	1:0.31	1:0.27	1:0.29
	fat-protein	1:1.19	1:1.09	1:1.1
Energy value	100 g of minced meat, kcal	227	215	211.8
	100 g of minced meat, kJ	949.85	899.6	886.19
pH of the meat		5.7	5.7	5.7
Water-binding ability (WBA), %		53.26	58.66	51.02
Maturity (ripeness) of meat, %		27.6	25.2	24.1
Precocity coefficient, %		0.68	0.61	0.59

The most optimal protein to fat ratio is 1:1. The obtained data clearly show that in all three groups, the fat-to-protein ratio was close to optimal.

After the inflow of oxygen stops, anaerobic hydrolytic decomposition of glycogen occurs in the muscle tissues of the animal, followed by the formation of lactic acid. The initial pH value of the muscle tissue means the level of hydrogen ions concentration directly after animal slaughtering. This value is very unstable. No veracious difference in the pH value was found; in all the three groups it was 5.7.

The ability of meat to bind water determines juiciness, tenderness, losses during thermal processing, and appearance and technological values. In recent years, much attention has been paid to studying the relationship between chemical synthesis to its physical and chemical properties, the water-binding ability in particular. Juiciness is determined by the humidity content in the lamb meat, and the content of intramuscular fat [32]-[34].

According to the data of the authors, the increased water-binding capacity of the meat of the rams is an evidence of the normal course of meat autolysis, since in the group of feeding behavior type II, this indicator was 58.66 %, which was by 5.4 and 7.67 % higher than in the groups of feeding behavior type I and III. This is due to the difference in the mass fraction of fat in the muscle tissue of rams.

Maturity of meat is the fat to moisture ratio in an average sample of meat; according to the calculations of the authors, the meat of the rams at the age of seven months had the maximum maturity in all studied samples, and varied in the range between 27.6 and 24.1 in the first and the third groups, respectively.

The dry matter to moisture ratio is manifested by precocity. According to the data of the authors, Tuvinian short fattailed sheep at the age of seven months are characterized by high precocity, indicating that the animals are intensively gaining muscle mass. For instance, in the group of feeding behavior type I, the ratio of precocity was the highest and amounted to 0.68 %, which was higher by 0.07 and 0.09 % than in groups of behavior types II and III.

The biological value of meat is determined by the degree of amino acids balance [35], [36]. The protein quality indicator of the muscle tissues (PQI) will be the higher, the more full-fledged proteins they contain. The PQI value of various types varies widely from 2.5 to 7.2. For beef, this value is 4.5; for pork – 5.4; and for lamb meat – 5.2. It is believed that the higher the PQI is, the better the quality of meat raw materials is [16], [37]-[39].

The ratio of amino acids in the composition of meat proteins, determined by the tryptophan to hydroxyproline ratio, is one of the criteria of meat nutritive value (Table II).

Table II. Protein quality indicator of the meat of rams at the age of seven months.

Feeding behavior type	Amino acid		Meat protein quality indicator
	tryptophan, mg/%	oxyproline, mg/%	
I	0.43 ± 0.08	0.156 ± 0.019	2.8
II	0.37 ± 0.074	0.146 ± 0.011	2.6
III	0.24 ± 0.048	0.132 ± 0.016	1.8

According to the obtained results, the muscle tissue protein quality indicator (PQI) in the rams of behavior type I at the age of seven months was higher than in rams of the second and the third groups by 0.2 and 1.0, respectively, and amounted to 2.8.

Tryptophan serves as the index of the content of more full-fledged proteins in the meat, while oxyproline serves as the index of less full-fledged proteins in the connective tissues. High level of tryptophan content was observed in the first group – 0.43 mg/%, which was higher by 0.06 and 0.19 mg/% than in similar groups. As to the content of oxyproline, its high content was observed in the first group – 0.156 mg/%, which, compared the groups of feeding behavior types II and III, was higher by 0.01 and 0.024 mg/%.

The value of meat as a protein product is mainly determined by the balanced content of amino acids. During the research, the authors have found that protein in the muscle tissue of rams at the age of seven months contained all groups in amino acids: both nonessential and essential amino acids (Table III).

Table III. Amino acid composition of the meat of rams

Amino acid, g per 100 g of protein	Feeding behavior type		
	I	II	III
Essential amino acids:			
Histidine*	0.66 ± 0.02	0.48 ± 0.01	0.58 ± 0.02
Threonine	0.96 ± 0.03	0.96 ± 0.03	0.86 ± 0.03
Valine	0.86 ± 0.03	0.68 ± 0.02	0.71 ± 0.02
Methionine	0.48 ± 0.01	0.44 ± 0.01	0.46 ± 0.01
Phenylalanine	0.66 ± 0.02	0.68 ± 0.02	0.62 ± 0.02
Isoleucine	0.59 ± 0.02	0.55 ± 0.02	0.61 ± 0.02
Leucine	1.32 ± 0.04	1.43 ± 0.04	1.51 ± 0.05
Lysine	1.99 ± 0.06	1.77 ± 0.05	2.07 ± 0.06
Tryptophane	0.43 ± 0.08	0.37 ± 0.074	0.24 ± 0.048
Total of essential amino acids	7.95	7.76	7.66
Nonessential amino acids:			
Aspartic acid	2.14 ± 0.06	1.88 ± 0.05	1.90 ± 0.06
Glutamic acid	3.22 ± 0.10	2.93 ± 0.08	2.78 ± 0.08
Serine	0.79 ± 0.02	0.86 ± 0.03	0.90 ± 0.03
Glycine	0.84 ± 0.03	1.02 ± 0.03	1.11 ± 0.03
Arginine	1.23 ± 0.04	1.21 ± 0.04	1.25 ± 0.04
Alanine*	1.18 ± 0.04	1.19 ± 0.03	1.15 ± 0.03
Tyrosine	0.36 ± 0.01	0.36 ± 0.01	0.39 ± 0.01
Cystine	0.26 ± 0.01	0.27 ± 0.01	0.26 ± 0.01
Proline	0.69 ± 0.02	0.77 ± 0.02	0.70 ± 0.02
Oxyproline	0.156 ± 0.019	0.146 ± 0.011	0.132 ± 0.016
Total nonessential amino acids	10.866	10.636	10.572
Total amino acids	18.80 ± 0.56	18.40 ± 0.52	18.20 ± 0.55

* * conditionally essential amino acids

The obtained data show that there is a definite and quite clear correlation between the amino acid composition of the meat and its organoleptic properties [40], [41]. The distribution of the total concentration of amino acids between essential and nonessential ones in minced meat of the rams at the age of seven months of various types of feeding behavior is different.

The total amount of essential amino acids in the meat of rams of various types of behavior was in the range between 7.95 for the first group of animals to 7.66 for the third group. The meat of the rams in the second group contained less by 0.19 g per 100 g of protein essential amino acids than the meat of the rams from the first group, while, compared to the third group, their content was higher by 0.1 g per 100 g of protein.

By the total amount of essential amino acids, the best characteristics were observed in the meat of the rams of the first type of feeding behavior; the indicator was 10,866, which was higher by 0.23 and 0.29 g per 100 g of protein than in the other two groups, respectively.

The distribution of the total concentration of amino acids between nonessential and essential amino acids in the minced meat of the rams at the age of seven months of various types of feeding behavior is different; for instance, the total amount of amino acids in all three groups exceeded 18.20 g per 100 g of protein. In the meat of the rams from the group of feeding behavior type I, the total amount of amino acids was veraciously higher by 0.4 and 0.6 g per 100 g of protein than in the meat of the rams from the second and the third groups of animals, respectively.

The obtained results about the content of amino acids show that the meat of the rams involved in the experiment is a biologically complete product.

IV. CONCLUSION

In the meat of the rams of the group of feeding behavior type I, moisture content was the lowest, and fat content – the highest (17.0 %), which was higher by 1.2 % and 1.6 % than in the groups of feeding behavior types II and III. The mass fraction of dry matter in the meat from the group of feeding behavior type I was higher by 1.49 and 1.73 % than in the second and the group of feeding behavior type III. At the same time, no significant differences were found by the mass fraction of protein and ash.

The energy value of 100 g of minced lamb meat in the group of feeding behavior type I was 227 kcal or 949.85 kJ, which was higher by 12 kcal or 50.25 kJ than in the group of feeding behavior type II, and higher by 15.2 kcal or 63.66 kJ than in the group of feeding behavior type III, respectively.

Maturity of the meat of the rams was the maximum at the age of seven months in all studied samples, and varied in the range between 27.6 and 24.1 in the first and the third groups, respectively. In the group of feeding behavior type I, the ratio of precocity was the highest and amounted to 0.68 %, which was higher by 0.07 and 0.09 % than in groups of behavior types II and III.

The muscle tissue protein quality indicator (PQI) in the rams in the group of feeding behavior type I at the age of seven months was higher than in the rams in the groups of feeding behavior type II nad III by 0.2 and 1.0, respectively, and amounted to 2.8.

High level of tryptophan content was observed in the group of feeding behavior type I – 0.43 mg/%, which was higher by 0.06 and 0.19 % than in similar groups. The content of oxyproline was also the highest in the group of feeding behavior type I, and amounted to 0.156 mg/%, which exceeded this value in the groups of feeding behavior types II and III by 0.01 and 0.024 mg/%.

By the total amount of essential and non-essential amino acids, the best results were observed in the meat of the rams of the group of feeding behavior type I. The total amount of amino acids in all the three groups exceeded 18.20 g per 100 g of protein. In the meat of the rams from the group of feeding behavior type I, the total amount of amino acids was higher by 0.4 and 0.6 g per 100 g of protein than the total amount of amino acids in the meat of the rams in the groups of animals of feeding behavior types II and III, respectively.

REFERENCES

1. N. G. Charmuliev, O. V. Chapurkina, “Kachestvennye pokazateli myasa ovets pri ispolzovanii antistressovykh preparatov” [“Qualitative indicators of the meat of sheep upon the use of anti-stress preparations”]. *News of the Lower Volga Agrouniversity Complex, vol. 3*(35), 2014, pp. 135–138.
2. N. I. Ryadinskaya, O. L. Ikonnikova, S. V. Mezentsev, “Khimicheskii i aminokislotnyi sostav myasa ovets prikatunskogo tipa gornoaltaiskoi porody v rannem postnatalnom ontogeneze” [“Chemical and amino acid composition of the meat of sheep of the Prikatun type of the Altay breed in early postnatal ontogenesis”]. *Bulletin of the Altai State Agrarian University, vol. 10*(96), 2012, pp. 92 – 95.
3. A. G. Koshchaev, I. V. Shchukina, A. V. Garkovenko, E. V. Ilnitskaya, V. V. Radchenko, A. A. Bakharev, L. A. Khrabrova, “Allelic variation of marker genes of hereditary diseases and economically important traits in dairy breeding cattle population”. *Journal of Pharmaceutical Sciences and Research, vol. 10*(6), 2018, pp. 1566-1572.
4. A. N. Troshin, A. N. Turchenko, P. D. Onischuk, A. G. Koshchaev, S. P. Kudinova, A. Y. Shantyz, O. V. Koshchaeva, “Long-term use of iron-mineral and iron-organic drugs”. *International Journal of Pharmaceutical Research, vol. 10*(4), 2018, pp. 791-797.
5. I.M. Donnik, A.S. Krivonogova, A.G. Isaeva, A.G. Koshchaev, O.P. Neverova, O.A. Bykova, “Productivity and health markers for large cattle”. *International Journal of Green Pharmacy, vol. 11*(3), 2017, pp. 620-625.
6. P. N. Shkilev, I. R. Gazeev, V. I. Kosilov, E. A. Nikonova, “Kachestvo myshechnoi tkani molodnyaka ovets yuzhnouralskoi porody” [“Quality of the muscle tissues of young South-Ural sheep”]. *Sheep, goats, wool business, vol. 3*, 2010, pp. 66 – 69.
7. A. G. Koshchaev, Y. A. Lysenko, A. V. Luneva, A. N. Gneush, M. V. Aniskina, V. I. Fisinin, I. P. Saleeva, “Studying Biological Activity of Lactobacillus Hydrolysates”. *Journal of Pharmaceutical Sciences and Research, vol. 10*(10), 2018, pp. 2475-2479.
8. L. N. Skvortsova, A. G. Koshchaev, V. I. Shcherbatov, Y. A. Lysenko, V. I. Fisinin, I. P. Saleeva, S. F. Sukhanova, “The use of probiotics for improving the biological potential of broiler chickens”. *International Journal of Pharmaceutical Research, vol.10*(4), 2018, pp. 760-765.
9. P.D. Onischuk, M.P. Semenenko, E.V. Kuzminova, A.G. Koshchaev, “Selective mechanisms of antiviral effect of triazole derivatives in a transplantable virus-producing cell culture of hamadryas baboon. Research Journal of Pharmaceutical”. *Biological and Chemical Sciences, vol. 7*(6), 2016, pp. 1778-1782.
10. N. V. Kenijz, A. G. Koshchaev, A. A. Nesterenko, R. S. Omarov, S. N. Shlykov, “Study the effect of cryoprotectants on the activity of yeast cells and the moisture state in dough”. *Dusunen Adam, vol. 9*(6), 2018, pp. 1789-1796.
11. A. C. Gagloev, A. N. Negreeva, D. A. Frolov, “Kachestva myasa i zhira raznogo genotipa” [“Quality of meat and fat of various genotypes”]. *Technology food processing industry in the AIC – healthy food products, vol. 2*, 2016, pp. 15.
12. A. V. Pikhtireva, “Aminokislotnyi sostav myasa ovets” [“Amino acid composition of lamb meat”]. *Animal breeding and veterinary medicine, vol. 3*, 2016, pp. 41-43.
13. M.I. Zverzhanovskiy, S.N. Zabashta, T.S. Kataeva, A.G. Koshchaev, M.V. Nazarov, “Epizootic trichinellosis situation and consortive links in jackals (Canis aureus L.) in North-western Region of Russia”. *Indian Veterinary Journal, vol. 94*(10), 2017, pp. 29-32.
14. I.V. Sobol, L.V. Donchenko, L.Y. Rodionova, A.G. Koshchaev, A.V. Stepovoy, “Peculiarities of analytical characteristics of pectins extracted from sunflower hearts”. *Asian Journal of Pharmaceutics, vol. 11*(1), 2017, pp. 97-100.
15. A.V. Garkovenko, V. V. Radchenko, E. V. Ilnitskaya, A. G. Koshchaev, I. V. Shchukina, A. A. Bakharev, S. F. Sukhanova, “Polymorphism of cattle microsatellite complexes”. *Journal of Pharmaceutical Sciences and Research, vol. 10*(6), 2018, pp. 1545-1551.

16. I. A. Sazonova, "Vliyanie kormovogo ratsiona estestvennykh pastbishch Povolzhya na khimicheskii sostav myasa molodnyaka ovets" ["The effect of feed diet of the natural pastures of the Volga region on the chemical composition of young lamb meat"]. *Efficient animal breeding, vol. 4*, 2018, pp. 79.
17. A.A. Bakharev, O.M. Sheveleva, K.A. Fomintsev, K.N. Grigoryev, A.G. Koshchaev, K.A. Amerkhanov, I.M. Dunin, "Biotechnological characteristics of meat cattle breeds in the Tyumen region". *Journal of Pharmaceutical Sciences and Research, vol. 10*(9), 2018, pp. 2383-2390.
18. I. N. Tuzov, V. G. Ryadchikov, A. N. Ratoshniy, N. I. Kulikova, A. G. Koshchaev, "Using Holstein Cattle in Conditions of the Krasnodar Territory". *Journal of Pharmaceutical Sciences and Research, vol. 10*(12), 2018, pp. 3160-3163.
19. A. B. Lisitsyn, V. P. Lushnikov, "Proizvodstvo i pererabotka baraniny: Spravochnik" ["Lamb meat production and processing: Handbook"]. Saratov: PC "Nauka", 2008, pp. 33 – 36.
20. V. E. Nikitchenko, D. V. Nikitchenko, "Myasnaya produktivnost ovets" ["Meat productivity in sheep"]. Moscow: RUDN, 2009.
21. V.I. Shcherbatov, L.I. Sidorenko, A.G. Koshchaev, V.K. Vorokov, L.N. Skvortsova, "Chicken hatching syncronization for artificial incubation". *Journal of Pharmaceutical Sciences and Research, vol. 10*(1), 2018, pp. 148-151.
22. V. S. Saratovsky, M. I. Liev, G. I. Emelyanov, "Sheep ethology". Moscow: Agropromizdat, 1990.
23. N.G. Starostina, A.G. Koshchaev, E.N. Ratner, A.B. Tsiomenko, "Cell surface hydrophobicity in methanotrophic bacteria by their adherence to hydrocarbons". *Mikrobiologiya, vol. 66*(2), 1997, pp. 185-191.
24. A. N. Troshin, P. D. Onischuk, A. G. Koshchaev, S. P. Kudinova, O. V. Koshchaeva, V. Y. Nikitin, A. S. Krivonogova, "Parameters of acute toxicity of the Ferro-Quin iron-sorbitol-protein complex". *International Journal of Pharmaceutical Research, vol. 10*(4), 2018, pp. 784-790.
25. Y. A. Yuldashbaev, M. I. Dongak, K. A. Kulikova, "Khozyaistvenno-poleznye priznaki u ovets tuvinskoi korotkozhirnokhvostoi porody i perspektivy izucheniya polimorfizma genov" ["Economically useful traits of the Tuvinian short-fattailed sheep and the perspectives of studying the polymorphism of genes"]. *News of the Saint-Petersburg State Agrarian University, vol. 42*, 2016, pp. 141–148.
26. E. I. Anisimova, A. G. Koshchaev, A. A. Nesterenko, A. A. Bakharev, A. G. Isaeva, T. M. Shuvaeva, T. V. Kalashnikova, "Comparative Assessment of the Relationship Between Intrabreed Types of Simmental Cows and Sectionized Traits". *International Journal of Pharmaceutical Research, vol. 10*(4), 2018, pp. 604-610.
27. M.A. Chasovshchikova, O.M. Sheveleva, M.A. Svjazhenina, N.I. Tatarkina, A.B. Satkeeva, A.A. Bakharev, E.A. Ponomareva, A.G. Koshchaev, "Relationship between the genetic variants of kappa-casein and prolactin and the productive-biological characteristics of cows of the black-motley breed". *Journal of Pharmaceutical Sciences and Research, vol. 9*(7), 2018, pp. 1038-1044.
28. S. V. Svistunov, A. G. Koshchaev, N. N. Bondarenko, O. V. Koshchaeva, A. M. Smirnov, Y. A. Yuldashbayev, O. G. Lorets, "Selection of Bees of the Gray Mountain Caucasian Breed: Apis mellifera caucasica L. of the Krasnaya Polyana Type". *Journal of Pharmaceutical Sciences and Research, vol. 10*(12), 2018, pp. 3185-3188.
29. Y. A. Yuldashbaev, K. A. Kulikova, M. I. Dongak, S. O. Chylbak-ool, "Kharakteristika vnutriporodnykh tipov ovets tuvinskoi korotkozhirnokhvostoi porody" ["Characteristic of intrabreed types of Tuvinian short-fattailed sheep"]. *Collection of articles with reports of the Timiryazev Academy. Part III*. Moscow: Publishing House RSAU-MAA, vol. 289, 2017, pp. 188–189.
30. I. S. Koba, A. A. Lysenko, A. G. Koshchaev, A. K. Shantyz, I. M. Donnik, V. I. Dorozhkin, and S. V. Shabunin, "Prevention of Mastitis in Dairy Cows on Industrial Farms". *Journal of Pharmaceutical Sciences and Research, vol. 10*(10), 2018, pp. 2582-2585.
31. I. P. Saleeva, V. S. Lukashenko, A. G. Koshchaev, V. G. Volik, D. Y. Ismailova, "Quality of Broiler Chicken Meat with the Use of Various Methods of Growing". *Journal of Pharmaceutical Sciences and Research, vol. 10*(11), 2018, pp. 2979-2984.
32. N. I. Zherebilov, L. I. Kibkalo I. A. Kaznacheeva N. A. Goncharova, N. I. Tkacheva, "Vlagosvyazyvayushchaya sposobnost myasa" ["Meat water-binding ability"]. Bulletin of the Kursk State Agricultural Academy, 2011, pp. 60 – 61.
33. E. A. Nikonova, V. I. Kosilov, M. B. Kalasov, Y. A. Yuldashbaev, "Fiziko-khimicheskie, tekhnologicheskie i strukturno-mekhanicheskie svoistva myshechnoi tkani molodnyaka ovets kazakhskoi kurdyuchnoi grubosherstnoi porody" ["Physicochemical, technological and structural-mechanical properties of muscle tissues in young sheep of the Kazakh fat-tailed coarse-wooled breed"]. *News of the Orenburg State Agrarian University, vol. 5*(67), 2017, pp. 180.
34. A. G. Koshchaev, Y. A. Lysenko, A. A. Nesterenko, A. V. Luneva, A. N. Gneush, "Development of feed additives for poultry farming". *Dusunen Adam, vol. 10*(1), 2019, pp. 1567-1572.
35. E. V. Kuzminova, M. P. Semenenko, A. G. Koshchaev, O. Y. Chernyh, A. N. Turchenko, "Pharmacological prevention of obstetric and gynecological diseases in cows". *Dusunen Adam, vol. 10*(1), 2019, pp. 608-612.
36. N. I. Kryukov, V. O. Yurchenko, A. G. Koshchaev, N. E. Gorkovenko, D. P. Vinokurova, A. A. Bogosyan, S. F. Sukhanova, "The Derivative of Prussian Blue Paint – Khzh-90 Cesium Isotopes' Sorbent at Mycotoxicoses". *International Journal of Pharmaceutical Research, vol. 10*(4), 2018, pp. 669-674.
37. K. V. Kharlamov, N. I. Minaev, A. R. Zhvakina, "Sravnitelnaya kharakteristika aminokislotnogo sostava myasa pomesnogo i chistoporodnogo molodnyaka krolikov" ["Comparative characteristic of the amino acid composition of the meat of purebred and crossbred young rabbits"]. *Reports of the Russian Academy Agricultural Sciences, vol. 4*, 2016, pp. 69.
38. I.S. Koba, A.A. Lysenko, A.G. Koshchaev, I.A. Rodin, A.U. Shantyz, "Effective treatment of chronic endometritis in cows by florinazol preparation". *Indian Veterinary Journal, vol. 94*(10), 2017, pp. 15-18.
39. A.G. Koshchaev, T.A. Inyukina, N.N. Guguchvili, Y.A. Makarov, A.M. Gulyukin, O.P. Neverova, V.N. Shevkopljas, "The influence of metabolic products of Echinococcus granulosus on the oxidation processes in the organism of pigs". *Journal of Pharmaceutical Sciences and Research, vol. 10*(9), 2018, pp. 2317-2325.
40. A. G. Koshchaev, Y. A. Lysenko, M. P. Semenenko, E. V. Kuzminova, I. A. Egorov, E. J. Javadov, "Engineering and development of probiotics for poultry industry". *Asian Journal of Pharmaceutics, vol. 12*(4), 2018, pp. 1179-1185.
41. A. N. Ratoshny, A. A. Soldatov, S. I. Kononenko, I. N. Tuzov, A. G. Koshchaev, "Organization of feeding dairy cows for preventing metabolic disorders". *Journal of Pharmaceutical Sciences and Research, vol. 10*(12), 2018, pp. 3273-3276.