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The studies of technological and physical-chemical properties of rabbit meat

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ABSTRACT

Each year worldwide, there is an increase in the consumption of rabbit meat, which is due to its high nutritional value and recognized dietary properties. We have studied the technological and physical-chemical properties of the rabbit meat of the most common in Georgia Californian and New Zealand white rabbit breeds. The modern, standard, generally accepted methods of research were used in this work. There have been determined the share of products obtained as a result of the slaughter of rabbit breeds under study, the yield capacity of anatomical parts obtained as a result of disintegration of the slaughtered carcass, their morphological composition and the meatiness index, on the basis of which, it is possible to develop technologies for the rational use of different parts of the processed rabbit meat. The studies of physical-chemical properties showed that pH value determining the stability of meat relative to decomposing microflora and the amino-ammoniac nitrogen content defining the goodness of meat did not exceed the norms and standards, the test for primary products od decay of proteins in the broth was negative, and the reaction of peroxidase was positive, indicating that the meat was produced by healthy animal. The studies of the contents of lead, cadmium, arsenic and mercury in different rabbit breeds do not exceed acceptable standards that indicate their safety, as well as their sanitary and hygienic reliability.

Keywords: Rabbit meat, Tissue composition, Physical-chemical characteristics, Toxic substances, Safety, Standard.

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Introduction

Meeting people's needs for high quality and safe foods is a major challenge of our day.

The meat is a nutritious food that must be included in the human diet. It contains a number of essential biologically active substances needed to regulate growth, regeneration, plastic and energy processes, as well as to restore protein resources of the organism.

In today's conditions, there is a deficit of meat in Georgia, as well as the significant increase in meat prices, which in turn leads to large quantities of imported meat products. According to data provided by Geostat, in 2017, Georgia imported 124 thousand tons of frozen meat [1]. In order to solve this very important problem, we need to find new types of local high quality meat.

Rabbit-breeding is a highly promising branch of livestock farming. Rabbit is distinguished by early maturity, high fecundity and high meat productivity. Its breeding does not require too much spending on major construction, energy and human resources. Consequently, costs of production for rabbit meat is also lower in comparison with other types of meat. On average, one doe produces 100 kg of meat and raw materials for producing 55 pieces of jackets [2-8].

Each year worldwide, there is an increase in the consumption of rabbit meat. The world leading countries manufacturers of rabbit meat are China, Italy, Spain and France. Its consumption per capita in Italy, for example, is 4,5 kg per year, while in Europe the average indicator is 2 kg [2,9-12].

In Georgia, the formerly well-developed rabbit-breeding branch, requires now the rejuvenation.

Rabbit meat is an ecologically clean product. American scientists have established that until the age of six months, rabbit does not accept at all strontium-90, as well as other products of atomic disintegration of pesticides and herbicides. Rabbit meat pertains to the "white meat", has a finely-fibred and gentle consistency, well-digested by the organism. Compared with beef, pork and poultry meat, morphological characteristics, technological properties, nutritional and biological value of rabbit meat of rabbit meat are higher: they distinct from them by significant yield of muscle tissue, and smaller quantity of connective tissue, the relatively larger amounts of easily digested complete and quite small amounts of fat and cholesterol. Rabbit meat is also a source of vitamins and minerals [13-25].

The above mentioned properties of rabbit meat indicate expediency of its use, as high-quality meat, in production of healthy foods, dietary and clinic nutrition. [9,26-29].

The aim of the work is to study the technological and physical-chemical properties of the rabbit meat.

Objectives and methods

The studies were carried out in the laboratories of the Department of Food Technologies of Akaki Tsereteli State University. The following rabbit breeds were chosen as the objects of study: the Californian rabbit and the New Zealand white rabbit, their age was 130 days. The rabbit meat slaughtered according to generally accepted methodology was stored at a temperature of +4 0C for 24 hours.

We assessed the quality of rabbit meat on the basis of technological and physical-chemical indicators. To this end, we used generally accepted methods of the analysis of meat products described in the appropriate standards, normative documents and special literature.

The share of products obtained as a result of the slaughter of different rabbit breeds, the yield capacity of anatomical parts remained after technological disintegration of the slaughtered carcass and its morphological composition were determined by calculating after removing non-food products from slaughtered carcass, disintegration of carcass into several parts and after they are weighted.

The index of meatiness of separate anatomical parts was determined by quantitative ratio of muscle and bone tissues.

We studied the physical-chemical properties of rabbit meat by State Standard [30] according to the following indicators: pH medium, amount of volatile fatty acids (mg/KOH), test for primary products od decay of proteins in the broth (reaction with CuSO4), amount of amino-ammoniac nitrogen (%), the reaction of peroxidase.

Stability of meat relative to decomposing microflora – pH medium was determined by potentiometric method, on a pH meter Mi150 according to the instruction [31]. Meat freshness was studied by the content of volatile fatty acids and test for primary products of decay of proteins in the broth (reaction with a 5%-solution of $CuSO_4$); goodness of meat – by amount of amino-ammoniac nitrogen; and meat healthiness – by the reaction of peroxidase.

The heavy metal content was determined on an atomic adsorption spectrophotometer SHIMADZU AA-6200, the lead content was determined by State Standard GOST 26932-86 [32], the cadmium content - by State Standard GOST 26933-86 [33], the mercury content - by State Standard GOST 26927-86 [34], and the arsenic content - by State Standard GOST 26930-86 [35].

Statistical processing of the results obtained and the assessment of the reliability of the data were made by the mathematical statistics methods using the Windows' IBM SPSS Statistics IBM SPSS Statistics software (version 20.0). To describe the variation series, we measured the arithmetic mean and the average standard error.

Graphical interpretation of the results was made by using Microsoft Excel.

Tables and graphs illustrate the data of the experiments performed, each value is a mean of at least five determinations.

Results and analysis

At the first stage of the work, we identified the share of products obtained as a result of the slaughter of Californian and New Zealand white rabbit breeds (Table 1).

Table 1. *The share of products obtained as a result of slaughtering different rabbit breeds*

Name of part	Yield capacity, % of live weight	
	Breeds	
	Californian	New Zealand white
Live weight, kg	3,00±21,5	3,260±21,5
Slaughtered carcass	64%	65%
Head	4,3%	4,2%
Skin	8,3%	8,0%
Ears, feet, tail.	2,9%	2,5%
Blood	2,0	2,0%
Liver	2,5%	2,5%
Heart, lungs.	0,8%	0,8%
Intestines without the contents.	5,4%	5,3%
Intestines fat	0,5%	0,5%
Other waste	9,3%	9,2%
Total	100	100

Table 1 demonstrates that both rabbit breeds are distinguished by high yield capacity, while the yield capacity of the New Zealand white rabbit breed's slaughtered carcass is greater than the yield capacity of the Californian rabbit breed's slaughtered carcass. Compared to other parts, the yield capacity jacket material - leather is high (8,3%). The total number of sub-products amounted to 16,4 - 15.8%. Still, it should be mentioned that the processing of rabbit meat is near zero-waste, because sub-products obtained as a result slaughtering (except the liver, which is deemed a valuable nutrient), blood and the intestinal contents are used for producing protein supplement (in the form of flour) for the formula feed.

The results obtained are in compliance with the similar data available in the literature on rabbit breeds under study. At the same time, according to a number of authors, the yield capacity of some of the parts obtained from the slaughtered carcass of other rabbit breeds (white Goliath, silver, chinchilla) differ from those that we obtained. In particular, the yield capacity of head among these breeds is 6,0-6,8%, skin's yield capacity is 13,3-13,4%, blood's yield capacity - 2,0-2,1%, liver's yield capacity - 3, 2-3.5%, intestine's yield capacity (without the contents) - 6,2-6,3%, other waste's yield capacity - 9,8-10,8%. There is also a significant difference in yield capacities of the slaughtered carcass, which according to Vasilenko vary between 52,9 and 55.9% [4]. This can be explained by the breed characteristics of rabbit.

For further studies, the slaughtered carcass of rabbit breeds under study was divided into four anatomical parts: coxofemoral, lumbosacral, scapulohumeral, and cervicothoracic. Their yield capacities are given in Table 2.

Table 2. *Yield capacities of anatomical parts of the rabbit's slaughtered carcass*

Indicator	Rabbit breeds	
	Californian	New Zealand white
Carcass mass, g	1920±21,5	2119±20,8
Coxofemoral part, g	679,7± 5,6	745,9±4,8
Yield capacity of coxofemoral part, %	35,4	35,2
Lumbosacral part, g	485,8±2,3	542,5±2,7
Yield capacity of lumbosacral part, %	25,3	25,6
Scapulohumeral part, g	472,3±3,7	506,4±3,6
Yield capacity of scapulohumeral part, %	24,6	23,9
Cervicothoracic part, g	282,2±3,4	324,2±3,9
Yield capacity of cervicothoracic part, %	14,7	15,3

An analysis of the data contained in Table shows that with yield capacity of anatomical parts, the rabbit breeds under study do not differ significantly from each other.

In both studied rabbit breeds, coxofemoral part is distinguished by highest yield capacity, yield capacities of cervicothoracic part is lower by 58.5 and 56.5% (by breeds), 30.5 and 32.1% lower is yield capaciies of scapulohumeral part and 28.5 and 27.3% lower is yield capacities of lumbosacral part.

The results of studying the morphological composition of individual parts of these rabbit breeds are shown in Fig. 1 and 2.

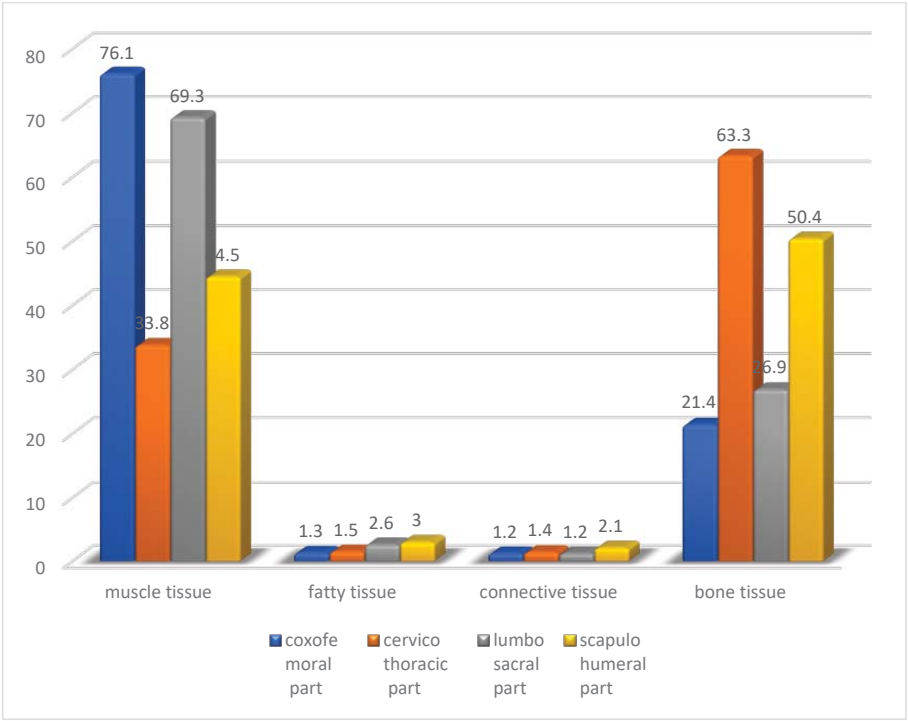

Fig. 1. *Morphological composition of the Californian rabbit's slaughtered carcass*

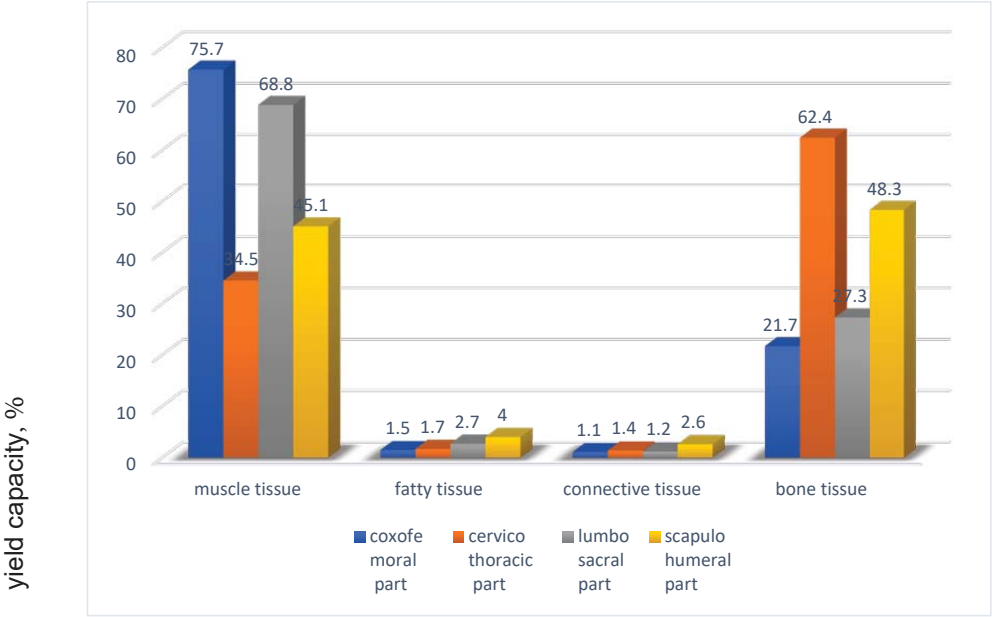

Fig. 2. *Morphological composition of the New Zealand white rabbit's slaughtered carcass*

Fig. 1 and 2 show that coxofemoral part contains the highest amount of muscle tissue (76.1% and 75.7%, by breeds), the lowest amount of bone tissue (21,4% and 21.7%) and the minimum amount of fatty (1,3% and 1,5%) and connective tissues (1,2% and 1,1%). The highest fatty tissue content is in scapulohumeral part. The percentage of muscle tissue in cervicothoracic part is 42.3 and 41.2 lower than in coxofemoral part, and 31.6 and 30.6% lower than coxofemoral part. The highest bone tissue mass content is observed in cervicothoracic part, and its content is 12.5 and 14,1% lower in scapulohumeral part, and the lowest content is observed in coxofemoral part (21,4% and 21,7%, accordingly).

It is noteworthy that meat muscle tissue differs from other tissues in a significantly higher nutritional value. Its content in coxofemoral part of the rabbit's slaughtered carcass, and the data we obtained earlier in the whole slaughtered carcass on muscle tissue (75.45% and 76.75%) [19], as well as similar data available in the literature [4,5,15,22, 36] demonstrate that the muscle tissue content in the rabbit's slaughtered carcass considerably exceeds its content in the slaughtered carcasses of other animals. In particular, the muscle tissue content in the slaughtered carcass of cattle is 57-62%, in the sheep's slaughtered carcass- 50-60%, in the pig's slaughtered carcass - 40-52%, and in broiler poultry - 51-53% [5]. Thus, the rabbit meat is more complete, soft and gentle.

An analysis of Figures 1 and 2 also shows that the meat of the front part of the rabbit's slaughtered carcass contains more quantities of connective tissue (4,5-6,6%) than its back part (2,3-2,4%). This indicates that the meat of the front part of the slaughtered carcass is more hard than the back part's meat.

Based on the obtained data, it is possible to choose those technologies for the rational use of anatomical parts of the different rabbit breeds, which contribute to maintaining their useful properties as long as possible.

It is believed that the most objective quality indicator of meat and its individual anatomical parts is the "meatiness index", which implies the quantitative ratio of muscle and bone tissues in the slaughtered carcass.

Fig. 3 illustrates the meatiness index of anatomical parts of meat of rabbit breeds under study.

As shown in Fig. 3, anatomical parts of the rabbit meat, according to the meatiness index, can be arranged in the following sequence: coxofemoral part, lumbosacral part, scapulohumeral part and cervicothoracic part.

When studying the technological and physical-chemical properties of meat, we determined their significant indicators, such as pH medium, reaction of peroxidase, test for primary products od decay of proteins in the broth, amount of volatile fatty acids and amount of amino-ammoniac nitrogen (Table 3).

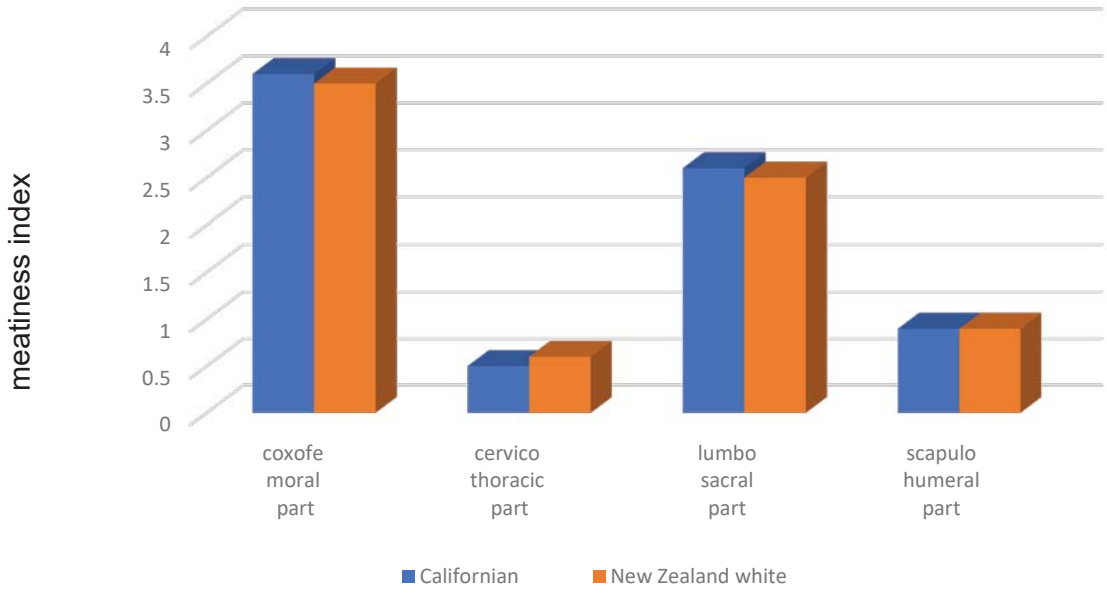

Fig. 3. *The meatiness index of anatomical parts of meat of different rabbit breeds*

Table 3. *Physical-chemical indicators of rabbit meat*

Indicators	Acceptable norm in frozen meat	Rabbit breeds	
		Californian	New Zealand white
pH	5,7- 6,2	6,03±0,31	5,87±0,29.
Reaction of peroxidase	Positive*	Positive	Positive
Test for primary products od decay of proteins in the broth (reaction with a 5%-solution of CuSO4)	Negative*	Negative	Negative
Amount of volatile fatty acids (mg/KOH)	≤2,25*	2,09±0,12	2,14±0,10
Amount of amino-ammoniac nitrogen (%)	1,4-2,0	1,65±0,08	1,52±0,03

An analysis of Table indicates that pH value determining the stability of meat relative to decomposing microflora in experimental samples does not exceed the norms and standards. In addition, the amount of fatty acids that determine the freshness of meat and the amino-ammoniac nitrogen content defining the goodness of meat are also within the limits of the standards, the test for primary products od decay of proteins in the broth was negative, but the reaction of peroxidase was positive, indicating that the meat was produced by healthy animal, since the enzyme peroxidase was active in all samples of meat. The extracted meat, after adding the Nessler's reagent, remained transparent in all cases.

Thus, the physical-chemical indicators of the rabbit breeds meat under study meet the quality requirements of meat.

In today's difficult environmental conditions, food safety issue is of high relevance. Therefore, we identified the content of the toxic substances in the meat of rabbit breeds under study (Table 4).

An analysis of Table shows that the contents of lead, cadmium, arsenic and mercury in different rabbit breeds do not exceed acceptable standards that indicate their safety, as well as their sanitary and hygienic reliability.

Conclusioin

1. With a view to enhancing the use of products produced from rabbit meat, there have been studied the share of products obtained as a result of its slaughtering, yield capacity of anatomical parts and morphological composition of the rabbit's slaughtered carcass.
2. It has been established that the highest amounts of muscle tissue (76.1% and 75.7%) are contained in coxofemoral part and lumbosacral parts (68,8-69,3) of breeds, and connective tissue – in cervicothoracic scapulohumeral parts. Based on the obtained data, it is possible to choose those technologies for the rational use of anatomical parts of the different rabbit breeds, which contribute to maintaining their useful properties.
3. Anatomical parts of the rabbit meat, according to the meatiness index, can be arranged in the following sequence: coxofemoral part (3,5-3,6), lumbosacral part (2,5-2,6), scapulohumeral part (0,9) and cervicothoracic part (0,5-0,6).
4. It has been established that the physical-chemical indicators of the rabbit breeds meat under study

Table 4. *The content of toxic substances in rabbit meat*

Indicators	Acceptable norm*, mg/kg	Rabbit breeds	
		Californian	New Zealand white
Lead	Up to 0,5	0,038±0,01	0,12-0,14 мг/кг.
Cadmium	Up to 0,05	не обн. <0,01	0,007-0,019 мг/кг.
Arsenic	Up to 0,1	не обн. <0,0025	
Mercury	Up to 0,03	0,011±0,005	

* SanPiN 2.3.2.1078-01 p. 59

meet the quality requirements of meat.
5. The content of toxic substances in the rabbit meat indicates their safety, as well as their sanitary and hygienic reliability.
6. The data on the morphological and technological characteristics and physical-chemical properties of the slaughtered carcass should be taken into account when developing technologies for producing from them dietetic therapeutic healthy foods.

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