Veterinary and Sanitary Assessment and Commodity Characteristics of Hare Meat (Lepus Timidus) in the Central Zone of Yakutia

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Abstract. In the modern world, providing the population with high-quality food is a step of paramount importance which aims to protect the interests of consumers at the current stage of development of society. One of the main provisions of the concept of state policy in the field of healthy nutrition of Russia is providing the population with high-quality nutrient products. One of the promising sectors of the livestock section is wild animal business. Hare meat is a product with good gastronomic qualities, which, in addition, has medical property. It has great biological value, high absorption, energy-restricted and hypoallergenic this is ground for recommending hare meat to elderly people, children, pregnant and lactating mothers. To determine the organoleptic, physico-chemical, microbiological, chemical-toxicological parameters, microscopy of smear-fingerprints, determine the parasitic purity, we conducted laboratory studies of hare meat samples obtained in the Central zone of Yakutia for compliance with regulatory requirements.

The objective of the study is to give the veterinary and sanitary assessment and commodity characteristics of hare meat in the conditions of the Central zone of Yakutia. To achieve the goal were established the following tasks: to study the organoleptic and physico-chemical parameters of hare meat (Lepus timidus) of the Central zone of Yakutia on conformity with the requirements; to conduct a microbiological study in accordance with safety requirements: determining the number of KMAFAnM, the presence of BGKP, the detection of pathogenic microorganisms including salmonella; to conduct a parasitological study of hare carcasses for the presence of maggots and worm eggs; to determine the content of toxic elements in hare meat. The study has established organoleptic, physico-chemical, microbiological, bacterioscopic, chemical-toxicological and parasitological indicators of the quality of hare meat and determined its safety.

1. Introduction

In recent years, there has been an increase of wild fowl popularity among consumers of Russia but in many developed countries, including Europe [1]. There is a question of public awareness about the well-being of animals and food safety which directly affects the profitability of supplies [2].

Insufficient quality control is causing the confusion for indigenous communities around the world. It addresses the problems of the impact of heavy metals because of the consumption of traditional foods in the areas of industrial enterprises with air emissions. According to the results of the study, it was noted a high concentration of Cd (3.79 mg / kg) and Hg (0.15 mg / kg) in the liver of hares that
dwell near a copper smelter factory in North America. In assessing a risk, necessary to take into account the nutritional and socio-cultural importance of traditional foods [3].

It was studied the bioaccumulative effect of heavy metals on histopathological changes in wild Arctic hares (Lepus arcticus) living in a former lead-zinc mine in the Canadian high Arctic. [4]

Active development of wild animals’ and birds’ habitat and development of industrial facilities, processing of agricultural pastures with using chemical leads to environmental pollution of soil, water, atmospheric air. Chemical contaminants of meat, such as pesticides, dioxins, poly chlorinated biphenyls, polycyclic aromatic hydrocarbons, heavy metals, and others reduce the quality of meat not only farm animals but also game fowl. New methods are being developed to detect chemical contaminants in meat products by gas and liquid chromatography-mass spectrometry [5].

It pays particular attention to modern methods of identification, determining the species of meat, including recommendations for testing DNA of meat and the perfection of monitoring systems for meat products in South Africa, Europe and Asia [6]. The use of selective and sensitive methods of analysis based on PCR diagnostics of the myostatin gene fragment helps to find and detect the falsification of food products [7].

Molecular research methods revealed inconsistencies in meat labeling from commercial facilities and butcher shops in South Africa. In 68% of the examined samples of meat and meat products were found an undeclared species of plants or animals such as pork, chicken, gluten, and soy. In some types of meat were found non-traditional species (donkey, goat, and buffalo) [8].

The quality of game fowl is determined by the level of bacterial contamination and pathogenic microorganisms, including Salmonella, S.enterica, S. Typhimurium and S. Enteritidis serovars. On the one hand, wildlife is exposed to salmonella, originating from farm animals and humans, and the fowl can be a source of salmonella in farm animals [9]. Peculiarities of production and non-compliance with sanitary requirements during slaughter, gutting and cooling of animals lead to a decrease of meat quality and slaughter products by microbiological indicators [10].

These factors require other laboratory tests. Conducting only organoleptic studies does not give a complete picture of the quality and safety of using of game fowl.

Hunting is a way of life and means of existence for the indigenous peoples of Yakutia, hunting as an added source of nutrition on wild animals and waterfowl that live in the vast territory of the republic. White hare hunting is one of the most popular types of hunting for game animals in Yakutia. This meat is considered being a nutritious, dietary product, non-greasy, has a dense texture, because hares lead an active lifestyle, eat natural feed, and hare habitat of the Central zone of Yakutia passes far from industrial zones. A distinctive feature of hare carcasses is a dark red color with a bluish tint. But the quality of meat depends on various factors: the method of animal extraction, bloodlessness, age of the animal, transportation and storage conditions, etc. [11].

Most methods of hare harvesting do not offer adequate bleeding of meat, which leads to increased moisture on the surface of carcasses and meat, and not always high-quality processing of carcasses creates conditions for the rapid development of microflora, including putrefactive [12].

It has been established that strains Escherichia coli (Escherichia coli) are the source of seeding products producing toxin not only meat of domestic but the meat of commercial animals [13].

Parasitic diseases, which reduce the immune status of animals and the biological value of meat have an adverse effect on the quality of hare meat worsening fatness and nutritional status [14].

The genus of hares is diverse and includes 10 subgenus, divided into several species. The most common representative of the hare genus is the white hare which lives throughout Russia, in Northern Europe, Ireland, Mongolia, South America and many other countries of the world. This hare is distinguished by a characteristic seasonal dimorphism - in areas with a stable snow cover, the fur color gains a pure white color, except for the tips of the ears. In the summer, the hare is gray.

The hare is a common type of small fowl; it resembles the taste of rabbit meat, but the hare’s meat is not so fatty but the meat of the hare is not so fat; more fragrant and tough. The hare carcass is much darker than rabbit meat, its taste qualities are influenced by the age of the animal, and the way it stores the meat. Hare meat is forbidden in some countries and but in others such as Bashkiria, Tatarstan or
Udmurtia a national dish. It is the best to slaughter horses for meat at the end of autumn, when they are the most well-fed. Using the hare is not the entire carcass of the animal, but only the hind legs and back. The entire front part is discarded and allowed to feed the dogs.

The caloric content of hare belongs to low-calorie types of meat, it is considered a dietary product. A hundred grams of hare meat on average has 124 kcal. Its energy value changes with the age of the animal: the older the hare, the higher the caloric content of its meat, protein and fat becomes more and water-less. The lower caloric content compared to rabbit meat can be explained because hares are wild animals, they lead an active lifestyle, and besides, they are the frequent stresses, because of which their muscle mass is more developed and the meat is less fat.

Useful properties of a hare. It is a very healthy and tasty product besides it has many preventive and therapeutic properties; they use in medicine, cosmetology, and dietetics.

Hare meat has less fat and cholesterol compared to other types of meat, so it will suited as baby food, and also recommended for nursing and pregnant women and the elderly.

The phosphorus in the hare helps strengthen bones, and useful for vision and mucous membranes.

Through the lecithin, rabbit meat serves as an excellent prevention of atherosclerotic plaques deposition on the walls of blood vessels. It is recommended to use it for diseases of the digestive tract, liver, gall bladder, allergies, and hypertension.

Up to 7 months the hare organism can not absorb strontium-90, which is formed during herbicidal and pesticide disintegration, so necessary to use its meat for cancer, and when receiving a certain dose of radiation.

Including a hare in the menu can keep normal fat metabolism and optimize the balance of nutrients. Vitamin B12 and its antioxidant properties, improves DNA synthesis in brain cells. Eating hare meat can increase the oxygen consumption of brain cells, which is a good prevention and treatment of acute and chronic forms of hypoxia.

Hare contains a small amount of purine bases, so it can be used by people suffering from gout and the chromium contained in meat regulates blood sugar levels, which makes it a valuable product for diabetics. The protein contained in hare meat is easily digestible. In combination with a rich vitamin and mineral composition, it helps to give energy and restore strength.

The amino acid lysine of the hare meat has antiviral properties, which makes it useful in the presence of herpes and acute respiratory infections. The amino acid tryptophan produces melatonin - a sleep hormone. Vitamin B6 ensures the normal functioning of the central nervous system, relieves cramps and muscle cramps, and numbness of the extremities. Vitamin B12 is the prevention of anemia.

Hare fat is useful as a means for healing wounds, with burns and frostbite. It is also used in the treatment of otitis media, bronchitis, they rub the chest with a strong cough.

Also, hare fat is successfully used in cosmetology as an ingredient that is part of masks and creams for the face and hands. Its use helps to smooth out wrinkles, soften and moisturize the skin, and improves the complexion. Masks based on hare fat are useful for chapped, flaky skin, they are good for removing irritation and healing cracks.

Hare is recommended to include in the diet menu for people who are trying to get rid of extra pounds, because this meat is among the lowest-calorie. It is in the first place in the list of dietary types of meat, overtaking goat meat and rabbit meat. As a dietary product, it is best to use the meat of animals that are under one years old, in this case it contains the least amount of fat.

Along with its useful properties, hare has contraindications. Although, but the meat of a hare has purine bases, which are converted in the human body into uric acid, which can cause gout and arthritis, and sometimes, it can lead to neuro-arthritic children’s diathesis. So, hare meat should be consumed in limited quantities. It is not recommended to include a hare meat in the diet for people who suffer from psoriasis or psoriatic arthritis, since the amino acids in this meat become cyanotic after digestion and reduce the acidity. And with these diseases, you need to take drugs that have, on the contrary, an alkalizing effect. The purpose of the study is to evaluate the quality of hare meat, find the indicators of freshness of meat based on the results of organoleptic, physico-chemical, microbiological analysis,
microscopy of smears-prints of animal muscles, and determine the parasitic purity of hare carcasses. The aim of the research was a comparative veterinary and sanitary assessment of hare meat in the conditions of the Central zone of Yakutia.

To achieve the goal were set the following tasks:
- study the organoleptic and physical and chemical parameters of hare meat in the Central zone of Yakutia for compliance with the requirements of standards;
- conduct microbiological studies of rabbit meat by safety requirements: determining the number of KMAFAnM, E. coli group bacteria, the detection of pathogenic microorganisms including salmonella;
- conduct a parasitological study of rabbit meat for invasive diseases;
- determine the content of toxic elements in the hare meat - cadmium, arsenic, mercury, lead.

2. Material and methods

To determine the veterinary safety of carcasses of hares caught by trap hunters in the winter, in taiga conditions of the Central zone of Yakutia, organoleptic, physico-chemical, microbiological, chemical and toxicological studies organoleptic, physical-chemical, microbiological, chemical-toxicological studies, smear-print microscopy and parasitic purity were performed in taiga conditions of the Central zone of Yakutia to figure the veterinary safety of hare carcasses obtained by hunters with traps in the winter. Microscopy of smear-fingerprints and parasitic purity. 10 samples of hare muscles (for 200 g) were selected for laboratory analysis from Ust-Aldansky (5 samples) and Churapchinsky district (5 samples) of the Republic of Sakha (Yakutia). Organoleptic, physico-chemical, and microscopic studies of meat samples were conducted under the requirements of interstate standards GOST 27747-2016, GOST 20235.0-74, and GOST 20235.1-74 [15-17]. Microbiological studies under the Russian standard GOST R 54354-2011 and the interstate standard GOST 21237-75 [18]. The content of heavy metals (cadmium, arsenic, lead, mercury) was determined by the atomic absorption method following GOST 30178-96 [19].

Parasitological studies of hare carcasses were conducted using the Scriabin method of incomplete helminthological autopsy. To detect moniezia cestodes and nematodes in the lungs of rabbits carcasses used helminthology method Fulleborn [20]. Organoleptic studies of hare meat were conducted according to the following parameters: appearance and color, consistency, muscles on the cut, smell, transparency and aroma of the broth. The results of the research are presented in table 1.

**Table 1. Results of organoleptic studies of hare meat Central zone of Yakutia.**

| Controlled indicators | According to regulatory documents | 5 samples Ust-Aldansky district | 5 samples Churapchinsky district |
|-----------------------|----------------------------------|--------------------------------|--------------------------------|
| Appearance and colors | It has a dark red color with a bluish tinge | It has a red drying crust, moist, shiny | It has a drying crust of dark red color with a bluish tinge |
| Consistency | The muscles are dense, elastic, when pressed with a finger, the resulting fossa is quickly leveled, the fat is dense | The muscles are dense, the fossa is quickly leveled when pressed with a finger | The muscles are dense, the fossa is quickly leveled when pressed with a finger |
| Muscles in the incision | Wet, slightly sticky, red | Slightly damp, do not leave a wet spot on the filter paper; red color | Wet, slightly sticky, do not leave a wet spot on the filter paper, dark red color |
| Smell | Specific characteristic of fresh meat of hares | Specific, peculiar to fresh meat of hares | Specific characteristic of fresh meat of hares |
| Transparency and aroma of the broth | Transparent, fragrant | Transparent, fragrant | Transparent, fragrant |
According to the results of an organoleptic study of carcasses of hares, the muscles were dense; the fossa was quickly leveled when pressed with a finger; the smell was peculiar to fresh hare meat; the broth was clear and fragrant. Differences were established in appearance, color, and muscle condition in the section. The appearance of carcasses of hares (Ust-Aldan region) has a crust of drying red, moist, shiny; the muscles in the section are slightly moist, do not leave a wet spot on the filter paper; Red. While the carcasses of hares (Churapchinsky district) have a crust of drying dark red with a bluish tint, the muscles in the section are moist, slightly sticky, do not leave a wet spot on filter paper, dark red.

Data from laboratory studies to determine the freshness of hare meat samples obtained in the Ust-Aldan and Churapchinsky districts by physicochemical parameters: determination of pH meat, reaction to peroxidase, reaction to ammonia according to Nessler, reaction with copper sulfate are presented in table 2.

### Table 2. Results of physical and chemical studies of hare meat Central zone of Yakutia.

| Controlled indicators | According to regulatory documents | 5 samples Ust-Aldansky district | 5 samples Churapchinsky district |
|-----------------------|----------------------------------|---------------------------------|---------------------------------|
| Determining the pH of meat | 5.7-6.2 | sample №1 - 5.4 | sample №6 - 5.9 |
| | | sample №2 - 5.8 | sample №7 - 6.0 |
| | | sample №3 - 5.7 | sample №8 - 5.9 |
| | | sample №4 - 5.6 | sample №9 - 6.1 |
| | | sample №5 - 5.8 | sample №10 - 6.2 |
| Reaction to the peroxidase | «positive» | «positive» | «positive» |
| Reaction to ammonia by Nessler | «negative», the extract is transparent, slightly cloudy light yellow colours | «negative», transparent, light yellow extract colors | «negative», the extract is slightly cloudy, light yellow colours |
| Reaction with copper sulphate | «negative», clear broth, without flakes, (allowed with flakes, slightly cloudy in thawed meat) | «negative», clear broth, with flakes | «negative», the broth turbid, with flakes |

According to the results of physical and chemical studies, it was found that the pH-value of hare meat samples (Ust – Aldan region) is in the range from 5.4 to 5.8 (with a norm of 5.7-6.2).

The reaction to ammonia according to Nessler is “negative”, the extract is transparent, light yellow; reaction with copper sulfate is “negative”, the broth is transparent with cereal.

Values of pH meat of hare meat samples (Churapchinsky district) are in the range from 5.0 to 6.2 (with a norm of 5.7-6.2). The reaction to ammonia according to Nessler is “negative”, the extract is slightly cloudy, light yellow; reaction with blue vitriol - “negative”, muddy broth, with cereal. The reaction to peroxidase in hare samples is “positive”.

The results of microscopic and microbiological studies of hare meat samples are presented in table 3.
Table 3. The results of microscopic and microbiological studies of the meat of hares of the Central zone of Yakutia.

| Controlled indicators | According to regulatory documents | 5 samples | 5 samples |
|-----------------------|-----------------------------------|-----------|-----------|
|                       |                                    | Ust-Aldansky district | Churapchinsky district |
| Microscopy of smears-prints | Microflora is not detected or is detected. isolated gram+, gram - bacilli, cocci | sample №1, sample №4 microflora is not detected | sample №2, sample №3, sample №5 single gram-positive rods were detected |
| KMAFA* \( \text{M}^* \text{COE/g} \) | 1 x 10^4 | sample №1 1 x 10^4 sample №2 5 x 10^3 sample №3 no growth sample №4 3 x 10^3 sample №5 1 x 10^4 | sample №6 1 x 10^4 sample №7 2 x 10^3 sample №8 1 x 10^4 sample №9 2 x 10^4 sample №10 3 x 10^4 |
| BCGP ** (coliform) in 0,01 g | not selected | not selected | not selected |

According to the results of microscopic studies of rabbit meat (Ust-Aldansky district), microflora was not detected in samples № 1, № 4; single gram-positive rods were found in samples № 2, № 3, № 5; the number of mesophilic aerobic and facultative anaerobic microorganisms in sample № 1 was not isolated, and in other samples within acceptable standards.

Microscopic examination of samples of hare meat (Churapchinsky district) obtained the following results: in all samples found single gram-positive sticks; in two samples revealed a slight excess of the number of mesophilic aerobic and facultative anaerobic microorganisms characteristic of commercial animals, in the sample number 9-2 x 10 in, in the sample number 10-3 x 10 at, with a norm of 1 x 10^4. In all samples of rabbit meat, E. coli bacteria were found in 0,01 g of the product, pathogenic microorganisms, including Salmonella in 25 g. were not isolated. It presents the results of parasitological studies in the table 4 by using the Fulleborn and Scriabin methods of complete helminthological autopsy.

Table 4. Results of parasitological research of hare meat in the Central zone of Yakutia.

| №  | methods of the research | indicators              | 5 samples | 5 samples |
|----|-------------------------|-------------------------|-----------|-----------|
|    |                         | Ust-Aldansky district   | Churapchinsky district |
| 1. | The Scriabin Method     | helminths               | not selected | not selected |
|    |                         | helminths and helminth eggs | not selected | not selected |

According to the results of parasitological studies, helminths and helminth eggs were not found in samples of solid meat.
To determine the salts of heavy metals: cadmium, arsenic, lead and mercury, were examined combined samples, one from the Ust-Aldan district and the second from the Churaphinsky district. It presents the results of determining the content of toxic elements in the heat of heroes in table 5.

Table 5. The results of toxic elements content in hare meat of the Central zone.

| №  | Indicator            | According to regulatory documents | sample of hare meat from Ust-Aldan district | sample of hare meat from Churaphinsky district |
|----|----------------------|----------------------------------|---------------------------------------------|-----------------------------------------------|
| 1  | Cadmium, mg / kg, not more than  | 0,05                             | less 0,02                                   | less 0,01                                     |
| 2  | Arsenic mg/kg, not more than | 0,1                              | less 0,1                                    | less 0,05                                     |
| 3  | Mercury mg / kg, not more than | 0,03                             | less 0,01                                   | less 0,01                                     |
| 4  | Lead mg/kg, not more than  | 0,5                              | less 0,1                                    | less 0,2                                     |

According to the results of studies of hare meat samples for the presence of toxic elements, a negative result was got, which proves the safety of this product, hare meat caught by hunters in the winter on traps in the taiga conditions of Central Yakutia.

3. Conclusion
1. Organoleptic studies of hare carcasses and internal organs indicate that the product is of good quality.
2. According to the results of physico-chemical studies on indicators: the value of pH-meat, reactions to peroxidase, to ammonia according to Nessler, copper sulfate, meat samples are classified as fresh.
3. Microscopy of the surface and deep layers of hare meat revealed no micro-organisms or single gram-positive rods.
4. In the bacteriological study of meat of all groups, the contamination with aerobic and anaerobic microflora, bacteria of the Escherichia coli group, pathogenic microorganisms, including Salmonella, were not isolated.
5. According to parasitological research methods of Scriabin, methods of Fulleborn helminths and helmint eggs were not found in all samples.
6. According to the results of veterinary and sanitary assessment and commodity characteristics of hare meat is allowed for sale without restriction.

The value of meat and meat products in the population’s diet is determined by what is the source of proteins, fat, mineral and extractive substances, vitamins whose consumption is essential for the normal functioning of the body. The conducted researches allowed to prove organoleptic, physical-chemical, microbiological, chemical-Toxicological and parasitological indicators of freshness of hare meat of the Central zone of Yakutia of the Republic of Sakha (Yakutia). As a result of this work, we came to the following conclusion: a mandatory condition for the production of high-quality products is compliance with the requirements for the slaughter of commercial animals, transportation, strict compliance with regime parameters at all stages of the technological process of production, sale and storage.

Assessing the quality and safety of hare meat as a food product requires not only visual inspection and determination of organoleptic parameters, but also additional laboratory physical-chemical, microscopic, microbiological, chemical-toxicological and parasitological studies.
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