Veterinary-Sanitary Examination of Migratory Bird Carcasses When Stored in a Glacier Under Permafrost Conditions

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Abstract. Due to the annual increase in harvesting wild ducks in the Republic of Sakha (Yakutia) regions, a detailed studying the wild bird meat is required to assess its quality and preserve the population health. Wild ducks harvested in the Ust-Aldan, Tattinsk, and Megino-Kangalassk regions of the Republic of Sakha (Yakutia) have been studied. The meat of the migratory bird carcasses has been studied twice by 4 samples: the first study – after 2-month freezing in a glacier, the second study – after 4-month freezing in a glacier. The materials studied were meat samples taken from gutted wild ducks of four species, harvested in the central zone in autumn, and marked as follows: Sample No. 1 – mallard carcass meat; Sample No. 2 – wigeon carcass meat; Sample no. 3 – shoveler carcass meat; Sample No. 4 – scoter carcass meat. For the study, gutted carcasses were frozen in a glacier at a relative humidity of 70-85 %; the glacier temperature was within -8 to -15 °C. The veterinary-sanitary examination was performed on gutted migratory bird carcasses when stored in glaciers under permafrost conditions with determining organoleptic, physicochemical, and microbiological meat indicators and studying subcutaneous fat of the meat of gutted migratory bird carcasses with determining toxic elements at the State Budgetary Institution of the Republic of Sakha (Yakutia) Yakutskaya RVIL (Yakut Republican Veterinary Testing Laboratory) and the Department of Veterinary-Sanitary Examination and Hygiene of the Veterinary Medicine Faculty of the Federal State Budgetary Educational Institution of Higher Education Arctic State Agrotechnological University. Based on the organoleptic, physicochemical, and microbiological results, as well as the content of toxic elements in the meat, it has been concluded that the use of healthy duck meat as a food product is advisable.
1. Introduction
The territory of Yakutia contains many rivers and lakes with dense riverside vegetation and many reservoirs, where massive seasonal migrations of more than thirty different wild bird species occur in spring and summer, including wild ducks of various families and breeds.

Unlike domestic duck, wild individuals feed exclusively on natural food and live in their natural environment. The migratory bird meat is used as therapeutic nutrition for humans since the duck meat contains healthy and tasty sources of easily digestible proteins, vitamins, and fatty acids. Duck meat also contains vitamins A, B, C, E, D, and K, and is rich in micro- and macro-elements.

Many scientists have performed the veterinary-sanitary examination of meat of certain game species (Kotelevich V.A., 1984; Matveychuk A.V., 2012; Shapkina L.M., 2003; Petrova E.M., 2017) [18, 19, 20, 22, 23].

The most relevant issues of veterinary-sanitary examination of migratory wild bird meat when stored in glaciers have not been studied enough, and the research results are rather contradictory. Harvesting game, storing carcasses, transportation, and sale is performed in violation of veterinary-sanitary and hygienic requirements, which leads to a deteriorated marketability and, in turn, damage to valuable products.

Our studies are aimed at identifying changes in the migratory bird carcasses harvested in the central zone when stored in glaciers. In the conditions of the Republic of Sakha (Yakutia), the most widespread method of long-term storage of the wild bird meat is freezing it in permafrost glaciers. This area is understood, and the available literature does not contain enough information. Therefore, there is a need for a detailed studying the quality of migratory bird meat stored in glaciers in a time aspect.

Glaciers are suitable for long-term meat storage in the Far North conditions (Glushnev M.P., 1962). The frozen meat quality directly depends on the duration and temperature conditions of freezing. A particularly effective method is ultra-fast meat freezing, due to which the growth of microorganisms is significantly slowed down. The most important factor is temperature (Lawrie R.A., 1973; Shur P.V., 1975; Sokolova N.A., 1975; Shabliy V.Ya., 1975; Sattykova A.K., 1977; Wizth T., 1975).

The migratory bird meat is of great importance for the human body since it provides the body with certain useful substances; this can be seen from the chemical composition of poultry meat, which depends on the specie, age, fatness, breed, and feed ration [24, 25, 26].

According to foreign and domestic authors, wild bird meat is one of the high-grade food products. One of the most active indicators of the nutritional value of meat is its chemical composition [25].

Many experts have studied the meat composition of certain types of waterfowl (Lobin N.V., 1963; Saveliev I.K., 1963; Pokrovsky I.K. et al., 1963; Saleev P.F., 1967; Koryazhnov V. P. et al., 1967; Ustimenko L.I., 1974; Zabolotnikov A.A., Ionova E.I., 1975; Batsman V.E., 1977; Ostapchuk P.P., 1979; Wadziak K., 1979, and others) [5, 6, 7, 8, 12, 14].

The chemical composition of muscle tissue is very complex and characterized by the most physiologically favorable ratio of nutrients, especially proteins (18-23 %), with a well-balanced composition of amino acids, which determines their high biological value. The chemical composition of poultry meat is as follows: proteins – 18-22 %, fat – 1.7-5 %, minerals – 1-1.2 %, extractive nitrogen-containing substances – 1.7-1.9 %, nitrogen-free extractive substances – 0.9-1.2 %, as well as vitamins, enzymes, and other substances formed in the metabolic processes of proteins, fats, and carbohydrates. On average, the water to solid ratio is 3:1. The younger the bird, the more water its muscles contain, and on the contrary, with an increase in fatness, the water content decreases. Protein substances are the building blocks of muscles; therefore, they account for 60-80 % of the solid residue. The muscle proteins form complex biologically active compounds [22].

The bird muscles are distinguished by a high content of minerals; they contain various biologically active macro- and microelements that endow the meat with certain dietary and, in some cases, therapeutic properties [30].
2. Research techniques

The research objective is a veterinary-sanitary examination of gutted migratory bird carcasses when stored in glaciers in permafrost conditions, with the solution of the following tasks: determining the organoleptic, physicochemical, and microbiological parameters of the meat of the gutted migratory bird carcasses when stored in glaciers in permafrost conditions, studying subcutaneous fat, determining toxic elements in the meat of the gutted migratory bird carcasses.

The study was performed at the State Budgetary Institution of the Republic of Sakha (Yakutia) Yakutskaya RVIL (Yakut Republican Veterinary Testing Laboratory) and the Department of Veterinary-Sanitary Examination and Hygiene of the Veterinary Medicine Faculty of the Federal State Budgetary Educational Institution of Higher Education Arctic State Agrotechnological University.

Wild ducks harvested in the Ust-Aldan, Tattinsk, and Megino-Kangalassk regions of the Republic of Sakha (Yakutia) have been studied. The meat of the migratory bird carcasses has been studied twice by 4 samples: the first study – after 2-month freezing in a glacier, the second study – after 4-month freezing in a glacier.

The materials studied were meat samples taken from gutted wild ducks of four species, harvested in the central zone in autumn, and marked as follows: Sample No. 1 – mallard carcass meat; Sample No. 2 – wigeon carcass meat; Sample no. 3 – shoveler carcass meat; Sample No. 4 – scoter carcass meat [1, 9, 10, 15, 16, 17].

For the study, gutted carcasses were frozen in a glacier at a relative humidity of 70-85%, the glacier temperature was within -8 to -15 °C.

Organoleptic indicators were determined according to GOST R 51944-2002 Poultry Meat. Methods for Determining Organoleptic Properties, Temperature, and Mass.

For technique used in physical and chemical studies is described in GOST 31470-2012 Poultry Meat, Edible Offal, and Semi-Processed Products. Methods for Organoleptic and Physicochemical Examinations [21, 17, 28].

To determine the meat purity and the possibility of using it as food, the below studies have been performed:
- response to peroxidase (benzidine test),
- determining the amount of amino-ammonia nitrogen,
- reaction with copper sulfate,
- determining the pH.

Response to peroxidase (benzidine test)

Microscopic examination techniques GOST 31931-2012

For the microbiological study, the below techniques have been used:
- GOST 50396.1-2010 Poultry Meat, Edible Offal, and Semi-Processed Products. Method for Quantity Determination of Mesophilic Aerobic and Optional-Anaerobic Microorganisms,
- GOST 31747-2012 Food Products. Methods for Detection and Quantity Determination of Coliforms,
- GOST R 53665-2009 Poultry Meat, Edible Offal, and Semi-Processed Products. Method for Detection of Salmonellae,
- GOST 32031-2012 Food Products. Methods for Detection of Listeria Monocytogenes.

The quantity of mesophilic aerobic and optional-anaerobic microorganisms (QMA&OAMO) was determined according to GOST 50396.1-2010

To determine the total viable count of QMA&OAMO, the dilutions are chosen, which, when inoculated in plates, give no more than 300 colonies.

Pathogenic microorganisms, including Salmonellae, salmonellosis. Salmonellae were determined according to GOST 31468-2012 Poultry Meat, Edible Offal, and Semi-Processed Products. Method for Detection of Salmonellae [2, 3, 4, 11, 13].

A technique for identifying and quantity determining of coliforms. Coliforms were determined according to GOST 31747-2012 Food Products. Methods for Detection and Quantity Determination of Coliforms.
A technique for identifying and quantity determining of Listeria monocytogenes. GOST 32031-2012 Food Products. Methods for Detection of Listeria Monocytogenes.

The method described in GOST 54676-2012 was used to study subcutaneous fat. To determine toxic elements, the study has been performed according to the below regulatory and technical documents:

- GOST 26933-86 Raw Materials and Foodstuffs. Methods for Determination of Cadmium,
- GOST 26932-86 Raw Materials and Foodstuffs. Methods for Determination of Lead,
- GOST 26927-86 Raw Materials and Foodstuffs. Methods for Determination of Mercury.

3. Research results

In our research: Sample No. 1 – mallard carcass meat; Sample No. 2 – wigeon carcass meat; Sample no. 3 – shoveler carcass meat; Sample No. 4 – scoter carcass meat.

According to the organoleptic study results, all the meat samples of the duck carcasses stored for 2 months comply with the technical and regulatory document GOST R 51944-2002 Poultry Meat. Methods for Determining Organoleptic Properties, Temperature, and Mass [29].

According to the organoleptic study results for the meat samples of the duck carcasses stored for 4 months, Sample No. 1 had characteristic changes on the carcass surface. All 4 samples in all aspects correspond to fresh meat according to the normative and technical document GOST R 51944-2002 Poultry Meat. Methods for Determining Organoleptic Properties, Temperature, and Mass.

According to the physicochemical study results, all samples of meat stored for 2 months in a glacier correspond to the regulatory documents in all respects.

According to the physicochemical study results, it has been proved that all samples of meat stored for 4 months in a glacier correspond to the regulatory documents.

Microscopic examination of all the investigated samples of duck meat stored for 2 months did not show microflora in the touch smears.

In Samples Nos. 2, 3, and 4, no microflora was found in the touch smears, and in Sample No. 1, only isolated microorganisms were detected in the preparation field of view. According to GOST 31931-2012 Poultry Meat. Methods for Histological and Microscopic Analysis, up to 10 microbial bodies are allowed.

Also, a microbiological study of wild duck meat was performed for the samples marked as follows: Sample No. 1 – mallard carcass meat; Sample No. 2 – wigeon carcass meat; Sample no. 3 – shoveler carcass meat; Sample No. 4 – scoter carcass meat.

For the microbiological study, we have taken samples from muscle tissue of 4 duck carcasses to determine the bacterial content of Salmonellae, Coliforms, and QMA&OAMO since in case of illness, microbes begin to penetrate from the muscle tissue surface.

The meat of the migratory bird carcasses has been studied twice by 4 samples: the first study – after 2-month freezing in a glacier, the second study – after 4-month freezing in a glacier.

In total, 8 duck meat samples have been tested, 2 samples from the superficial and deep muscle tissue layers of each duck species.

QMA&OAMO, Salmonellae, Coliforms, and L. monocytogenes were not found in duck meat stored for 2 months.

According to the QMA&OAMO study results, among of all 8 meat carcass samples studied, microorganisms were detected only in Sample No. 1.

According to the results of examining muscle tissue samples, Salmonellae were not detected in samples, except for Sample No. 1. 5 bacteria colonies grew in Sample No. 1.

According to the results of examining for Coliforms and L. monocytogenes, the growth of microorganisms was observed in Sample No. 1.

According to the subcutaneous fat study results, the duck fat melting point shows its specie and the purity degree. Some time passes between the start and the end of the solid-liquid transition of fat; therefore, to avoid errors, the fat melting point should be determined at least 2 times.
The first study was performed after 2-month freezing in a glacier. The fat melting point data obtained for Sample No. 1 – 34.5 °C, Sample No. 2 – 33.9 °C, Sample No. 3 – 32.8 °C, and Sample No. 4 – 32.3 °C characterize meat as valid.

The second study was performed after 4-month freezing in a glacier. The fat melting point data obtained for Sample No. 1 – 34.8 °C, Sample No. 2 – 34 °C, Sample No. 3 – 33 °C, and Sample No. 4 – 32.5 °C characterize meat as valid.

The refractive index of fat at 20 °C after 2-month freezing in a glacier obtained for Sample No. 1 – 1.452, Sample No. 2 – 1.451, Sample No. 3 – 1.451, and Sample No. 4 – 1.450 indicate the good quality of fat.

The refractive index of fat at 20 °C after 4-month freezing in a glacier obtained for Sample No. 1 – 1.453, Sample No. 2 – 1.452, Sample No. 3 – 1.452, and Sample No. 4 – 1.451 indicate the good quality of fat.

Toxic elements have been identified for the duck meat samples marked as follows: Sample No. 1 – mallard carcass meat; Sample No. 2 – wigeon carcass meat; Sample no. 3 – shoveler carcass meat; Sample No. 4 – scoter carcass meat.

It has been found that the content of cadmium, lead, and mercury in duck meat does not exceed the permissible limits.

4. Conclusions

The organoleptic (appearance, condition of muscle and adipose tissue, consistency, color, etc.) and physicochemical (amino-ammonia nitrogen, reactions with copper sulfate, peroxidase test, pH) parameters have been determined for the meat of the migratory birds harvested in the central zone when stored in a glacier.

Microbiological study of wild duck meat stored for 2 months has identified QMA&OAMO, Salmonellae, Coliforms, and L. monocytogenes in Sample No. 1, the content of which do not exceed the permissible limits set by regulatory and technical documents.

The content of toxic elements in the muscle tissue of wild migratory birds does not exceed the permissible concentration.

When storing the migratory bird carcasses in a glacier for up to 4 months at a relative humidity of 70-85 % and the glacier temperature within -8 to -15 °C, their good quality is ensured in terms of organoleptic, physicochemical, and microbiological indicators, subcutaneous fat parameters, and the content of toxic elements.

Wild duck shooting in the Republic of Sakha (Yakutia) is currently generating interest in the industrial harvesting duck meat. Wild duck meat is one of the most valuable protein products with high nutritional value, which meets the body's needs for proteins, lipids, minerals, and vitamins. Ducks have many nutritionally useful biological characteristics; their main advantage is the excellent quality of meat. The organoleptic, physicochemical, and microbiological study results and the content of toxic elements in the meat allow concluding that the use of healthy duck meat as a food product is advisable.

5. References

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