MUSCLE PARASITES IN REINDEER: DIFFERENTIAL DIAGNOSTICS AND RUSSIAN FOOD SAFETY LEGISLATION

Olga A. Loginova, Larisa M. Belova (Parasitology Dept.), Anton N. Tokarev (Food Safety Dept.),
St. Petersburg State Academy of Veterinary Medicine

Introduction
Different parasites can infest muscle tissue of reindeer: *Protozoans* (Sarcocystis spp., Toxoplasma gondii), *Insects* (larvae of flies: Hypoderma tarandi, Wohlfahrtia magnifica), Helminthes (larvae of Cestodes: Echinococcus spp., Cysticercus spp., Nematodes: Elaphostrongylus rangiferi, Trichinella spp.). Parasite in the reindeer muscles is not just a cause of animal health damage, but also a human health threat. In Russia veterinary and sanitary examination of carcasses of reindeer is carried out in accordance with the "Rules for veterinary inspection of slaughter animals and veterinary and sanitary examination of meat and meat products" (approved by the Chief Veterinary Department of the Ministry of Agriculture of the USSR on December 27, 1983). The Ministry of Agriculture of the Russian Federation prepared a draft “Rules in the field of conducting the veterinary and sanitary examination of meat and other products of slaughter” (March 22, 2017), but at the time of this writing, the said rules did not come into force.

Materials and Methods
In October 2018, mixed gendered 200 heads of Nenets breed reindeer aging from 6 months to 7 years was slaughtered in the Zapolyarny region of the Nenets Autonomous District. During the veterinary and sanitary examination in several carcasses (obtained from adult males and females), elongated whitish objects, not characteristic for reindeer muscle tissue, were found. They were delivered to the Department of Parasitology of St. Petersburg State Academy of Veterinary Medicine and studied macro- and microscopically (using a dark-field microscopy method in oblique light, light-field microscopy method in transmitted light) in native form and with lactic acid clearing. MBS-10 and Micmed-6 (LOMO) microscopes were used. Pictures were taken with Canon SD Mark II.

Results
It was found that those objects were of different lengths (ranging from 1 to 3 mm) with a width of up to 0.3 mm. They were motionless and had a cavity divided into chambers (Figures 1 and 2).

Discussion
Differential diagnosis of muscle parasites is based on: 1) measuring their linear dimensions; 2) study of their morphology (color; shape; presence of body segments, organs or other structures); 3) estimating mobility or immobility; 4) genetic data; 5) results of bioassay.

Conclusion
According to their size, shape, structure, color and motionless, found objects were assumedly identified as cysts of Sarcocystis rangi. To clarify the diagnosis, it is advisable to conduct a genetic and histological examination. According to the current Russian Food Safety legislation, the meat invaded by Sarcocystis if not damaged can be sold without restrictions. The proposed by the Ministry of Agriculture, but not yet in force "Rules in the field of veterinary and sanitary examination of meat and other products of slaughter" (March 22, 2017), demand the use of such meat for the manufacture of canned food or cooked sausages. If meat has Sarcocystis + depletion / hydremia / discoloration / calcification / degenerative changes it must be disposed according to the both documents, i. e. such meat must be used only for animal feed and similar production.

Parasite & <br>Observations & <br>Restrictions

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<td>&quot;Rules for veterinary inspection of slaughter animals and sanitary examination of meat and meat products&quot; (1983)</td>
<td>sarcocysts + no changes - no restrictions; sarcocysts + degenerative changes - disposal (p. 3.2.12)</td>
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<td>≤ 5 larvae per 40 cm² + no changes - freezing and then - sausages or cans; &gt; 5 larvae + degenerative changes - disposal (pp. 3.2.3, 11.4.1)</td>
<td>multiple damage - carcass utilization; limited damage - disposal of affected areas, unaffected meat - without restrictions (p. 3.2.5)</td>
<td>≥ 1 larva per 24 slides – disposal of carcass (p. 3.2.4)</td>
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<td>&quot;Rules in the field of veterinary and sanitary examination of meat and other products of slaughter&quot; (2017)</td>
<td>sarcocysts + no changes - sausages or cans; sarcocysts + degenerative changes - disposal (p. 13.1.4)</td>
<td>carcasses must be disinfected by cooking (p. 131.17)</td>
<td>the same (p. 131.15)</td>
<td>affected areas - disposal, the rest of the meat - without restrictions (p. 131.22)</td>
<td>≥ 4 live or dead larvae per 40 cm² - disposal; ≤ 3 - freezing, boiling or salting, then - sausages, pies or cans (pp. 131.2, 131.2.1 and 131.2.2)</td>
<td>the same (p. 131.3)</td>
<td>the same (p. 131.11)</td>
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Fig. a. TOP: View of an object retrieved from the muscle tissue of reindeer. Light field microscopy in transmitted light, lactic acid clearing.

Fig. a. BRIGHT: The appearance of objects found in the muscle tissue of reindeer. A – Elaphostrongylus rangiferi; B – Toxoplasma gondii; C – the same with dark-field microscopy (indicated by arrows).