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**INFUSORIAN FAUNA OF DIFFERENT STOMACH COMPARTMENTS
OF THE REINDEER (*RANGIFER TARANDUS L.*)
IN THE TUNDRA ZONE OF CHUKOTKA AUTONOMOUS REGION**

ABSTRACT. Stomach compartments of the reindeer and other related wild hoofed mammals are a habitat of very different in morphology and systematic position types of infusorians. However the fauna and life cycles of the majority of the known types of the endobiotical infusorians living in the animal stomach as well as their influence on the organism of the owner have not been sufficiently studied. Thus, studying of the fauna, features of biology and ecology of infusorians in wild ruminants inhabiting different regions of the world deepens our knowledge about these peculiar and well adapted to the organism of their owner protozoa.

The present research is devoted to the study of the fauna, biological and ecological features, and the number of infusorians in the stomach of the reindeer widespread on the territory of Chukotka Autonomous Region. In order to achieve the main goal we set the following tasks: to research the species composition of the infusorians found in the digestive tract of the reindeer, to describe the quantitative structure of the infusorians, to define spatial distribution of the infusorial fauna in the digestive tract.

The article contains original data on the species composition and the number of infusorians in different compartments of a reindeer stomach. 16 types of infusorians are singled out. This figure has been confirmed by other protozoologists engaged in the study of the infusorial fauna of the reindeer in different natural zones and habitats.

KEY WORDS. *Infusorial fauna, differential diagnoses of species, stomach compartments of a ruminant, conditions of digestion, symbiosis.*

Introduction. The history of the study of the endobiotic infusorial fauna began in the middle of XIX century when the first work describing the protozoa species in the digestive tract of farm animals (a horse, a pig and a bull) was published [1].

The most important discoveries in the study of the fauna of endobiotic infusoria of wild ruminants were made in the first half of XX century [2-5], [6-8].

The contemporary scientific literature has descriptions of new species and forms of endobiotic infusoria basically from the digestive tract of hoofed mammals – antelope “kob” (*Kobus leche kafuensis*), saiga (*Saiga tatarica L.*), antelope greater kudu (*Tragelaphus strepsiceros*), American elk (*Alces americana*), and Indian elephant (*Elephas maximus*). There were also some works devoted to the endobiotic infusoria of the digestive tract of marsupials, which have significantly changed views on phylogeny and taxonomy of these peculiar protozoa.

The first work containing data on the infusorial population of the pre-stomach of the reindeer caught in the northern part of Europe belonged to V. A. Dogel where he provides data on the number and species diversity of the infusoria [9]. Later there appeared articles on the infusorial fauna of the red deer [10], northern deer from the territory of Finland [11], and from Canada [12]. In 2004 a scientific article on the infusorial population of the reindeer of China was published [13]. At the same time a Russian protozoologist O.A. Kornilova et. al publishes data on the infusorial population of the stomach of the wild and domestic reindeer of the taiga zone in Siberia [14]. That was the first publication of the original information on the infusorial population of the reindeer from the territory of the tundra zone.

Materials and methodology of the research. Material for the research was collected in 2005-2011 from the reindeer inhabiting the territory of Bilibinskiy and Anadyrskiy districts of Chukotka autonomous region. We took 500 samples from different stomach compartments of 10 reindeer species. In addition we took samples from different compartments of the intestinal tract of each species: blind gut, straight intestine and large intestine. The samples were fixed with 4% formalin. The research material was obtained with the help of two optical phase-contrast microscopes BioMed-2 and МБИ-6. The fixed infusoria were counted in field of view and in Gorjaev's counting chamber.

Calculation of the number of infusoria was made with the method of "calibrated drop" i.e. we counted all the trophozoites of the infusoria which occurred in a drop of 0.1 ml of the 1:2 sample dilution in the fixer. The species identification was made according to the tables of Ophryoscolecidae [15]. We processed all the garnered material with standard statistical methods using "Statistica V6.0" software.

Research findings. At the end of the research we have obtained data on the quantity and species diversity of infusoria in the digestive tract of the reindeer (*Rangifer tarandus*) (table 1, fig. 1).

We can see in the table that the infusorial fauna of the reindeer consists of the families typical for wild and domestic hoofed animals: *Ophryoscolecidae* with 5 genera and *Isotrichidae* with 2 genera. On the whole the infusorial fauna of different stomach compartments of the reindeer inhabiting the tundra zone of Chukotka is represented by 16 species of endobiotic infusoria.

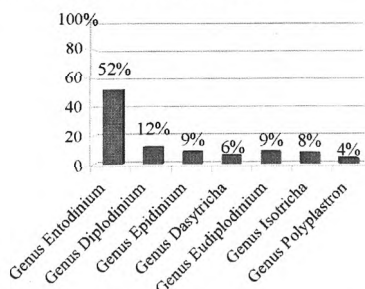


Fig. 1. Percentage ratio of the infusorium species in the reindeer stomach

Table 1

The species diversity of infusoria and their total number in different stomach compartments of the reindeer (*Rangifer tarandus*)

Infusoria	Number (sp/ml)	% of the total number of the species	Stomach compartments			
			Rumen (first stomach)	Reticulum	Omasum	Abomasum
<i>Genus Entodinium</i>						
<i>E. bursa</i>	178,6±9,1	5%	+	+	+	-
<i>E. nanellum</i>	181,4±9,3	5%	+	+	+	-
<i>E. simplex</i>	207±10,2	6%	+	+	-	+
<i>E. exiguum</i>	131,6±8,4	4%	+	+	-	-
<i>E. longinucleatum</i>	271,3±12,2	8%	+	+	-	+
<i>E. furca crassicaudatum</i>	212,1±2,2	6%	+	+	+	-
<i>E. furca nanellum</i>	184,1±6,1	5%	+	+	-	-
<i>E. minimum</i>	452,7±7,6	13%	+	+	+	+
<i>Genus Epidinium</i>						
<i>E. ecaudatum-ecaudatum</i>	154,3±4,1	4%	+	+	+	-
<i>E. ecaudatum caudatum</i>	182,8±6,2	5%	+	+	-	-
<i>Genus Dasytricha</i>						
<i>D. ruminantium</i>	211,6±3,2	6%	+	+	+	-
<i>Genus Diplodinium</i>						
<i>D. rangiferi f. major</i>	436,0±10,7	12%	+	+	+	+
<i>Genus Eudiplodinium</i>						
<i>E. maggii</i>	166,7±6,5	5%	+	+	+	-
<i>E. neglectum impale</i>	143,7±5,3	4%	+	+	-	-
<i>Genus Isotricha</i>						
<i>I. intestinalis</i>	278,6±4,1	8%	+	+	+	+
<i>Genus Polyplastron</i>						
<i>P. multivesiculatum</i>	161,3±5,4	4%	+	+	+	-
Total number of species for each stomach compartment			16	16	10	5

We can conclude that the genus *Entodinium* prevails in the species diversity and quantity of the foregut infusorial population which is also generally typical for other wild and domestic hoofed species. According to our data, the total number of infusoria in 1 ml of the forestomach contents reached maximum about 27.000 animal units. These quantitative data and species composition are characteristic for the reindeer of other regions as well, which is confirmed by the abovementioned scientific publications. One peculiarity of the reindeer infusorial fauna is the presence of the species *Entodinium minimum*, which is the most numerous and makes up 13% of the total number of the infusorium species. The morphological features of this species are quite unique as it has an oblong "swordlike" shape, unlike the other representatives of the genus. Another peculiarity of the reindeer

infusorial fauna is the presence and large quantity of the species *Diplodinium rangiferi* which is 10-15 times more numerous than that of the elk and roe deer.

The reindeer as a ruminant representative has a very big stomach the content of which equals to 20% of the animal's weight. The first three chambers (rumen, reticulum, omasum) are the fore-stomachs. They lack digestive glands and are responsible for the preliminary food processing via microbial flora including infusorial. The last chamber (abomasum) is usually referred to as the stomach proper where the processes of fermentative digestion take place.

The rumen is a so-called "incubator" with ideal living conditions for infusoria: weakly alkaline environment (pH 6.5-7.0), constant temperature (37°C), and abundance of feed. We registered the maximum amount (27504.6) of the infusorial units in 1 ml of the sample exactly in the rumen (fig. 2). In spite of the fact that the rumen and reticulum form practically one part of the stomach, they perform different functions. The reticulum acts as a filter which distributes the food bolus either further along the digestive tract or part of food is regurgitated from the reticulum into the superposed chambers for further fragmentation. This explains the change of pH level, which is 6 in the reticulum, violating the normal environment for infusoria and, as a consequence, reducing their number in this stomach compartment of the reindeer. The average quantity of infusoria in the reticulum of the Chukotka tundra reindeer is 19121.6 sp/ml.

In the next stomach compartment – omasum – pH level is even lower (5-5.5). Therefore, the number of infusoria decreases by 3, as compared to the rumen, and becomes equal to 10326.4 sp/ml. Further reduction of the hydrogen potential level is only bigger closer to the abomasum and reaches here 2.7-3.14. Infusoria cannot exist in such conditions; and in the abomasums we came across only dead or partially deformed species. The number of infusoria in the abomasum is minimal and equals 2616.2 sp/ml. Naturally the number of protozoa species also decreases from the rumen to abomasum.

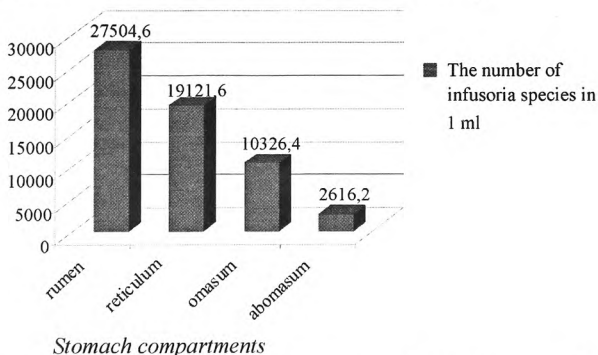


Fig. 2. Infusoria quantity distribution in different stomach compartments of the reindeer

Conclusion. On the basis of the research performed we can claim that endobiotic infusoria from the reindeer stomach are foregut i.e. inhabiting only the stomach as they have not been found in any compartments of the intestinal tract.

The infusorial fauna of the reindeer (*Rangifer tarandus*) inhabiting the territory of the tundra zone of Chukotka autonomous region has been described for the first time. It is represented by 16 species of endobionts, the most numerous of which is *Entodinium minimum*, whose total average is 452.7 ± 6 or 13% of the total number of all the infusorium species found in the reindeer stomach. *Diplodinium rangiferi* f. *Major* with a total average of 436.0 ± 10.7 is the second most numerous species. The total number of all the endobiotic infusoria in 1 ml of the stomach contents is high and according to our data is equal to 27504.6 sp/ml. These data are also confirmed by protozoologists studying the infusorial fauna of the reindeer of different natural zones and geography.

REFERENCES

1. Gruby, D., Delafond, O. Sur les animalcules développement dans l'estomac et les intestins plus avant digestion des animaux herbivores et carnivores. *C. R. Acad. Sci. Paris.*, 1843. T. 17. P. 1304-1308.
2. Dogel', V.A. New Parasitic Infusoria from Reindeer Stomach. *Russk. arh. protistol.* — *Russian Arch. Protistology.* 1925. Issue 4. Pp. 43-65 (in Russian).
3. Dogel', V.A. *Infuzorii iz zheludka sajgi* [Infusoria from Saiga Stomach]. Alma-Ata: Academy of Sciences of Kazakhstan SSR, 1946. Pp. 18-29 (in Russian).
4. Gassovskij, G.N. On the Microfauna of the Horse's Bowels. *Trudy Petrogradskogo obshhestva estestvoispytatelej* — *Works of Petrograd Society of Natural Scientists.* Leningrad, 1918. Pp. 20-37, 65-69 (in Russian).
5. Poljanskij, Ju.S., Solov'eva, V.A. Parasitic Infusoria from the Goral Stomach. *Vestnik Leningradskogo universiteta* — *Herald of Leningrad University.* 1959. № 15. Pp. 27-30 (in Russian).
6. Cunha, A.M. da, Muniz, J. Contribution to the knowledge of ciliata parasitic in Mammalia of Brazil. *Scientia med.* 1925. Pp. 740-747.
7. Kofoid, C.A., MacLennan, R.F. Ciliates from *Bos indicus* Linn. I. The genus *Entodinium* Stein. *Univ. Calif. Pub. Zool.*, 1930. Pp. 471-544.
8. Sladeczek, F. Ophryoscolecidae z bachoru jelena (*Cervus elaphus* L.), danka (*Dama dama* L.) a srnce (*Capreolus capreolus* L.). *Vest. Ceskosl. Zool. Spol.* 1946. Pp. 201-231.
9. Dogel', V.A. Article on the Infusoria Fauna Inhabiting the Reindeer's Stomach. *Trudy Arkticheskogo instituta* — *Works of Arctic Institute.* L., 1935. Pp. 143-148 (in Russian).
10. Kubikova, M. Infusorien aus dem Pausen von *Cervus elaphus* L. *Zool. Anz.* 1935. 111. Pp. 175-177.
11. Westerling, B. Rumen ciliate fauna of semi-domestic reindeer (*Rangifer tarandus* L.) in Finland: composition, volume and some seasonal variations. *Acta zool. fenn.* 1970. № 1. Pp. 1-76.
12. Lubinsky, G. Ophryoscolecidae (Ciliata, Entodiniomorphida) of reindeer (*Rangifer tarandus* L.) from Canadian Arctic. *Can. J. Zool.* 1958. Pp. 819-825, 937-959.
13. Imai, S., Oku, Y., Morita, T., Ike, K., Guirong. Rumen ciliate protozoal fauna of reindeer in inner Mongolia, China. *J. Vet. Med. Sci.* 2004. Pp. 209-212.
14. Kornilova, O.A., Fedorova N.P., Machahtyrov G.N., Bajmakova L.G. Biodiversity of the Infusoria from the Stomachs of *Equus caballus*, *Capreolus pygargus* and *Rangifer tarandus*. *Funkcional'naja morfologija, jekologija i zhiznennye cikly zhivotnyh* — *Functional Morphology, Ecology, and Life Cycles of Animals.* Issue 4. St. Petersburg, 2004. Pp. 55-63 (in Russian).
15. Dogel', V.A. *Prostejshie* — *Protozoa. Maloresnichnye infuzorii* — *Infusoria Oligotricha. Sem. Ophryoscolecidae. Opredelitel' po faune SSSR.* [Protozoa. Infusoria Oligotricha. Family Ophryoscolecidae. Reference Book on USSR Fauna]. Leningrad: USSR Academy of Sciences publ., 1929. 96 p. (in Russian).