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COMPARATIVE CHARACTERISTIC OF THE MORPHO-PHYSIOLOGICAL PARAMETERS, BIOLOGY AND EPIDEMIOLOGY OF IXODIDAE (IXODES AND DERMACENTOR)

Abstract. During the period of 2017 ticks were collected on a “flag” or “drug” from domestic animals and people in 38 settlements from 33 districts and 9 regions of Ukraine: Zakarpatska (trans-Carpathian), Lviv, Ivano-Frankivsk, Ternopil, Volyn, Rivne, Khmelnytskyi, Vinnytsia, and Zhytomyr. 291 samples of ticks belonging to the species *Ixodes ricinus* and *Dermacentor reticulatus* were examined in order to find certain regularities in changes of their morphological sizes in separate body parts depending on engorgement of females and males. Moreover, about 400 samples of ticks collected from children residing in 37 settlements from 8 districts of Ternopil region and the town of Ternopil itself were examined. In addition to morphological features epidemiology of the examined ticks collected from animals and those collected from children was investigated.

Key words: *Ixodidae* ticks, *Ixodes ricinus*, *Dermacentor reticulatus*, morphology, epidemiology.

Introduction. Ixodidae ticks (IT) rank the priority among the carriers of infectious diseases among animals and people. Among 30 species of IT widespread on the territory of the western regions of Ukraine 2 species occur more frequently: *Ixodes ricinus* and *Dermacentor reticulatus*. *Ixodes ricinus* are spread all over Europe except northern part of the Scandinavian Peninsula, North Africa (Algeria, Tunisia), Asia (Arabia, Turkey, Japan, China), sometimes found in North America [2]. Ticks of *Dermacentor reticulatus* species are most often found in many European countries including Czech Republic, Slovakia, Hungary, Bulgaria, Romania, Poland [4, 5].

Nymphs and females of the first species are most often found on people, cats and dogs. Females and males of the second species more often attack dogs, cows, and horses [3]. Single cases of male attacks on people are registered, and still less – female attacks.

Objective: to determine changes of morphological parameters of separate body part

of Ixodidae ticks depending on their engorgement; to examine epidemiology of ticks by means of polymerase chain reaction.

Materials and methods. The main material for the study was Ixodidae ticks of the following species: *Ixodes ricinus* and *Dermacentor reticulatus*, collected from people and domestic animals in the town of Ternopil, Ternopil, Zakarpatska (trans-Carpathian), Lviv, Ivano-Frankivsk, Volyn, Rivne, Khmelnytskyi, Vinnytsia and Zhytomyr regions of Ukraine.

The main method of examination was laboratory identification of ticks by means of optic electron system SEO – IMAGLAB and tables for detection [1]. Epidemiological properties of ticks were determined by means of polymerase chain reaction (PCR) using the amplifier «ROTORGene - 6000» in «real time».

Results. The study was conducted in 38 settlements in order to find different stages of IT of *Ixodes ricinus* and *Dermacentor reticulatus* species on people and domestic animals during spring-autumn of 2017.

291 samples of IT were collected including only 17 samples (5,8 %) of *Ixodes ricinus* species, the rest 94,2 % – to *Dermacentor reticulatus* species. IT were collected from people and 4 kinds of domestic animals: cats, dogs, cattle and horses. The majority of IT were collected from dogs (132 samples) and cows, including 45,3 % and 39,7 % respectively. 10 samples were collected from cats (3,4 %), 12 from horses (4,3 %), 7 from people (2,4 %) and 14 IT were collected on a “flag” (4,9 %).

Moreover, during April-October 2017 the Central Scientific-Research Laboratory of I. Horbachevsky Ternopil State Medical University performed identification of ticks collected from children in the first-aid center of Ternopil Municipal Children Clinical Hospital. 400 samples of TI belonging to 2 species were examined during that time. Children afflicted with ticks resided in 37 settlements from 8 districts of Ternopil region and the town of Ternopil itself.

Large parks, small public gardens and greenbelts adjoining to houses were the places of tick attacks. Nymphs were found to attack children more often in April-May. In July-August female IT of *Ixodes ricinus* species were more active. Several attacks of males and females of *Dermacentor reticulatus* species within the borders of Ternopil were detected.

A comparative analysis of morphological parameters of the two IT species was made depending on the degree of their engorgement. The gradation of engorgement degree of ticks was accepted according to the following categories: non-engorged, partially engorged, engorged, very engorged, and maximally engorged. Analysis of morphological parameters of *Ixodes ricinus* females collected from people showed the following results of correlation in an average body length (BL) to an average belly width (BW) in mm: 3,1:1,69; 3,7:2,2; 4,07:2,44; 5,6:2,94; 8,7:6,16 respectively to the accepted categories. In ticks collected from dogs the ratio of BL to BW was the following: 3,1:1,76; 4,65:2,16; 5,88:3,45; 6,97:4,35; 10,5:7,4 respectively. Therefore, average parameters of minimal sizes are practically similar, but further engorgement indices increase and reach their maximum which is practically 2 mm more in length and 1,5 mm in width than in those ticks collected from children.

Having analyzed morphological parameters of

BL and BW ratio of IT belonging to *Dermacentor reticulatus* species minimal sizes of non-engorged males were found to be the following: 2,2 mm of general BL and 1,2 mm of BW, and maximal sizes of non-engorged males were in the ratio 5,6:3,6 respectively. Therefore, in case of maximal engorgement BL of males became 2,5 times longer, and their BW – 3 times as much.

Awareness of regularities concerning changes in the tick body ratio depending on the time of their nourishment will enable to predict probable host infection by infectious agents.

Female sizes of IT from *Dermacentor reticulatus* species depending on the degree of their engorgement change in wider ranges. At the same time certain peculiarities of morphological parameters are found depending on the kind of a host where females were fed on.

Females with minimal BL of 3,2 mm and minimal BW of 2,0 mm were collected on a “flag”. Females with BL of 3,4 mm and BW of 2,0 mm were collected from animals. At the same time maximally engorged females were 13,0 mm long and 9,3 mm wide collected from dogs, 11,1 mm of BL and 8,0 mm of BW – from cows, and 8,9 mm of BL and 5,8 mm of BW – from horses. Ticks collected from cats were of maximal BL 12,5 mm and BW 8,0 mm (fig.1).

Therefore, nourishment of ticks from *Dermacentor reticulatus* species is maximal on cats and dogs, it is a little lower on cows and horses. On the basis of these parameters it can be suggested that maximal BL of IT on dogs and cats in comparison with hungry ticks becomes 4 times as much, and belly width – 4,7 times. In ticks fed on cows and horses these parameters are 3,5 and 4 times and 2,8 and 2,9 times respectively.

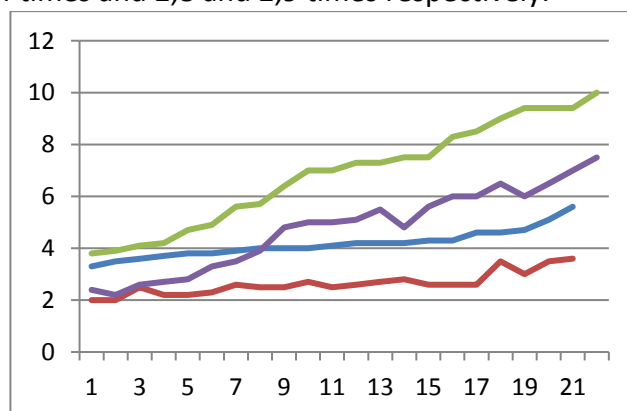


Fig. 1. Changes of the body length and belly width of ticks from *Dermacentor reticulatus* species. Notes: 1 blue line – body length of males; 2 red line – belly

width of males; 3 green line – body length of females;
4 violet line – belly width of females.

On the basis of samples of IT from *Dermacentor reticulatus* species fed on dogs and cows, the volume of the belly in case of different degree of engorgement was analyzed (fig. 2). The belly volume was found to be over 15 mm³ in case of minimal engorgement of a female with BL of 4 mm and BW 2,7 mm. In case of female maximal engorgement BL was 13,0 mm, BW was 9,3 mm, and the belly volume was 558 mm³. Thus, the volume increased 37 times as much.

Another situation was observed in the nourishment of males. In case of their minimal engorgement BL was 3,8 mm, and BW – 2,0 mm, the volume of the sucked blood was about 4,5 mm³. In case of maximal engorgement of males their BL was 5,6 mm, BW – 3,6 mm, the volume of the sucked blood was 28 mm³. Therefore, the volume of the sucked blood increased only 6,5 times as much.

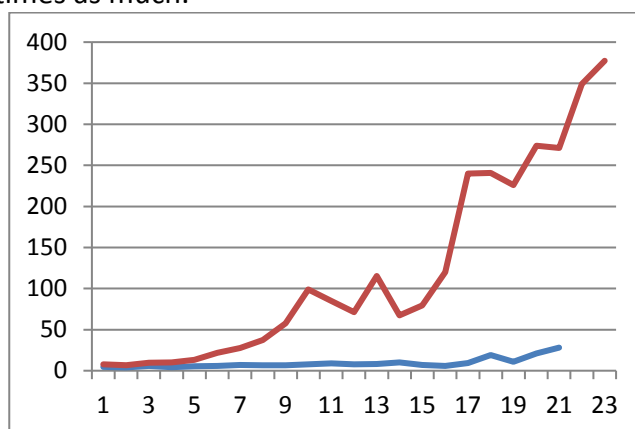


Fig. 2. Changes of the belly volume in case of feeding ticks from *Dermacentor reticulatus* species. Notes: 1 blue line – volume of the male bodies; 2 red line – volume of the female bodies.

The Central Scientific-Research Laboratory of I. Horbachevsky Ternopil State Medical University analyzed IT concerning the carriage of infectious diseases. By means of PCR Ixodidae ticks from *Dermacentor reticulatus* species were examined. It was found that about 16 % of ticks were carriers of *Borrelia Burgdorferi s.l.* and *Anaplasma phagocytofilum*. By the results of the similar investigations of IT from *Ixodes ricinus* species a part of ticks infected by *Borrelia Burgdorferi s.l.* was over 21 %, *Anaplasma phagocytofilum* – 10 %, and *Borrelia miyamotoi* – 1 %.

The results of the study, and the information

concerning geographic, landscape and biotopological spread of IT, their epidemiology and morphological parameters in particular, were entered into the medical geo-information system. On the basis of this system the charts will be made enabling to determine certain regularities concerning the spread of agent carriers and infectious diseases on the territory of Ternopil region and later in other regions of Ukraine.

Conclusions. 1. The main carriers of ticks from *Ixodes ricinus* species are people, cats and dogs, and the carriers of *Dermacentor reticulatus* species – dogs, cows and horses. 2. In case of engorgement of female ticks from *Dermacentor reticulatus* species from minimal (body length 4 mm, and belly width – 2,7 mm) to maximal (BL – 13,0 mm, BW – 9,3 mm) the volume of belly increases 37 times as much (15 – 558 mm³). Similar changes are found in males: changes of tick engorgement from minimal (BL – 3,8 mm, BW – 2,0 mm) to maximal (BL – 5,6 mm, BW – 3,6 mm) result in 6,5 times increased volume as much (4,5 mm³ - 28 mm³). 3. 16% of ticks from *Dermacentor reticulatus* species are carriers of *Borrelia Burgdorferi s.l.* and *Anaplasma phagocytofilum*. A part of ticks from *Ixodes ricinus* species infected by *Borrelia Burgdorferi s. l.* is over 21 %, and infected by *Anaplasma phagocytofilum* – about 10 %.

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