



COMPOSITION AND TOXICITY OF POISONS PRODUCED BY TICKS OF FAMILIES OF THE IXODIDAE AND THE ARGASIDAE

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ABSTRACT

The toxicity of the secretion of the salivary glands of ticks of Ixodidae and Argasidae is generally the same for rats, with LD₅₀ equal to 170,40 mg / kg for venom of mites of *Hyalomma asiaticum* and 175,50 mg / kg for *Hyalomma plumbeum turanicus* and 174,00 mg / kg for *Ornithodoros tartakovskyi* respectively. The poison of ticks of Ixodidae and Argasidae has phospholipase, neurotoxic, hemorrhagic activity. The neurotoxic effect prevails in the nature of intoxication.

KEYWORDS: *Hyalomma*, *Ornithodoros*, salivary glands, biologically active substances, ticks, fauna, biology.

INTRODUCTION

The Ixodidae keep and carry the infections and parasitic pathogens. Ticks are less known as poisonous animals. According to popular belief, the saliva of some of them, introduced into the wound at the time of suction to the host provides an anesthetic effect and contains poisonous substances^[1].

The functions of the salivary glands of the Ixodidae are multiform, and this demonstrates itself in the multicomponent nature of the saliva that they form. Various aspects of the physiological activity of salivary glands and the biochemical composition of saliva are investigated in numerous special studies^[2, 3].

It is well known that the toxic effect of the secret of various ticks is not the same, but some of them, for example *Ixodes holocyclus*, show a serious danger for humans and farm animals. The bite of *I. holocyclus* leads to the development of flaccid paralysis, after which death often comes. However, the enzymatic activity and toxicity of poisons produced by the ticks of the families Ixodidae and Argasidae in the fauna of Uzbekistan have not been studied.

MATERIALS AND METHODS

All the steps of purification were carried out at 4 ° C. The heads of ticks of *Hyalomma*, *Ornithodoros* were separated from the body by a microscale (the size of these ticks is about 3 mm).

The heads of ticks have been ground in a mortar with a small amount of distilled water. This mixture was centrifuged for 5 minutes at 1500 g. The supernatant was ly-

ophilized, the resulting material was used as a preparation of venom.

The venom of the ticks (30 mg) was dissolved in 1.5 ml of 50 mM NH₄HCO₃, pH 8.0. The dissolved poison was centrifuged at 10000 g. for 10 minutes before the separation of the insoluble part. The supernatant liquid is placed in the G-75-120 column of Sephadex (1.5 x 45.5 cm) and equilibrated with several solutions. The yield of poison and its toxicity depend on the season of the year, the size, fatness and physiological status of the ticks; the highest yield of poison is in the active period of ticks. A fresh poison of various species of ticks is a colorless or yellowish viscous liquid. The reaction of the poison is weakly acidic. Liquid and dried poison is highly soluble in water and solutions of various salts. The poison does not lose toxicity for 2-3 days, being dissolved in a physiological solution and in an aqueous solution of glycerin. Boiling caused inactivation of the poison.

The poison of the studied ticks, like other poisons produced by animals, is destroyed by the action of ethanol, ether, chloroform, strong acids and alkalis, as well it can be destroyed by exposures of high temperatures, the preparations of the poison persist for a long time at low temperatures (-20-30°C), almost without losing the toxicity.

RESULTS AND DISCUSSION

In experiments on the study of the composition of venom of ticks, we found the activity of the following enzymes in it:

Hyalomma asiaticum phospholipase A 0.28 μmol / min.mg, protease 0.07 μmol / min.mg, protein content

75-80%; *Hyalomma plumbeum turanicus* phospholipase A 0.33 $\mu\text{mol} / \text{in.mg}$, protease - 0.12 $\mu\text{mol} / \text{min.mg}$, the protein content is 75-80%; *Ornithodoros tartakovskyi*

phospholipase A - 0.32 $\mu\text{mol} / \text{min.mg}$, protease - 0.09 $\mu\text{mol} / \text{min.mg}$, protein content - 75-80% (Fig.).

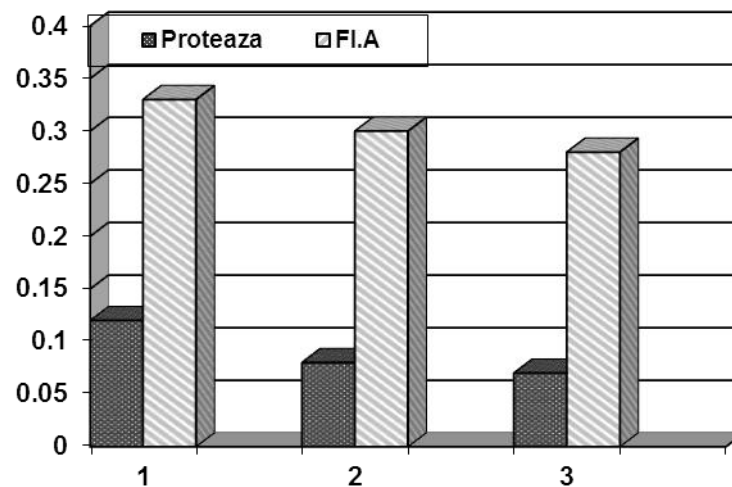


Fig. The activity of phospholipase and protease (mkmol / min., mg of protein) of the venom of the ticks of the Ixodidae.

The parameters of incubation: 0.01% Triton X-100, 10 mM CaCl_2 , 150 mM NaCl , phosphatidylcholine of egg as a substrate of phospholipase. The poison is added in an amount of $1 \cdot 10^{-4}$ g / l. The denotations of the figure: 1- *Hyalomma asiaticum*, 2 – *Hyalomma plumbeum turanicus*, 3- *Ornithodoros tartakovskyi*

There are no specific data on the toxic-morphological nature of the action of the poison of the ticks of the Ixodidae in the literature. Therefore, the LD_{50} of the venom of the ticks was determined in the experiments on mice and rats.

We determined the toxicity of the poison of the Ixodidae in experiments on mice and rats. Each animal had been weighed, and then the appropriate groups were selected from their number. Before the experiment began, the poison had been diluted in physiological solution and been injected into animals by micro syringe intraperitoneally. The obtained data were statistically processed by methods of Litchfield and Wilcoxon in order to calculate LD_{50} ^[4]. The results were denoted in doses (mg of sub-

stance) causing a lethal effect of 50% of the animals, in terms of 1 kg of mice and rats.

The introduction of the venom of *Hyalomma asiaticum*, *Hyalomma plumbeum turanicus*, *Ornithodoros tartakovskyi* into mice and rats caused at first paralysis of the hind legs, then the forelegs. There was a rapid increase in respiration and a convulsive state. The severity of these effects and their rapidity depended on the dose of the poison. Typical symptoms were anxiety, increased tone of muscles, muscle-tonic convulsions.

Animals died from asphyxia with the hard convulsive state of the animals with the introduction of large doses (LD_{100}).

We determined that values of LD_{50} , which for *Hyalomma asiaticum* were 180 mg/kg, for *Hyalomma plumbeum turanicus*- 168,10 mg/kg and for *Ornithodoros tartakovskyi* - 162 mg/kg respectively. The poison of ticks of Ixodidae has phospholipase, neurotoxic, hemorrhagic activity. The neurotoxic effect prevails in the nature of intoxication.

Table: Determination of the toxicity of poisons of some species of ticks of the Ixodidae in case of intraperitoneal introduction comparing to the poisons of other arthropods

Experimental animals	LD_{50} (mg/kg)	LD_{100} (mg/kg)
<i>Hyalomma asiaticum</i>		
Mice	180,00	185,00
Rats	170,40	200,10
<i>Hyalomma plumbeum turanicus</i>		
Mice	168,10	200,30
Rats	175,50	220,50
<i>Ornithodoros tartakovskyi</i>		
Mice	162,00	280,00
Rats	174,00	210,40

<i>Spider of Lycosa singoriensis</i>		
Mice	15	Orlov and Gelashvili. 1985.
<i>Hyalomma anatolicum</i>		
Mice	172,00	Kazakov I. 2010.
Rats	194,00	
<i>Spider of Argiopa lobato</i>		
Mice	175	Nasirov K. E. 1991.
<i>Spider of Areneus grossus</i>		
Mice	190	Nasirov K. E.1991.

SUMMARY

The value LD₅₀ for the venoms of the mites *H. asiaticum*, *H. plumbeum turanicus* and *O. tartakovskiyi* used on experimental mice and rats has been found to reach the following levels: 180.00, 170.40 mg/kg, 168.10, 175,50 mg/kg and 162,00, 174,00. mg/kg. The venom of the Ixodidae and Argasidae ticks shows the phospholipase, protease, hemorrhagic and neurotoxic activities, the latter effect prevailing in the process of intoxication.

CONCLUSION

Thus, the picture of poisoning of warm-blooded animals with venoms of ticks is largely the same, although the main feature of intoxication is apparently due to the neurotoxic effect. In general, the toxicity of ticks' poison was close to spiders' one of Argiopalobata and Araneusgrossus^[5]. These data are enough to classify the Ixodidae as a group of poisonous arthropods.

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