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Some peculiarities of the relationships between sturgeon of the Caspian Sea and their parasites

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Abstract
The protein spectrums of blood serums and livers of sturgeons of the Caspian Sea and their parasites were obtained by the method of polyacrylamide gel disc electrophoresis. Each protein fraction is characterized by the relative electrophoretic mobility (REM). The similarities of protein fractions of parasites and fish tissues was revealed in REM. The greatest number is noted in the zone of the location of globulin proteins, which are responsible for the formation of antibodies. It has been established that parasites belonging to different classes, but parasitizing same family of fish, operate the same mechanism of adaptation to the hosts. The fractions with high REM, without the hosts was found in the electropherograms of the protein spectra of parasites.

Keywords: Sturgeon fish, parasites, blood serum, liver, electrophoresis, protein spectra, adaptation

Introduction
The study of the specificity of parasites to the hosts and their mutual adaptation, as well as the study of changes occurring in the host organism during the parasitic invasion, allow us to reveal the mechanisms of the formation of parasite-host systems. The adaptation of parasites to host organism is carried out through biochemical mechanisms that are under the genetic control of protein molecules. It is therefore advisable to study in the comparative aspect of protein spectra of extracts of parasites and tissues of their hosts. This will not only determine the degree of adaptation of the parasite to the host, but also to identify differences in their protein composition. It is important to consider in the selection of anthelmintic drugs that act only on the parasite without adversely affecting to the host. Another academic K.I. Skryabin [1] noted that the most important area in the development of comparative biochemistry and physiology, and also in solving practical problems of drug therapy of parasitosis, is the detailed study of the biochemical features of particular parasites. Without understanding the biochemical and physiological processes occurring in the parasites, science does not pick up a key to solve the issue of the mechanical action of anthelmintic drugs and to find new drugs with specific deworming efficacy. Due the main biochemical features of parasites, when helminth entered into the animal's organism, it is not recognized as "foreign". Because suitable legislative mechanism to the immune system of the owner was occurred in helminth’s body. As is known, foreign proteins are antigens, when enters in to the animal's body, it causes the synthesis of antibodies, which subsequently leads to an immune reaction in the body of the latter. Many authors [2-10] have established that the development of an immune response in the animal's body, mainly depends on the globulin proteins. The studies of the amino acid composition of proteins of some parasites have shown that they have some similarity with the amino acid composition of proteins of host’s tissues [11, 12]. It has been identified that in the surgical transfer of the trematode *Schistosoma mansoni* from the bloodstream of the mouse into the circulatory system of the rhesus macaque, the latter develops an antigen reaction corresponding to the reaction to pure mouse 2-macroglobulin [3]. Thus, it was established that if a parasite synthesizes or simulates proteins identical to host proteins, then it continues to evolve in it, without experiencing from the immune system of the host an attack of antibodies. During the high intensity of invasion secretion of the waste products of vital activity (toxins), as well as mechanical destruction of the host tissues are possible, which leads to an imbalance of the immune system. But this has a secondary character. In this case, the host organism suffers mainly: allergic reactions develop, the host gets sick, and the gate opens for secondary infections.

According to the opinion of many authors [6, 13-17] changes in the host organism during parasite infestation are associated with the release of toxins and the violation of the process of food absorption due to the mechanical action of the parasite. If the parasite does not have a system for including protein compatibility with this animal, then the parasite, even if it gets into it, simply destroyed by the animal's immune system or begins its development, but it stops in an early stage and cannot reach sexual maturity in these hosts. Why do some parasites develop only in some hosts, while others may have a wide range of hosts? This question is one of the most pressing in parasitology, revealing the essence of the phenomenon of parasitism. For disclosure of this process, the complex comparative study of protein spectra of, possibly DNA, parasites belonging to different classes, but parasitizing in one species, and also one species of parasites but parasitizing in different animal species is necessary with the help of modern technology. Parasites of sturgeon and fishes are used as objects for these studies. 17 species of parasites specific only for family of sturgeon of the Caspian Sea, and 7 species of parasites were identified in many other fishes. [18]. The aim of the work was to identify some aspects of the relationship between sturgeons of the Caspian Sea and some of their parasites.

Materials and Methods

The work was carried out in the fisheries of the Middle Caspian and Kura River. Four species of sturgeon fishes were examined by the method of complete parasitological autopsy: European sturgeon (*Huso huso caspicum*), bastard sturgeon (*Acipenser nudiventris*), Kura sturgeon (*Acipenser güldenstadti*) and starry sturgeon (*Acipenser stellatus*). The living parasites, fresh blood and liver of fishes were used for biochemical studies. Fractionation of proteins was carried out on a disc-electrophoresis device in a polyacrylamide gel according to the standard procedure [19]. For each fraction was determined relative electrophoretic mobility (REM). The recommendations of a number of authors [5, 17, 20] were used in the analysis of the electrophoregrams of parasitic and host proteins. Tiselius nomenclature was used, in which the fractions of blood serum of fish, are given names similar to the electrophoretic mobility of human serum proteins. The reliability of the statistical processing of the data was carried out according to the Student [21].

Results

We obtained protein spectra of 4 species of helminths parasitizing only sturgeons: (*Amphilina foliacea*, *Bothrimonus fallax*, *Cucullanus sphaerocephalus*, *Leptorhynchoides plagicephalus*) and of one species of nematodes (*Eustrongylides excisus*) from sturgeon fishes, which has a wide range of hosts. In the electrophoregrams of the extract of proteins specific for sturgeon parasites protein follicles were observed: *A. foliacea*-27, *B. fallax*-28, *C. sphaerocephalus* -36, *L. plagicephalus*-27 and nematodes *E. excisus*-24. (Table 1) (Fig. 1). At the same time, protein spectra of blood serum and liver of four species of sturgeon were investigated. The number of protein fractions in the serum of fishes were identified: European sturgeon - 22, bastard sturgeon - 20, Kura sturgeon - 21 and starry sturgeon - 18. (Fig. 2). 31, 26, 27 and 27 protein fractions were respectively found in the liver extract of these fishes (Fig. 3). In all investigated fishes protein-like fractions similar in the REM were identified, which naturally belong to the same family. A comparison of the REM of protein fractions specific for sturgeon helminths with the tissues of these fishes showed the greatest similarity in the location of globulin proteins, known to be responsible for the formation of antibodies.

Table 1: Relative electrophoretic mobility (REM) of protein fractions of blood serum, liver extracts of sturgeon and parasites (n = 6, for all values of EIA m, not more than +0.004)

Blood serum				Liver				* Parasites				
1	2	3	4	5	6	7	8	9	10	11	12	13
0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01 -	- 0,02 0,03	-	-	0,01
0,02 -	0,02	0,02	0,02 -	0,02 -	0,02 -	0,02 -	0,02 -	0,03	- 0,05	0,02	0,02	0,02
- 0,05 -	-	0,03	- 0,05 -	-	- 0,05 -	- 0,05 -	-	-	- 0,07 0,09 -	-	0,03	-
- 0,09	-	- 0,05	- 0,09 -	- 0,05 –	- 0,09 -	- 0,09 -	- 0,05 -	0,05 –	0,13 0,15	0,04	-	-
0,11	0,05	-	0,13	- 0,09 -	0,13	0,13	- 0.09 -	- 0,09	- 0,18 0,21 -	–	0,05	0,05
0,13	-	0,07	0,15	0,13	0,15	0,15	0,13	- 0,13	- 0,26 - 0,28	-	-	0,06
0,15	-	0,09	-	0,15	- 0,18	- 0,18	0,15	0,15	- 0,31 - -	0,07	0,07	-
- 0,18	0,09	- 0,13	0,18	-	0,21	0,21	- 0,18	-	0,38 0.40 -	-	0,09	0,09
0,21	-	0,15	0,21	0,18	0,24 -	0,24	0,21	- 0,21	- 0,43 - 0,45	0,11	0,11	-
0,24 -	0,13	-	0,24 --	0,21	-	-	0,24 -	-	-	-	0,13	0,13
-	0,15	0,18 -	-	0,24	- 0,28 -	-	-	- 0,26 –	- 0,50 - 0,54	0,15	0,15	-
-	-	0,24 –	-	-	-	- 0,28	-	0,28	- 0,57 0,58	-	0,17	-
0,28	0,18	-	0,28	- 0,27	0,33	- 0,31 -	-		0,62 - 0,64 -	0.18	0,18	0,18
-	0,21	-	-	0,28	0,36 -	0,36	0,28	- 0,33	0,68 - -	0,21	0,21	0,21
0,31	0,24		0,31	- 0,31	0,40	0,38	-	0,36	-	-	0,24	0,24
0,33	-	0,28	0,33 -	0,33	-	0,40	0,31	0,38	- 0,74 -	0,25	-	-
0,36	-	-	0,38 -	0,36	- - -	-	0,33	0,40 –	- 0,77 - 0.79	-	0,26	0,26
0,38	-	0,31	- - - -	0,38	0,45 –	-	0,36	- - -	-	-	-	-
0,40	0,28	0,33	- 0,45	0,40	- 0,50		- 0,40 -	-	- -	-	-	0,28
-	-	0,36	-	-	0,52	- 0,45	- -	0.45	- -	0,29	0,29	-
0,42 -	0,31	0,38	0,48	- - - 0,45	- 0,56		- 0,45		- 0,88	0,31	0,31	0,31
-	0,33	0,40	- - 0,54	- 0,48	-	0,48	- 0,48	0,48	-	-	0,33	-
0,45	0,36	-	-	0,50	- 0,62 -	0,50	0,50	0,50	- 0,91	-	0,36	0,36
-	-	0,42 - -	-	0,52	-	0,52 -	0,52	0,52		0,38	0,38	0,38
0,48 -	0,40	0,45 - -	0,62 -	-	- 0,68	0,56	- 0,56 -	- - 0,57		-	-	-
- 0,54	-	-	-	0,56	0,70	- 0,58	-	0,58		-	0,41	-

- - - 0,62 - - - 0,68	0,42 - 0,44 0,45 - 0,48 - - 0,54 - - - 0,62 - - - 0,68	- 0,52 - - - - 0,62 - - - 0,68	- 0,68	- 0,58 0,62 - - - - 0,68 0,70 - - 0,73 0,74 - 0,76 - 0,78 – - 0,82 - - 0,86	- - 0.73 - - 0,76 – 0,78 – - 0,82 - - 0,86	0,62 - - - - 0,68 - - - 0,73 0,74 - 0,76 - 0,78 - - 0,82 - - 0,86	- 0,62 - - 0,66 0,68 - - - 0,73 - 0,76 – 0,78 - - 0.82 - - 0,86	0,62 0,63 - - - 0,68 - - - - 0,74 - - - - 0,78 - - 0,82 - - - 0,87 - - - - 0,93		- 0,43 - - 0,46 0,48 0,50 - - 0,56 - - 0,62 - - - 0,68 - - 0,72 - - 0,75 - - - - - - - 0,84 - - - - 0,90 - - - 0,95 - - 0,98	- - 0,44 - 0,46 - 0,50 - 0,54 0,56 - - 0,62 - - - 0,68 - 0,71 - - - 0,75 - 0,77 - - 0,80 - 0,83 - - 0,87 - - 0,90 - 0,93 - - 0,96	- - 0,44 0,45 - - - 0,52 - 0,56 - 0,58 - - 0,64 - 0,68 - - - - 0,74 - 0,76 - - - 0,80 0,82 - - - - - 0,89 - - - 0,94
22	20	21	18	31	26	27	27	27	28	24	36	27

Amphilina foliacea (9), *Bothrimonus fallax* (10), *Eustrongylides excisus* (11), *Cucullanus sphaerocephalus* (12), *Leptorhynchoides plagicephalus* (13).

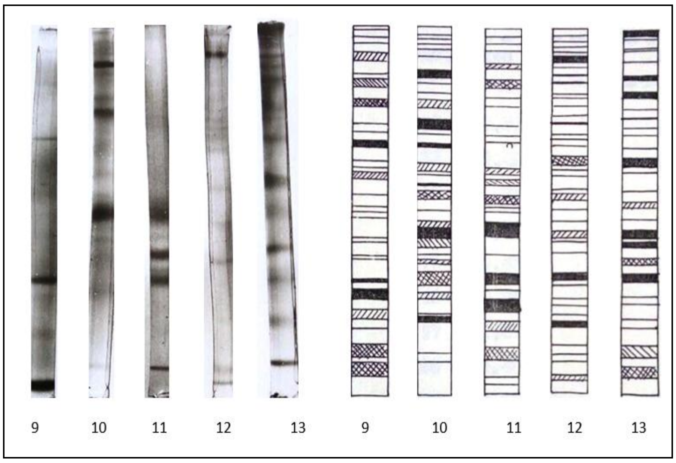

Fig 1: Electrophoregrams and schemes of protein spectra of sturgeon parasites: 9 – *Amphilina foliacea*, 10 – *Bothrimonus fallax*, 11 – *Eustrongylides excisus*, 12 – *Cucullanus sphaerocephalus*, *13 – Leptorhynchoides plagicephalus.*

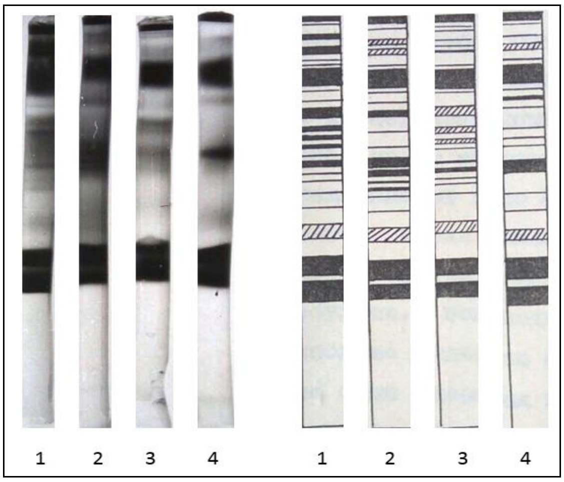

Fig 2: Electrophoregrams and schemes of protein spectra of blood serum of sturgeon: 1 - European sturgeon, 2 - bastard sturgeon, 3 - Kura sturgeon, 4 - starry sturgeon.

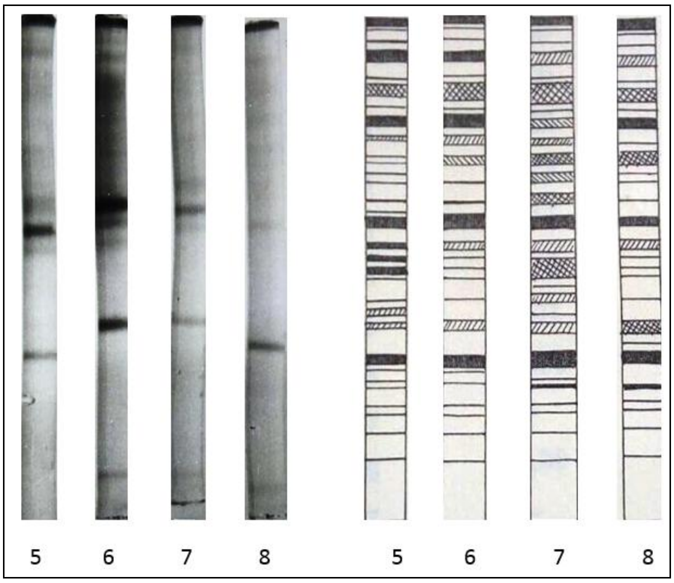

Fig 3: Electrophoregrams and schemes of protein spectra of liver extract of sturgeon: 6 - European sturgeon, 7 - bastard sturgeon, 8 - Kura sturgeon, 9 - starry sturgeon.

It was observed that the studied helminths that belong to different classes, but parasite to the fishes of the same family operate the same mechanism of protection against host antibodies. Probably, this is the manifestation of specificity. During the study of the protein spectrum of the *E. excisus* nematode, which has a wide range of hosts, the smallest number of protein fractions was found in comparison with the specific helminths for sturgeons. Likely the least amount of protein components enables this nematode easier to adapt to a wide range of hosts. When comparing the protein spectra of this nematode with sturgeon tissue, the most similarity was observed to the host's proteins in the zone of the globin locus. Thus, as in specific sturgeon parasites, the synthesis of proteins in the *E. excisus* nematode, which has a wide range of hosts, occurs in the zone responsible for the formation of antibodies. Since this nematode parasitizes many species of fish, probably, for its survival in different hosts, it must have a minimal set of protein components and a unique way of synthesizing the proteins of the corresponding host. This in turn suggests that, parasitizing in different hosts, this nematode will have a protein set of components that is peculiar only for a given parasite-host system. It is possible that the *E. excisus* nematode from different hosts will have a different protein spectrum. This difference is likely to be observed in the zone of the location of globulin proteins. In the literature, there is information about studies of the protein composition of the nematode *Trichinella spiralis*, which has a wide range of hosts [22]. Author notes a significant decrease in the diversity of proteins in this nematode and indicates similarity the synthesis of proteins with the structure of proteins of the hosts. There is also information about the similarity between the antigenic structures of helminths with their hosts, which is explained by the production of proteins similar to the hosts in the parasite [7]. Given the above, we believe that it is appropriate to use in the systematics of the protein spectra of parasites having a wide range of hosts it is necessary to indicate the name of its corresponding host. Fractions with high electrophoretic mobility, absent from the hosts, were detected in the protein spectra of all studied parasites. These fractions can serve as a search for anthelmintic drugs that affect only the parasite, without affecting the host's proteins in the future. Thus, by examining several similar systems, one can reveal unique mechanisms of parasite survival in the host organism, which bring us closer to revealing the essence of the phenomenon of parasitism.

Conclusions

1. For the first time protein fractions of five helminth species were obtained by disc - electrophoresis. The relative electrophoretic mobility (REM) was determined for each fraction.
2. The data obtained for protein spectrum of parasites specific for sturgeon fishes are stable and can be used in their taxonomy as specific feature.
3. The protein composition of liver of four species of sturgeon of the Caspian Sea was studied for the first time.
4. In electropherograms of protein fractions of parasites and fish tissues were revealed similar protein fractions by REM. The greatest number of them was noted in the zone of slowly migrating (globulin) proteins, involved in the formation of antibodies.
5. Fractions with high electrophoretic mobility, absent from the hosts, were detected in the protein spectra of all studied parasites. These fractions can serve as a search for anthelmintic drugs that affect only the parasite, without affecting the host's proteins in the future.

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