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BIOCHEMICAL ASPECTS OF ADAPTATION OF A TREMATODE SCHISTOSOMA TURKESTANICUM (SKRJABIN, 1913) TO HABITAT CONDITIONS

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ABSTRACT: The phospholipid composition of the whole body of Schistosoma turkestanicum and cattle liver has been comparatively studied. Qualitative compositions of phospholipids of adult forms of trematode Sch. turkestanicum and healthy cattle liver are close, but not identical. It was revealed that the phospholipid composition of the liver of uninfected and infected cattle with trematode is sharply different. It is assumed that in the process of evolution, a mechanism has been developed in the host-parasite system that forms the phospholipid composition of the quality necessary for the parasite.

KEYWORDS: Trematodes, Schist soma turkestanicum, Phospholipids, Biochemical adaptations, Cattle.

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I. INTRODUCTION

Trematodes Schistosoma turkestanicum (Skrjabin, 1913) are widely represented in the biogeocenoses of the Indo-Small and Palearctic as components of the tropical and subtropical fauna. They adapted to parasitism in the venous vessels of mammals, morphologically, physiologically, biochemically adapting to their environment, and cause serious animal diseases, causing enormous damage to the national economy. Lifestyle features of parasitic organisms, including trematodes Sch. turkestanicum, are associated not only with the need to adapt to the first-order habitat (external environment), but also with the ability to receive many metabolites that the host organism synthesizes (second-order environment) in ready form (Azizov and others, 1996; Oymatov and others, 1996). According to modern concepts, an important role in the processes of interaction of parasites with the host belongs to cell membranes (Sidorov and others, 1989). The general physiological status of the host depends on the activity of membrane structures, in particular, the composition and state of membrane phospholipids. One of the first signs indicating a difference in cell membranes during animal pathogenesis is a change in the phospholipid composition. In this case, it can be assumed that parasites in the process of evolution have developed a mechanism for the selective assimilation of substances in the environment. One of the criteria for assessing the structural and functional characteristics in the "parasite-host" system can be the phospholipid composition of the whole body of the parasite and the host organ, where helminths parasitize. Therefore, a comparative study of the phospholipid composition of the parasite and the host is of interest in terms of understanding the biochemical mechanisms that regulate the stability of the parasite-host system. Information on the composition of phospholipids in the trematode system Sch. turkestanicum - Bos taurus", we did not find in the literature.

II. MATERIAL AND METHODS

In experiments, uninfected and infected trematode Sch. turkestanicum were used 20 heads of cattle belonging to various farms of Karakalpakstan. Infected animals were separated according to the results of helminthovoscopy. Control animals in the amount of 10 animals were taken from schistosomiasis-free farms. Experimental and control groups of animals were slaughtered at slaughterhouses on farms. The opening of cattle was carried out by the method of complete and non-complete helminthological autopsies according to K.I.Skryabin (1928). Lipid extraction was carried out according to the method of Folch (Folch, 1957). Phospholipids were fractionated by thin layer chromatography. In this case, the well-known methods of biochemistry and experimental parasitology were used (Biochemical study of membranes, 1979; Kargapalov, 1981; Chromatography, 1986; Bergelson, 1981; Vaskovsky and others., 1975).

III. RESULTS AND DISCUSSION

A comparative analysis of the results shows that the qualitative compositions of phospholipids of adult forms of trematode Sch. turkestanicum and healthy cattle liver are close, but not identical. The most significant fractions in the composition of phospholipids were phosphatidylcholine and phosphatidylethanolamine (table). Phosphatidylcholine is the main component of phospholipids in whole organs, tissues and various subcellular organelles of animals, including helminths (Sidorov and others,1989), it is more saturated phospholipid than phosphatidylethanolamine. The total content of phosphotidylcholine and phosphatidylethanolamine in adult forms of trematode Sch. turkestanicum is 70.1%, the homogenate of a healthy animal liver is 74.6%, and the content of the remaining identified phospholipids - cardiolipin, phosphatidic acid, sphingomyelin, phosphatidylserine, phosphatidylinositol, lysophosphatidylcholine and lysophosphatidylethanolamine - 28.3 and 24.0%, respectively.

Differences are observed in the content of individual fractions of phospholipids of the body of trematode Sch. turkestanicum and cattle liver. In body homogenate Sch. turkestanicum has a higher phosphatidic acid content (5.7%) compared with cattle liver (1.5%). Phosphatidic acid is contained in very small amounts in cell membranes, however, it is an important intermediate product of the biosynthesis of other phospholipids and performs ionophore functions by participating in the formation of ion channels (Kreps, 1983).

Table 1: The Content of Phospholipid Fractions in the Body of Sch. Turkestanicum and Liver Homogenate of Uninfected Animals and Changes in the Composition of Phospholipids with Parasitization by Schistosomes (M ± m) (% of the Sum of all Phospholipids)

№	Phospholipid fractions	*Sch. turkestanicum* (n=100)	Large liver cattle	
			Uninfected (n=10)	infected (n=10)
1	Phosphatidylcholine	38,8 ± 1,5	44 8 ± 2,4	35,9 ± 2,1
2	Phosphatidylethanolamine	31,3 ± 1,8	29,8 ± 1,7	22,1 ± 1,9
3	Cardiolinin	4 ,7 ± 0 5	2,1 ± 0,2	3,7 ± 0,4
4	Phosphatidic acid	5,7 ± 0,7	1,5 ± 0,3	0,9 ± 0,1
5	Sphingomyelin	6,1 ± 0,6	4,8 ± 0,6	6,8 ± 0,4
6	Phosphatidylserine	7,9 ± 0 3	6,8 ± 0,3	9,6 ± 0,9
7	Phosphatidylinositol	footprints	3,8 ± 0,5	4,7 ± 0,4
8	Lysophosphatidylcholine	3,0 ± 0,2	3,1 ± 0,3	10,3 ± 0,4
9	Lysophosphatidylethanolamine	0,9 ± 0,1	1,9 ± 0,2	5,3 ± 0,7
10	Unidentified phospholipids	1,6 ± 0,2	1,4 ± 0,2	0,8 ± 0,02

Phosphatidylinositol in the whole body of Sch. turkestanicum is present in very small amounts (less than 0.5%), while in the homogenate of a healthy animal liver it is 3.8%. It is known that phosphatidylinositol plays an important role in the regulation of the permeability of various substances (primarily divalent cations), the synaptic transmission and conduction of impulses along nerve fibers, and also in the energy processes of cells (Tretyak and Limarenko, 1978). It was revealed that with parasitism Sch. turkestanicum in the blood vessels of the liver of cattle, there is a significant decrease in the quantitative content of the main phospholipids: phosphatidylcholine - by 19.8%, and phosphatidylethanolamine - by 25.8% compared to healthy ones against the background of an increase in lysophosphatidylcholine by 3.3 and lysophosphatidyl ethanolamine in 2.8 times. The ratio of amine-containing (PhEA, PhS, LPhEA) to choline-containing (PhCh, SM, LPhCh) phospholipids in the infected liver is 0.7, which is close to the value of this indicator in uninfected animals. An increase in the quantitative content of lysophosphatidylcholine against a background of a decrease in phosphatidylcholine indicates the activation of phospholipase A2 during infection of animals. It is believed that helminths during the process of functional activity release phospholipase molecules into the host tissue, increasing the permeability of cell membranes, but not destroying their integrity (Guryanova, Sidorov, 1985).

The lysophosphatidylcholine molecules themselves have strong detergent and hemolysing properties, which contributes to the destruction of the membrane structures of the host tissues and, in the first place, directly adjacent to the parasite's location. In this case, changes in the composition of phospholipids occur, leading to violations of the vital functions of the body as a whole, including an increase in membrane permeability, which, apparently, is required for the normal existence of the parasite.

Thus, in the process of evolution, a mechanism has been developed in the host-parasite system that forms the phospholipid composition of the quality necessary for the parasite. It can be assumed that the presence of trematode Sch. turkestanicum in the blood vessels of the liver of cattle determines such a composition of phospholipids and the principle of organization of the membranes of cell structures that possibly reduce their damage when interacting with the pathogen.

IV. CONCLUSION

A comparative study of the phospholipid composition of the liver of cattle in normal and pathological conditions showed that the process of infection of the liver with trematodes Sch. turkestanicum is accompanied by a change in the structural organization of the membranes. Perhaps in the infected liver there is an interconversion of phospholipid fractions, which are manifested in a change in their ratio. This is probably facilitated by the increased activity of phospholipases, as evidenced by an increase in the quantitative content of phospholipid lysoforms. Phospholipase A2 promotes cleavage from phospholipids, mainly from phosphatidylcholine and phosphatidylethanolamine, unsaturated fatty acids and, in particular, arachidonic acid (Petrov, Ataullakhanov, 1991). Fatty acids are able to increase the permeability of cell membranes for ions and some water-soluble substances (Marzoyev and others, 1983). In addition, arachidonic acid is able through a series of reactions to turn into active effectors: prostanglandins, leukotreans, thromboxanes. The second product of the action of phospholipase A2 on phosphatidylcholine is most often the phosphatidylcholine lysoform. Lysophosphatidylcholine, which appears in the composition of membrane phospholipids during liver infection, is one of the factors that inhibit phosphorylation, and inhibition of membrane-bound enzyme activity, according to some reports, activates guanylate cyclase, i.e. can act as an inducer of CGMPh (cyclic 3,5 - guanosinemonophosphate) - signal (Petrov, Ataullakhanov, 1991). Such modifications of the structural organization of membranes possibly cause changes in the conformational and physicochemical properties of membrane protein enzymes. This, in turn, can lead to disruption of lipid-protein and protein-protein interactions in the membranes of liver cells invaded by trematodes Sch. turkestanicum.

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