

The body of parasitic worms has been found to contain acetylcholine and cholinesterase, and also serotonin [1, 2, 4, 18, 20]. No information is available concerning the presence of catecholamines in these worms. It has been shown [18], that ephedrine, amphetamine, and tyramine stimulate the movements of trematodes while adrenalin and noradrenalin have no appreciable action on them. Reactions to adrenalin and ephedrine have been found in tapeworms and nematodes [3]. Ascorbic acid has been detected in parasitic worms [19, 21, 22], and the synthesis of catecholamines is associated functionally with this compound.

Because of the theoretical and practical importance of the study of chemical agents in relation to the motor activity of helminths [6], investigations have been undertaken to look for catecholamines in different classes of parasitic worms.

#### EXPERIMENTAL METHOD

To obtain material, helminths collected during slaughter of animals at meat factories, at autopsy of laboratory animals, and after deworming of human patients were used.

Catecholamines were determined by Shaw's adsorption-colorimetric method as modified by N. A. Smazhnova [10]. A series of tests was carried out by a biological method on a segment of the rabbit's small intestine [12], and also fluorometrically [15]. As a rule, each determination was carried out on pooled material from the tissues of several tens of worms of the same species. Tissues of living parasitic worms were cooled to 4° before mincing and extraction.

#### EXPERIMENTAL RESULTS

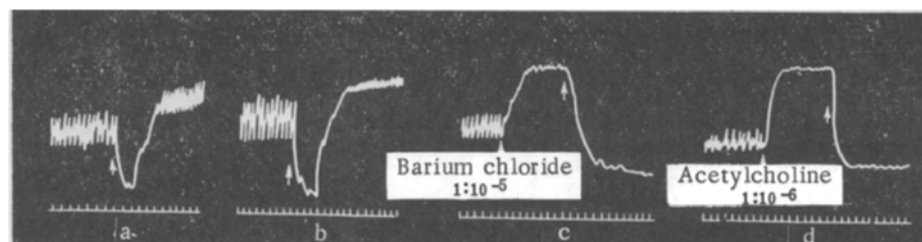
As the table shows, catecholamines were discovered by Shaw's method in all species of helminths investigated. In ascarids rather less was found than in cestodes and trematodes. More catecholamines were detected in young, unfertilized females than in sexually mature ascarids. The content of catecholamines in the tissues of the ascarids could be associated with the presence of nerve cells.

Because of divergent opinions regarding the specificity of Shaw's method [7, 11, 13, 15, 16], the presence of catecholamines in the helminths was confirmed by fluorometric and biological methods. Fluorometrically catecholamines were found in amounts 20-50 times less than by Shaw's method (1.7  $\mu\text{g}\%$  in trematodes—*Fasciola hepatica*, 0.6  $\mu\text{g}\%$  in cestodes—*Taeniathynechus satinatus*, and 0.3-0.58  $\mu\text{g}\%$  in ascarids—*Ascaris suum* collectively). For the biological determination, extracts of the fresh tissues were tested on fragments of the rabbit's intestine. Consistent results were obtained.

Dilutions of extracts (0.01%) of the macerated tissues caused a very slight and slow increase of tone. Dilutions of 0.1% led initially to a sharp decrease of tone and to abolition of the contractions of the segments of intestine, after which the tone increased (see figure, a-b). Adrenalin ( $10^{-7}$ - $10^{-8}$ ) had approximately the same effect. A 1% dilution of extracts of macerated tissues of the helminths caused a prolonged decrease of tone, and abolished and prevented the effect of carbachol and barium chloride. It may be concluded from these results that the tissues of helminths contain substances with an adrenalin-like action on the isolated rabbit's intestine. The similar action on the segment of intestine and the effect of the tissues of various helminths on the heart, observed previously [8, 9, 14], may also be explained by the presence of adrenalin-like substances in the tissues of these parasites.

Results of Detection of Catecholamines by Adsorption-Colorimetric Method in the Tissues of Various Species of Helminths

Species of helminths	Characteristics of material	Concentration of catecholamines (in $\mu\text{g}\%$ )	
		adrenergic substances	adrenalin-like substances
<i>Fasciola hepatica</i>	500 whole specimens from the biliary tract of cattle (10 determinations)	12-50 (On the average 34)	0-60 (On the average 23.5)
<i>Hymenolepis nana</i>	300 whole specimens from the intestine of mice (2 determinations)	18-30	36-42
<i>Moniezia expansa</i>	Fragments of 4 specimens from the intestine of calves (2 determinations)	19-40	22-25
<i>Taeniarhynchus saginatus</i>	Fragments of 1 specimen after deworming of a human patient (1 determination)	23.5	24
<i>Echinococcus granulosus</i> (larva)	Cyst fluid of 10 specimens from the lungs of cattle (2 determinations)	8-10	0-0
<i>Alveococcus multilocularis</i> (larva)	Tissue of 2 specimens from the liver of cotton-tail rats (1 determination)	30	10
<i>Macracanthorhynchus hyrudinaeus</i>	4 whole specimens from the intestine of pigs (2 determinations)	20-45	15-25
<i>Ascaris suum</i>	Hemolymph of 125 sexually mature females from the intestine of pigs (5 determinations)	8-16.5 (On the average 12)	8-16 (On the average 10.7)
<i>Ascaris suum</i>	Hemolymph of 100 unfertilized females (4 determinations)	15.7-48 (On the average 26.7)	22.5-30 (On the average 26.4)
<i>Ascaris suum</i>	Hemolymph of 25 sexually mature males (1 determination)	8	9
<i>Ascaris suum</i>	Muscles of head end 1 determination	18	9
<i>Ascaris suum</i>	Muscles of lateral walls each on 100 specimens	12	0



Changes in tone of the rabbit's intestine during the action of 0.1% hemolymph of an acarid (a), 0.1% tissue extract of *F. hepatica* (b), 1% tissue extract of *Moniezia expansa* after treatment with barium chloride (c), and 1% tissue extract of *Macracanthorhynchus hyrudinaeus* after treatment with acetylcholine (d).

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of the first issue of this year.

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