THE ROLE OF DIETARY PROTEIN AND SCHISTOSOMIASIS INFECTION ON THE GROWTH RATES AND BLOOD SERUM PROTEINS IN MICE

By

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SUMMARY

1. Comparative studies of the growth rates of mice in Schistosomiasis infection and/or protein malnutrition indicated that infection did not interfere with the normal growth of mice. When offered the deficient diet, an immediate stimulus to growth retardation occured ; almost at the same rate amongst both infected and uninfected groups — indicating that growth retardation is a function of nutritional deficiencies but not of pure Schistosomiasis infection.

2. Comparison between the total blood serum protein and its different fractions indicated that both infection and deficient diet resulted in a reduction in the total protein level and in the albumin fraction. This was rather aggravated in mice with the double stress of infection and malnutrition. Infection alone was characterized by rather high serum globulins ; mainly due to a drastic rise in the γ fraction. This occured almost at the same rate in the two infected groups maintained on the low and normal protein diets. The uninfected — low protein diet group was characterized by rather low serum globulins ; with the γ globulin fraction even lower than normal.

INTRODUCTION

The frequent co-existance of malnutrition with infections and infestations has attracted attention for many years (for review-Platt, 1p57-1958). One aspect of this work is the role of the nutritional status on the infected host.

As the nutritional status in most of the underdeveloped communities is usually a diet low in protein, and the infection is usually Schistosomiasis, it was decided to investigate the problem experimentally. The object of the present communication is to provide information regarding the relative growth rates and blood serum protein changes in *Schistosoma mansoni* infection and/or protein malnutrition in mice.

MATERIAL AND METHODS

Experimental Host :

60 male albino mice, averaging 20 grams of body weight at the commencement of the experiment were used.

Infecting Parasite :

An Egyptian strain of *Schistosoma mansoni* ceraria maintained in the laboratory.

Diet :

Two types of dietary regimens were employed ; a normal well — balanced diet and a low protein diet. The ingredients and the percentage compossition of each is given by the following table :

TABLE 1

Compossition of the experimental diets

Ingredient	percentage compossition in the mixture	
	Normal diet	Low protein diet
Casein (protein)	20%	5%
Corn oil (fat)	10%	10%
Maize starch (carbohydrate)	65%	80%
Salt mixture (Jones Foster-1942)	5%	5%
Vitamin mixture (Woodruff-1950)	In excess	In excess

Mice were divided according to the following scheme :

Group I : Were infected with approximately 100 cercaria / mouse, and were maintained on the normal diet.

Group II : Were kept uninfected, and were maintained on the low protein diet.

Group III : Were similarily infected as group I, and were maintained on the low protein diet.

Also, agroup of healthy uninfected mice were fed on the normal diet ; these served as controls (*Control group*).

The infection method is basically that of Standen (1949). Diet was fed ad-libitum to all the groups ; 10 grams/mouse were offered daily.

A weekly record of the body weights of each group was performed. At the end of the 6th. week, mice of all groups were autopsied by head decapitation, blood samples from each mouse were collected separatly. Total serum proteins were estimated according to the method of Greenberg - (1929). The electrophoretic separation of serum proteins as well as the estimation of albumin and various globulins were carried out on A spincomodel R paper electrophoresis apparatus using a barbiturate buffer (PH 8.6), according to the standard technique.

RESULTS

Growth rates :

Figure (1) illustrates the body weight curves of the different groups employed in the study.

During the six weeks period, both infected and control groups (group I) offered the normal diet continued to grow almost at the same rate, and only minor variations were detected between the two groups.

Progressive growth retardation was indicated amongst both infected and uninfected mice fed the low protein diet (Groups II & III). Marked body weight losses started from the first week, and progressed through so that by the sixth week, surviving mice had lost in the average 30% of their initial body weights.

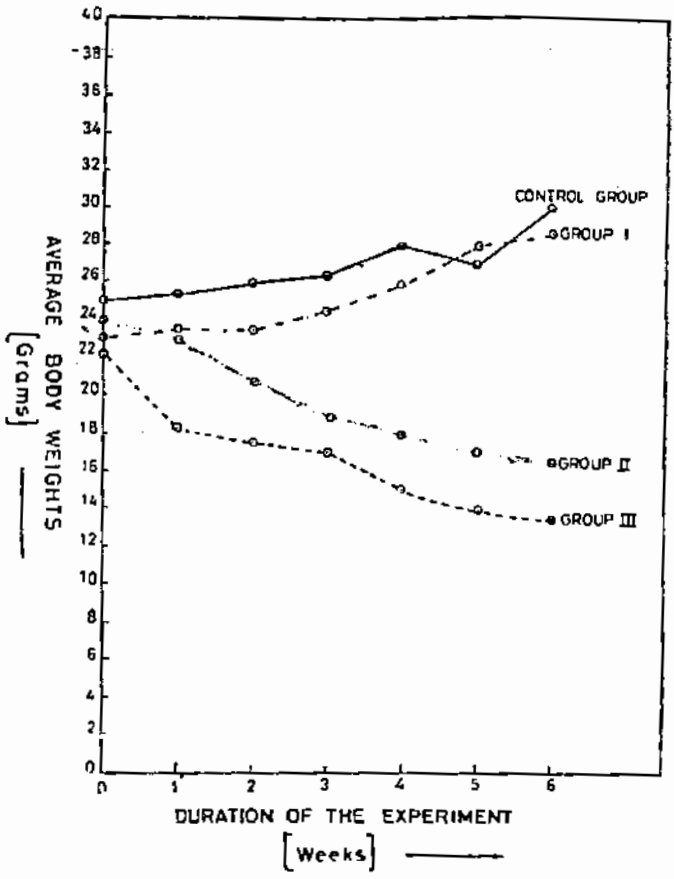

Fig. (1)

Blood Serum Proteins :

The distribution of the protein components of blood serum of the different groups is compared with the results of the controls in table 2.

Using the control data for comparison, it is evident that group I mice (infected and maintained on the normal diet) showed a slight decrease in the total plasma protein concentration. Reflecting this change however, the total amount of albumin shows a striking decrease. The increase in the globulin component is due primarily to the γ globulin fraction ; which showed 57% elevation than normal. Alterations in the albumin and globulin levels produced an A/g ratio of 0.7, as compared with 1.1 for the controls.

TABLE 2

Blood serum proteins and protein fractions of the different groups

Group Distribution	Total Protein	Albumin	Globulin	A/g	Globulin Fractions			
					α_1	α_2	B	γ
Control Group	6.7	3.6 * 53.7%	3.1 64.3%	1.1	0.5 7.4%	0.6 8.9%	0.6 8.9%	1.4 20.8%
Group I (Infection + Normal diet).	6.4	2.7 * 44.0%	3.7 57.7%	0.7	0.4 6.2%	0.8 12.5%	0.3 4.6%	2.2 35.9%
Group II (Low protein diet)	5.5	2.9 * 52.7%	2.6 47.2%	1.1	0.3 5.4%	0.7 12.3%	0.5 9.0%	1.1 20.0%
Group III (Infection + Low protein diet)	∓ 5.9	2.0 * 33.9%	3.9 66.1%	0.5	0.3 5.0%	0.8 13.5%	0.2 3.0%	2.6 44.0%

* Absolute amounts (calculated in terms of the total protein determinations).

The low protein diet alone (Group II) reflected a marked lowering in the total protein level (from 6.7 to 5.5 gm%). This was due to a uniform decrease in the albumin as well as globulin components, with maintainance of A/G ratio, and with a slight elevation in the α_2 globulin fraction.

Mice of group III, with the double stress of the dietary deficiency and infection, demonstrated a rather low total plasma protein level ; which primarily reflected a marked decrease in the albumin component. Serum globulin component was slightly increased with the resultant A/G ratio very low. The greatest change, however, was in the γ globulin fraction which was increased by twofolds (from 20.8% to 44.0%).

DISCUSSION

Evidence of progressive growth retardation of both the infected and non infected groups of mice when placed on the deficient diet is available from some reported experimental studies under other dietary deficiencies (De Meillon and Paterson, 1958) and (Bhattacharyya, 1965). The present investigation has demonstrated that both infected and unifected groups of mice showed no significant variations in growth when they were maintained on the normal diet. Feeding the low protein diet to the infected and uninfected groups resulted in a uniform progressive growth retardation. This evidence, however, seems to indicate that growth retardation is a direct result of the nutritional deficiencies and that schistosomal infection does not interfere with the normal development of mice ; when maintained on an adequate diet.

Serum protein changes characterizing Schistosomiasis infection in experimental animals (De Wett, 1957) and in the human (Ghaffar, et al. - 1964) indicate serum globulin levels above the normal range. This, as is demonstreated by the present study, is due primarily to marked rise in the γ fraction. The analysis of globulin fractions is of interest in relation to the phenomenon of immunity. The immune bodies which are concerned with resistance to infections, are an important constituent of the serum globulins especially the γ fraction. The γ globulin also increases in response to other infectious diseases.

Hypoalbuminaemia have also been stressed in dogs fed diets of low protein value (Platt and Heard, 1965) and in children with Kwashiorkor (El Gholmy et al. 1960). Serum albumin concentration is Known to be lowered in liver disease, since this organ is the

sight of its formation. The effect of the same diet used in the present study on the liver have been tested by one of the authors (Ashry et al. 1970) ; who reported the development of severe fatty infiltration followed by cirrhosis.

Serum protein changes under the double stress of Schistosomiasis and a nutritionally deficient diet are available from the investigation of De Witt, (1957). In mice experimentally infected with *S. mansoni* and maintained on a Torula, yeast ration deficient in cystine, the auther reported the fialure of Schistosomiasis infection to produce alterations in the serum protein levels of the deficient animals. This, as explained the auther, was due either to the incapacity of the deficient animals to respond to the infection, or the inability of the stimuli produced by the under developed worms to elict a response. In contrast, the present investigation has demonstrated clearly marked differences in the serum protein patterns between both infected and uninfected mice ; when maintained on the same deficient diet.

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