DYNAMICS OF BLOOD CATALASE AND PEROXIDASE ACTIVITY IN RABBITS DURING PROLONGED CHOLESTEROL FEEDING

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During prolonged feeding of cholesterol to rabbits there is a decrease in the catalase and peroxidase activity of the blood. The dynamics of the blood lipids and the severity of atheromatosis of the aorta in the animals was opposite to the changes in the blood catalase and peroxidase activity.

Isolated reports of the accumulation of lipid peroxides in atherosclerosis have been published recently [2-4, 7, 9, 10], and the phenomenon has been linked with the pathogenesis of the disease. The enzymes catalase and peroxidase are known to play a protective role against the accumulation of peroxides in the body. The ability of exogenous catalase, when injected, to lower the level of the cholesteremia and to inhibit the development of experimental atherosclerosis has been described [6, 8] and a similar effect has been observed on injection of peroxidase [6]. A decrease in the blood catalase activity has been found in patients with atherosclerosis [5].

This paper describes the results of a study of the relations between the levels of catalase and peroxidase activity and the lipid concentration in the blood and the degree of atheromatosis of the aorta in rabbits fed with cholesterol.

EXPERIMENTAL METHOD AND RESULTS

Two series of experiments were carried out (22 rabbits in each series, subdivided by weight and sex into two equal groups). All the animals received a standard diet and were kept under identical conditions.

TABLE 1. Dynamics of Catalase and Peroxidase Activity of Blood during Prolonged Feeding of Rabbits with Cholesterol (M ± m)

Index	Group of rabbits	Initial	After 1 month	After 3 months	After 5 months
Catalase number	1	12,06±0,49	12,17±0,80	12,15±0,61**	11,80±0,52**
	2	11,95±0,49	11,48±0,50	9,68±0,56**	7,74±0,61**
Catalase index	1	2,40±0,14	2,24±0,07	2,25±0,13**	2,16±0,11**
	2	2,37±0,06	2,19±0,10	1,85±0,12**	1,59±0,13**
Peroxidase number	1	12,94±0,43	12,45±0,50	13,40±0,70**	12,60±0,56**
	2	13,29±0,58	13,39±0,41	11,57±0,46**	9,90±0,66**
Peroxidase index	1	1,15±0,05	1,02±0,05	1,03±0,07	0,94±0,05**
	2	1,20±0,07	1,16±0,05	0,93±0,04	0,80±0,05**
Blood cholesterol concentration	1	56,9±5,8	53,9±5,1**	59,5±6,2**	52,0±3,8
	2	58,8±6,9*	361,5±36,1**	487,9±44,2**	652,6±86,6**

Note. Differences between indices marked by an asterisk are statistically significant.

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TABLE 2. Relationship between Catalase and Peroxidase Activity of Blood and Blood Lipid Concentration (M ± m)

Index and its level	After 1 month				After 3 months				After 5 months			
	number of rabbits	blood cholesterol	lecithin/cholesterol ratio	blood β-lipoproteins	number of rabbits	blood cholesterol	lecithin/cholesterol ratio	blood β-lipoproteins	number of rabbits	blood cholesterol	lecithin/cholesterol ratio	blood β-lipoproteins
Catalase number:												
above average† . .	5	330±37,8	0,76±0,07	475±70,1	5	372,2±52,7*	0,86±0,14	565±57,2	5	396±65,0*	0,75±0,13*	602±73,6*
below average . .	5	325±59,0	0,75±0,04	461±81,5	5	579±71,5*	0,58±0,07	912±195,0	5	945±81,7*	0,28±0,04*	1335±186,0*
Peroxidase number:												
above average . .	5	365±38,2	0,74±0,07	564±60,1	4	337±52,5*	0,82±0,19	488±56,5*	4	580±113,0	0,55±0,15	1016±150,0
below average . .	5	374±78,8	0,68±0,07	527±148,0	4	553±31,5*	0,60±0,01	778±65,0*	5	819±143,0	0,38±0,07	1052±230,0

* Differences between indices statistically significant.

† Above arithmetic mean.

The animals of group 1 (10) were the control, while the rabbits (12) of group 2 received cholesterol in a dose of 0.3 g/kg daily with their food for 5 months. The lipid concentration and catalase and peroxidase activity of the blood were determined at intervals (before the beginning of cholesterol feeding and 1, 3, and 5 months after). At the end of the experiments (after the rabbits had been killed by injection of air into the auricular vein) the severity of the atheromatous changes in the aorta was estimated visually and planimetrically and the cholesterol concentration was determined in its homogenates. The catalase activity of the blood was investigated manometrically and the peroxidase activity by the indigo-carmine method [1]. The catalase index was calculated as the ratio between the catalase activity of the blood (in mg of peroxide broken down) and the red cell count of the blood (in millions/mm^3). The peroxidase index also was calculated as the ratio between the peroxidase number and the hemoglobin concentration.

The results (Table 1) showed that during feeding of the rabbits with cholesterol the catalase activity of the blood fell progressively. The dynamics of the catalase index was similar. The blood peroxidase activity after cholesterol feeding of the rabbits for 1 month was not significantly different from its level in the control animals, but after feeding for 3 and 5 months this index showed a progressive decrease.

The peroxidase index in rabbits receiving cholesterol for 5 months also was significantly lower than in the controls.

The differences in the catalase and peroxidase activity of the blood in the rabbits of these groups were not connected with the red cell count or the hemoglobin concentration in the blood, although these parameters also were a little lower in the animals receiving cholesterol at the end of the experiment than in the controls. There was no significant difference in the weight of the two groups of animals at any time during the experiment.

By the 3rd month of cholesterol feeding (Table 2) the animals with below average catalase activity had a higher concentration of cholesterol and β-lipoproteins in the blood, and also a lower lecithin/cholesterol ratio. These differences became greater toward the end of the experiment (i.e., toward the 5th month).

Similar relationships were observed between the peroxidase activity and the lipid concentration in the blood, the only difference being that the differences in the blood cholesterol and β-lipoprotein levels in the groups with comparatively high and low peroxidase activity in the blood did not become significant until the 3rd month of the investigation.

The blood catalase activity investigated before the rabbits were sacrificed was compared with the severity of the atheromatosis and with the cholesterol level in homogenates of the aorta. In animals whose atheromatosis was rated 2-4 points (6 rabbits) the blood catalase activity was 6.1 ± 0.43 mg, while in rabbits whose atheromatosis was rated 0-1 point it was 9.4 ± 0.57 mg ($P < 0.001$). A similar correlation was found between the blood catalase activity and the cholesterol level in homogenates of the aorta. No clear dependence of the blood peroxidase activity on the severity of the atheromatosis or on the cholesterol level in homogenates of the aorta was observed. No

connection was found between the severity of the atheromatosis and the blood cholesterol level toward the end of the experiment, on the one hand, and the blood catalase and peroxidase activities on the other.

During prolonged cholesterol feeding of rabbits there is thus a progressive decrease in the blood catalase and peroxidase activity. These changes are evidently linked with the progressive depression of oxido-reduction in the animal body during cholesterol overloading and they probably play a definite role in the accumulation of lipid peroxides and the development of atheromatosis.

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