THE EFFECT OF PLANTAIN (PLANTAGO MAJOR) ON THE COURSE OF EXPERIMENTAL ATHEROSCLEROSIS IN RABBITS

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Atherosclerosis is one of the most widespread of diseases. A. L. Myasnikov [9] states that atherosclerosis is one of the most important causes of loss of working capacity, disability, and death. It has to be admitted that the range of drugs at present used in the treatment of this disease is extremely limited. In order to lower the excitability of the central nervous system, sedatives are given—sodium bromide, phenobarbital, chloral hydrate, sodium amytal [2, 5, 7, 10, 16]; certain vitamins (ascorbic acid, vitamins B_1, B_{12}, etc.) may be beneficial as a result of their nonspecific effect on metabolic disturbances in atherosclerosis [7, 9, 11, 12, 15]. In some cases various endocrine preparations and anticoagulants are given as an addition to other methods of treatment.

The foregoing facts, coupled with N. N. Anichkov's statement that the changes in atherosclerosis are reversible, explain the tremendous interest displayed in the search for drugs influencing the development of atherosclerosis and the course of the cholesterol metabolism.

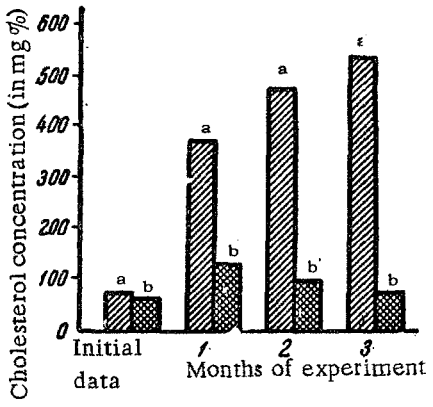

Fig. 1. Effect of plantain extract on the blood cholesterol concentration in rabbits. a) Control; b) experiment.

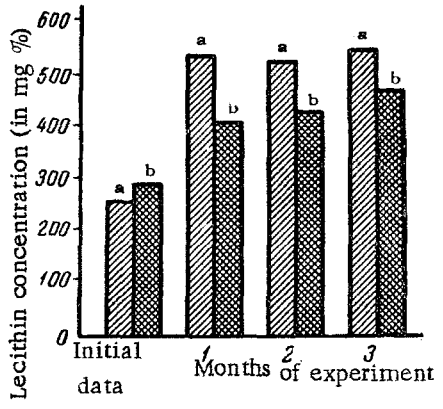

Fig. 2. Effect of plantain extract on the blood lecithin concentration in rabbits. a) Control; b) experiment.

Among the numerous experimental and clinical researches into the effect of various substances on the course of atherosclerosis, many have paid considerable attention to substances obtained from plants. Such substances which have been studied include sterols [6, 17, 18, 22, 25,26, 27], saponins [13, 20], artichokes [23, 28, 29, 30], horse-chestnut [21]and others. The results obtained indicate that plant preparations may be effective means of lowering the cholesterol concentration in the blood and liver, preventing fatty infiltration of the aorta, and accelerating the reversal of the atherosclerotic process. In respect of plantain we could find only one reference in the accessible literature. M. I. Sumtsova [14] studied the value of plantain as a tonic and observed that the general condition of patients suffering from atherosclerosis improved after treatment with this substance.

We therefore considered it of interest to study the effect of plantain on the course of experimental atherosclerosis in rabbits.

Experimental atherosclerosis was produced in the animals by N. N. Anichkov's method. The material tested was the dry leaves of Plantago major and an extract of the leaves prepared in the phytochemical laboratory by A. G. Gorin (Head of Laboratory, D. G. Kolesnikov).

EXPERIMENTAL METHOD

Fifty rabbits were used in the experiments, divided into three groups. All the animals were kept on an ordinary diet. The animals of the first group (20) were controls, and received cholesterol by mouth daily in a dose of 0.2 g/kg in an oily solution. The animals of the second group (12) received the same daily dose of cholesterol and, in addition, instead of hay, they were given 50 g of dried plantain leaves. The animals of the third group (18) received daily, besides the cholesterol, 1 ml of extract of plantain leaves (corresponding to 100 g of the dried leaves). The blood cholesterol of all the animals was determined before administration of cholesterol by the Engel'gardt-Smirnova method; in half the control animals and also in all the animals of the third group the lecithin concentration was also determined by the sulfite-hydroquinone method. Subsequently the cholesterol and lecithin were determined every 2-4 weeks.

At the end of the experiment the rabbits were sacrificed, and the aorta and heart extracted and treated with Sudan III to ascertain the degree to which the intima of the aorta was affected by atherosclerotic plaques.

EXPERIMENTAL RESULTS

In the rabbits of the first, control group a gradual, regular increase in the blood cholesterol was observed, reaching an average value of 559.1 mg % at the third month of the experiment with extreme variations of 350 and 785 mg %; the lecithin content rose less to an average at this time of 556.1 mg %, compared with the normal value of 269.5 mg %. The degree of lipoidosis of the aorta was very marked in most cases (+++, ++++). The experimental results obtained in the animals of the second group (receiving cholesterol + plantain leaves) are shown in Table 1.

It will be clear from Table 1 that as a result of feeding the rabbits on plantain the development of hypercholesteremia was clearly retarded: at the third month of the experiment the blood cholesterol fell in most cases to the initial level. This blood cholesterol level was maintained when the feeding of the rabbits with cholesterol and plantain continued, and in some cases a fall in the blood cholesterol below the initial level was actually observed.

Table 1. Cholesterol Concentration (in mg %) in the Blood of Rabbits Receiving Cholesterol and Plantain Leaves

Rabbit no.	Initial level	Period of administration of cholesterol and plantain (in months)					
		1	2	2½	3	4	5
6	97	110	108	147	—	—	—
7	70	210	321	303	—	—	—
8	92	127	90	127	—	—	—
9	87	200	127	90	—	—	—
10	97	190	285	210	—	—	—
16	63	108	145	150	110	50	55
17	70	108	165	150	72	55	63
18	95	165	275	190	220	115	150
19	55	228	150	102	55	—	—
20	55	210	75	72	48	42	55
21	70	228	150	108	55	45	55
22	63	145	150	165	63	42	55

In all the rabbits of this series the changes in the aorta were slight and the degree of lipoidosis was assessed as + or ++. Atherosclerotic plaques were situated mainly in the ascending aorta, and in a few cases isolated plaques were seen in the thoracic part of the aorta.

In the rabbits of the third group (receiving cholesterol + extract of plantain leaves), as in the second group, the inhibiting effect of plantain on the development of experimental atherosclerosis was observed. This effect was shown, however, at earlier stages of the experiment.

It may be seen in Fig. 1 that administration of plantain extract prevented the hypercholesteremia observed in the control experiments. This action was apparent after the first month of administration of the extract, and at the third month the cholesterol concentration fell to its initial level.

According to the currently held opinion, an important factor in the pathogenesis of atherosclerosis is the phospholipid content of the blood, responsible in conjunction with proteins for increasing the stability of the cholesterol. An important feature here is the value of the lecithin/cholesterol ratio. An increase in this index is regarded as a favorable sign. In the series of experiments in which plantain extract was given, the blood lecithin concentration of the animals rose gradually (Fig. 2). The lecithin/cholesterol ratio, which was 3.5-5.0 with effect from the second month, did not differ significantly from its value in intact animals [3, 4], whereas in the animals receiving cholesterol only, the value of this ratio at the second and third months was 0.98. The degree of lipoidosis of the aorta in this series of experiments was slight (+, ++).

The results show that Plantago major undoubtedly has a retarding influence on the course of experimental atherosclerosis in rabbits. The investigations are being continued.

SUMMARY

Experiments were performed on 50 rabbits. A possibility was established of preventing the experimental hypercholesteremia by the introduction of Plantago major leaves into the diet of experimental animals. Control group of rabbits received cholesterol alone. The content of blood cholesterol ranged in them from 350 to 785 mg percent. Lipoidosis of aorta was marked in the majority of the cases. In the experimental groups rabbits were given leaves of extract of Plantago major in addition to cholesterol. An inhibition in the development of hypercholesteremia and atherosclerosis was noted (see Table 1). By the third month of experiment blood cholesterol content in the majority of the experimental animals dropped to the initial level.

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