

# Studying Non-Drug Correction of the Condition of Patients With Atherosclerosis-Associated Diseases of the Cardiovascular System

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## ABSTRACT

The effectiveness of functional food products, in particular bread enriched with plant fiber, was evaluated in the diet of people suffering from atherosclerosis, taking into account the associated diseases of the cardiovascular system. In the diet of a group of volunteers, consisting of men and women aged 65–77 years with atherosclerosis-associated diseases of the cardiovascular system, the whole bread was replaced with grain bread containing wheat germinated grains and amaranth flour. Upon admission and discharge, the lipid profile was monitored in patients. It was found that as a result of regular consumption of grain bread, there was a positive dynamics in lipid metabolism: total cholesterol in the blood by the end of the study was reduced by 2.59 % compared with the value of its level at the time the group entered treatment; indicators of the level of high-density lipoproteins and low-density lipoproteins in serum by the time of discharge decreased by 2.55 and 5.41 %, respectively; and the level of triglycerides in the blood serum of the studied group of patients decreased by 1.8 %. Thus, the possibility of a non-drug reduction of the lipid load on the body and a decrease in the level of cholesterol in the blood of patients was established.

**Keywords:** atherosclerosis-associated diseases of the cardiovascular system, functional foods

## 1. INTRODUCTION

Atherosclerosis and associated diseases of the cardiovascular system are one of the reasons for the increasing mortality of the population of the Russian Federation, despite the continuous improvement of medical and diagnostic medical technologies. Indeed, according to Rosstat in 2014, complications of cardiovascular diseases caused the death of 64,548 people. It is predicted that by 2030, due to the increasing number of patients with coronary heart disease and stroke, mortality will increase to 23.4 million people worldwide [1]. The presence of these diseases causes premature aging of the human body. The risk group includes the elderly, as well as those suffering from high blood pressure, dyslipidemia, those who smoke and refuse physical activity. One of the main treatment methods for patients suffering from cardiovascular diseases is a lifestyle change, including a change in diet along with regular exercise programs and quitting smoking [2]. Treatment and prevention of diseases of the cardiovascular system is possible by correcting lipid disorders. This can be

achieved both in a medication way that affects lipid metabolism by using different lipid-lowering drugs according to the mechanism of action [1, 2], and by observing a specialized diet based on a decrease in the proportion of lipid component in the diet [3].

It is known that lipid-lowering therapy is aimed at lowering blood levels of low-density lipoprotein cholesterol. For this purpose, various classes of substances are used to influence the level of cholesterol in the blood [4]. At the present stage, these include HMG-CoA reductase inhibitors–statins, an intestinal cholesterol absorption inhibitor (ezetimibe), bile acid sequestrants, fibroic acid derivatives (fibrates), nicotinic acid (niacin), omega-3 unsaturated fatty acids. Studies have been conducted that have shown that an effective therapeutic agent for atherosclerosis and associated cardiovascular diseases can be a drug based on citrus flavonoids [5], which can have a positive effect on modulation of lipid metabolism and adipocyte differentiation. The antisclerotic activity of the biologically active form of the triterpenoid saponin compound, Akebia Saponin D (ASD), was studied. It has been experimentally proved that ASD lowers blood lipids (TG, TC and LDL-C) and lipid deposition in the liver, as well as a slowdown in the development of atherosclerotic

lesions of the blood vessel walls [6]. It is noted that the additional introduction of vitamin E into the therapeutic diet allows one to reduce the ischemic manifestations caused by an increase in blood cholesterol due to the neurological protective function exerted by vitamin E [7].

The role of nutrition in the development and progression of atherosclerosis and its associated cardiovascular diseases has been studied fairly well. A diet containing a large proportion of fats is highly likely to cause atherosclerosis and insulin resistance [8, 9]. An increase in the proportion of polyunsaturated fatty acids in nutrition affects the slowdown in the development of coronary atherosclerosis. [10]. A diet that includes a significant amount of olive oil, whole grains, fruits, vegetables and legumes, and is characterized by a low content of cholesterol and saturated fats, can reduce the risk of stroke in patients with a high predisposition to 40 % or more. Salt intake is limited to 2–3 grams per day. The presence of foods rich in vitamins E and B12 in the diet reduces the risk of stroke [7, 11]. An increase in the proportion of dietary fiber that normalizes the functioning of the gastrointestinal tract in food products intended for patients with atherosclerosis-associated diseases of the cardiovascular system has a positive effect on the process of lowering total cholesterol in the blood. Vegetable fibers include various substances (pectin, gluten, oat flakes and plantain,  $\beta$  – glucan, chitosan), resistant to the effects of enzymes of the gastrointestinal tract. The lipid-lowering effect of these agents is due to several mechanisms: lengthening the passage time through the intestines, increasing the feeling of satiety, inhibiting the synthesis of cholesterol in the liver and increasing excretion of cholesterol [12, 13].

The formulation of special dietary bakery products is aimed, in particular, at increasing the proportion of dietary fiber in the finished product [14]. Studies were conducted that confirmed the feasibility of introducing whole grain bread into the diet of patients suffering from atherosclerosis and associated diseases of the cardiovascular system. Its consumption favorably reduced the level of atherosclerosis markers [15].

Our studies were aimed at studying the possibility of non-pharmacological correction of the health status of people, in particular patients with atherosclerosis, by introducing into their diet a functional product—grain bread produced from germinated wheat grain using amaranth flour of the first grade [16]. This product is a functional food product, as the degree of satisfaction of the daily needs of an adult with the consumption of 100 g of bread in macro- and micronutrients is at least 15 %: by 17.3 % of dietary fiber, 15.3–32.8 % of minerals (magnesium, phosphorus, iron and zinc), 27.1 % of vitamin B1 [17]. At the same time, the increased biological value of grain bread with amaranth flour is noted in comparison with bread made from wheat and a mixture of wheat and rye flour. The daily requirement for protein is covered by 13.6 %, and by 11.1–20.9 % for essential amino acids due to the use of 100 g of grain bread with amaranth flour [16].

To achieve the goal of the study, the following tasks were solved:

- study of the effect of grain bread with amaranth flour on biochemical markers of atherosclerosis: indicators of blood lipids in patients with atherosclerosis;
- statistical analysis of experimental data using the STATISTICA 10 software package.

## 2. METHODS AND MATERIALS

The studies were carried out in the Gorky Clinical Sanatorium of Voronezh with the assistance of the Department of Occupational Medicine of the Institute for Further Postgraduate Education of Voronezh State Medical University named after N.N. Burdenko. An open, clinical, double-controlled, non-randomized trial was performed. The distribution of patients into groups is shown in table 1. Inclusion criteria: men and women aged 65–77 with a treatment period of at least 18 days; patients with atherosclerosis and associated diseases of the cardiovascular system at the age of 65–77. Exclusion criteria: patients with type 1 diabetes; patients with oncopathology at the time of the study and a history of up to 5 years; patients with circulatory failure above 2A degree; patients with severe violations of the liver, kidneys and respiratory system; patients with acute myocardial infarction in the history up to 6 months; patients with acute cerebrovascular accident history up to 6 months; patients with severe cognitive impairment.

The statistical analysis of the data was carried out using the STATISTICA 10 package (StatSoft Inc.). The subordination of the analyzed indicators to the law of normal distribution was determined using the Shapiro-Wilk test [18]. In the case of a normal distribution of the characteristic, the results obtained are presented in the form  $M \pm SD$ , where  $M$  is the arithmetic mean,  $SD$  is the standard deviation.

The critical level of statistical significance was considered the value of 0.05. The calculation of representativeness was carried out according to the formula:

$$n = \frac{t^2}{K^2}, \quad (1)$$

where  $n$  is the sample size in the planned study;  $t$  is the number of sigmas corresponding to a probability index sufficient in the planned study;  $K$  is the permissible inaccuracy in this experiment, expressed in sigmas,

$$K = \frac{\Delta}{S}; \quad \Delta = \bar{x} - \hat{x} \text{ is permissible inaccuracy in}$$

determining the general average from its sample average. For biomedical research, the reliability of the results can be ensured with a probability of 95 %, and the confidence coefficient is 2 ( $t = 2$ ). The marginal error is 2 %.

After calculating the number of samples necessary and sufficient to obtain reliable values, it was found that representative data can be determined by examining 30 people, both for the control group and for the main group.

Groups of the cardiological profile were formed – the main and the control, 30 people each with atherosclerosis-associated diseases of the cardiovascular system over the age of 65 years.

**Table 1** Distribution of patients by group

Nosology	Main	Control	Total
<b>Atherosclerosis</b>	<b>30</b>	<b>30</b>	<b>60</b>

The control group was fed according to the standard menu of the “general diet version”. In the “general diet version” of the main (research) group of volunteers, bread was completely replaced with grain bread from germinated wheat with amaranth flour (200 g per day). Upon admission and discharge to patients of both groups, a “lipid profile” was determined: biochemical analysis of total cholesterol (TC), high density lipoproteins (HDL alpha-cholesterol), low density lipoproteins (LDL beta-cholesterol) and triglycerides (TG) in serum [19].

In addition, throughout the study, patients were under medical supervision in accordance with the standard of health resort treatment and in order to track adverse events and monitor the ongoing study.

All patients, regardless of the stage of the study and diagnosis, received the prescribed medication, balneotherapy and physiotherapeutic procedures. In the absence of contraindications, massage and physiotherapy exercises were performed. Possible adverse events were monitored by doctors during examination and fixing

**Table 2** Dynamics of indicators of blood lipids in the control group of patients with atherosclerosis

Indicator	Admission			Discharge		
	Value	SW-W criterion	SW-W test probability	Value	SW-W criterion	SW-W test probability
TC	6.62±0.81	0.99	0.99	6.49±0.72	0.99	0.99
HDL	2.25±0.66	0.97	0.61	2.21±0.56	0.98	0.97
LDL	4.02±0.67	0.96	0.53	3.94±0.64	0.97	0.66
TG	2.27±0.95	0.98	0.69	2.25±0.91	0.97	0.58

**Table 3** Dynamics of indicators of blood lipids in the basic (study) group of patients with atherosclerosis

Indicator	Admission			Discharge		
	Value	SW-W criterion	SW-W test probability	Value	SW-W criterion	SW-W test probability
TC	6.57±0.82	0.97	0.74	6.40±0.72	0.90	0.50
HDL	2.43±0.62	0.98	0.91	2.37±0.56	0.96	0.50
LDL	3.74±0.70	0.97	0.78	3.54±0.64	0.98	0.76
TG	2.24±0.96	0.97	0.69	2.20±0.91	0.96	0.50

complaints of patients. The minimum undesirable side effects that were possible when eating unusual foods were predicted: dyspepsia (heartburn, belching, abdominal discomfort, flatulence, stool disorders), allergic reactions. Serious adverse events requiring the termination of observations and/or medical care were not noted.

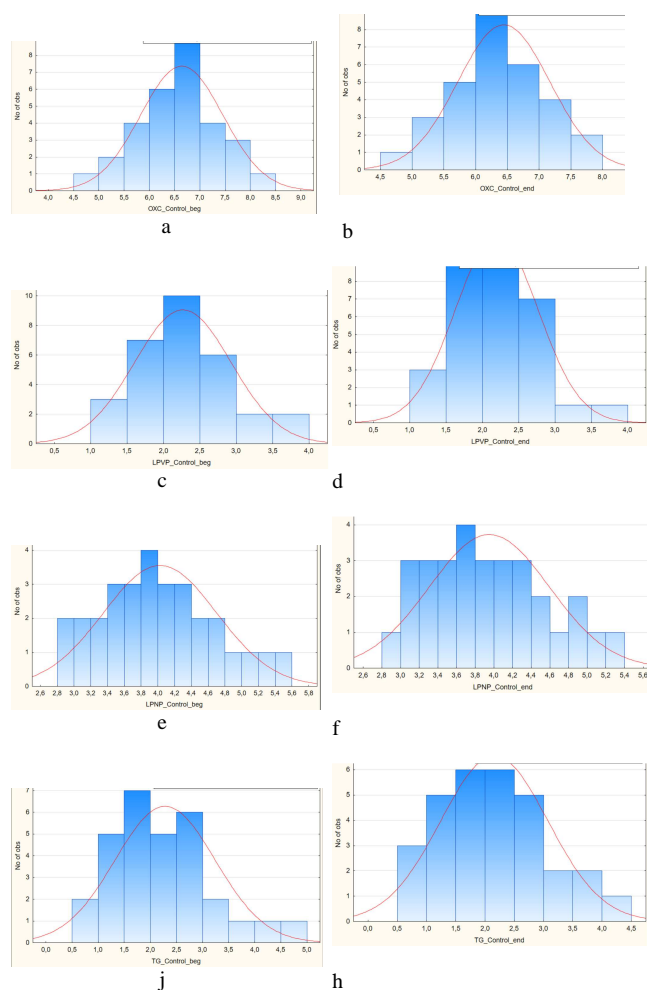
### 3. RESULTS

The introduction of a functional product–grain bread prepared from germinated wheat grain with the addition of first-class amaranth flour–into the diet of patients with cardiovascular diseases and atherosclerosis led to a positive trend in biochemical markers of atherosclerosis. Overall health (according to medical records) improved in 100 % of patients. Hemodynamic parameters remained stable in all observed patients.

The results of the assessment of the “lipid profile” of blood in the control and main groups of patients with atherosclerosis and associated cardiovascular diseases indicate an improvement in lipid metabolism in volunteers of the study group compared to the control one (Tables 2 and 3).

Statistical processing of the obtained data was to determine the normality of the distribution of experimental values according to Shapiro-Wilk test. An analysis of the tests shows that the probability of the Shapiro-Wilk criterion for groups of lipid metabolism indicators: total cholesterol, HDL, LDL, and TG exceeds 0.05, which does not allow rejecting the normal distribution hypothesis.

A graphical interpretation of the calculations for the control group is presented in Figure 1, and that for the main (studied) group of volunteers, in Figure 2.

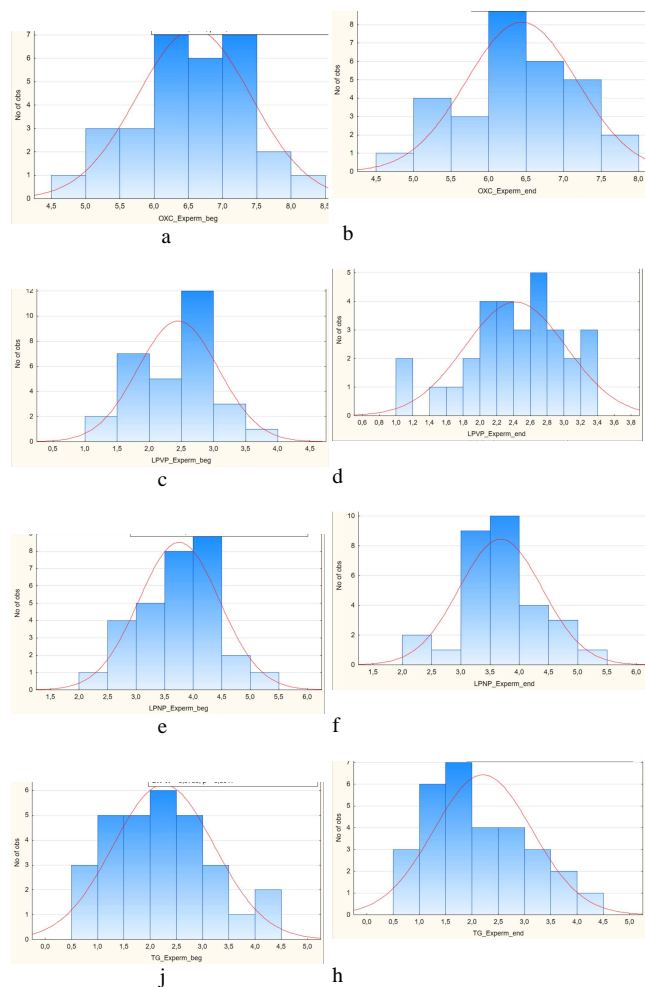


**Figure 1** Assessment of the normality of the distribution of experimental data for the control group according to Shapiro-Wilk: a, c, e, g are indicators of total cholesterol, HDL, LDL and TG upon admission; b, d, f, h are distribution of total cholesterol, HDL, LDL and TG at discharge

Statistical estimates of the main (study) group are similar to the estimates of the control group of volunteers and also confirm the normal distribution of samples for all three indicators (TC, HDL, LDL and TG).

The graphs (Figure 1 and 2) for all groups are symmetrical. Functions based on the mean and standard deviation parameters accurately describe the sample data.

Thus, the statistical processing of blood lipid profile indicators in volunteers with atherosclerosis for the control and main groups indicates that for such studies, a sample size of 30 was acceptable.



**Figure 2** Assessment of the normality of the distribution of experimental data for the main (studied) group according to Shapiro-Wilk: a, c, e, g are indicators of total cholesterol, HDL, LDL and TG upon admission; b, d, f, h are distribution of total cholesterol, HDL, LDL and TG at discharge.

## 4. CONCLUSION

For a group of patients with a cardiological profile with atherosclerosis-associated diseases of the cardiovascular system aged 65–77 years, introducing into the diet grain cereal from germinated wheat with amaranth flour instead of rye-wheat bread positively affected the lipid metabolism of the main (study) group compared to the control one.

This was confirmed by the results of the assessment of blood lipid parameters in the control group of patients and studied by the time of discharge: total cholesterol was within the normal range for this age group of patients and decreased by 2.58 % by the end of the study compared to the level of total cholesterol at the time the group entered treatment; indicators of the level of HDL and LDL in the blood of the main patients did not exceed the normalized

values, and by the time of discharge decreased by 2.55 and 5.41 % for the level of HDL and LDL, respectively; the level of TG in the blood of the studied group of patients decreased by 1.8 % compared with the control group.

The paper established the possibility and expediency of introducing functional cereal bread from germinated wheat grain with the addition of amaranth flour of the first grade into the diet of people suffering from atherosclerosis and other concomitant cardiovascular diseases, which will reduce the lipid load on the patient's body in order to reduce cholesterol levels.

## ACKNOWLEDGMENT

This work was financially supported within the support of applied research by the Ministry of Education and Science of the Russian Federation within the framework of the federal target program "Research and Development in Priority Directions for the Development of the Russian Science and Technology Complex for 2014–2020" under grant agreement No. 14.577.21.0256 of 26 September 2017; unique identifier PNIER RFMEFI57717X0256.

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