



Dietary nutrients in preventing cardiovascular diseases: a narrative review

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ABSTRACT

Foods play an important role in preparing the health of body. Foods and nutrients are effective in increasing health and regulating the immune system as well as in prevention of different diseases such as cardiovascular diseases. In the past few years, the prevalence of cardiovascular disease is progressively increasing. Change in lifestyle and dietary pattern of the societies plays an important role in inducing cardiovascular diseases. Studies have shown that the risk of cardiovascular disease among people consuming more vegetables is lower. Recent findings suggest that foods rich in omega-3, vitamins, antioxidants and fibers are useful for the health of cardiovascular system and such nutrition, in addition to disease prevention, reduces the cost and side effects of chemical treatments. In this article, different clinical trials introducing beneficial dietary approaches in preventing cardiovascular diseases are reviewed.

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Introduction

WHO (World Health Organization) estimates that about 16.7 million people annually die of cardiovascular diseases (CVD), and it has been estimated that the mortality rate will reach 25 million people by 2020 as a result of CVD (1). People now believe that changes in the dietary lifestyle has a major impact on cardiovascular diseases (2). Drugs that are usually administered to lower the cholesterol are useful to prevent CVD, but their side effects restricted their wide applications. When supplements combine with food, similar to statins drugs, they can reduce the risk of CVD. In many studies, the benefits of vegetarian diets on CVD have been emphasized (1,3). The term "Nutraceutical" (a food or part of a food that has medicinal and health benefits) may be effective in the prevention and treatment of congestive heart failure (CHF), arrhythmias, hypertension, angina

and hyperlipidemia (4). In the following article, various nutraceuticals, which are used for the prevention and treatment of CVDs, are discussed. For this purpose, a review study was conducted on studies that introduce nutraceuticals used in the treatment and management of CVDs.

Literature Review

Possible dietary approaches towards reducing cardiovascular disease

1) Type of fat

Several studies were conducted on the relationship between the intake of saturated fatty acids and CVDs. Change in the type of fat you eat, is very useful in this regard (1). There is a strong correlation between mortality as a result of coronary heart disease and consumption of saturated fatty acids (5). Saturated fatty acids increase plasma

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cholesterol, and unsaturated fatty acids reduce plasma cholesterol (6). First-line treatment of patients with moderate increases in cholesterol and triglyceride levels is the change in their diet to reduce the percentage of energy intake from fats to about 30%, which should not be more than 10% from saturated fat (7). In a research, it was shown that reducing energy derived from fats from 40 to 27 percent, reduces cholesterol and triglyceride levels more than 20% (8). In a study, it was found that exercise therapy, stress management and eating a diet consisting of 10% fat, have a positive impact on the health of cardiovascular system (9). This program caused the oxidized low density lipoprotein (LDL) to be changed and eliminated by the macrophages of the artery walls (9). The results of a cross-sectional study conducted in the North and South India showed a strong correlation between total cholesterol and meat consumption. This study showed that total cholesterol is reduced by eating fruits and vegetables (10).

1-1) Saturated fatty acid

Different saturated fatty acids have different effects on plasma lipids and lipoproteins. Among these fatty acids, myristic acid acts more powerfully in elevating cholesterol than lauric or palmitic acid. According to the study findings, stearic acid in contrast to myristic acid and palmitic acid, lowers LDL, although it reduces high density lipoprotein (HDL) (6). In a study, middle-aged men who were at high risk for CVD were placed in the experimental group, who used grains, vegetables, fruits and some unsaturated fatty acids and fish oil in their diet, resulting in a 36% reduction in mortality, a 44% reduction in CVDs and a decrease in serum cholesterol by 13%. They were followed for more than 6 years with the control group (11). The study showed that stearic acid cannot increase serum cholesterol, but compared to mono or polyunsaturated fatty acid reduces HDL-C (12).

1-2) Unsaturated fatty acid

1-2-1) Olive oil and soybean oil

Many studies have shown beneficial effects of vegetable oils rich in linoleic acid such as olive oil and soybean oil (13). Foods containing polyunsaturated fatty acids are structurally classified to n3 and n6. One of n6 fatty acid that is present in foods is alpha-linolenic acid (an essential fatty acid), which is a precursor of arachidonic acid and has essential biological effect in the body. Linoleic acid has clearly an effect on reducing cholesterol, LDL and HDL levels in the body. Arachidonic acid has little effect on plasma lipoproteins (14). Omega-6 polyunsaturated fatty acids have other benefits in addition to improving lipid profiles. Consumption

of omega-6 polyunsaturated fatty acid is significantly associated with reduced incidence of type 2 diabetes (DM2)(15). Polyunsaturated fatty acid intake reduces the risk of coronary heart disease (CHD) (1).

1-2-2) Fish oil

The main part of these polyunsaturated fatty acids is marine resources. The omega-3 reduces mortality associated with myocardial infarction (MI). Eicosapentaenoic (EPA) and docosahexaenoic acid (DHA) that are found in foods, rich in omega 3, could decrease the risk of CVDs. Randomized trial conducted on 2033 men after MI showed that consuming fish oil reduces mortality in a 2-year period by 29% (16). A landmark study conducted in Italy on 110,324 patients who were followed for 3 and a half years showed that consumption of fish oil has a significant impact on reducing sudden deaths due to CVDs (4). Marine lipid supplements have shown to improve coronary arteries in frequent angina (4). Clinical trials have suggested that omega-3 fatty acids reduce the risk of cardiac arrhythmia, hypertension and atherosclerosis (17). American Heart Association recommends omega-3 fatty acid intake by the consumption of fish and plant source oils for providing heart health (4). Alpha – linolenic acid (ALA, in fish oil) is an essential fatty acid for humans. Adequate intake of ALA and n-3 long-chain fatty acids is necessary for children and teenagers (13) and patients with nutrition through enteral parenteral (18). In a study conducted on French farmers, it was found that by changing the type of fat (replacing butter with canola oil and margarine rich in ALA), EPA of plasma lipids and their platelets' phospholipids were dramatically increased and after two years of feeding, a large reduction was observed in platelet aggregation (19). In a study, it has been reported that the risk of death due to CHD decreased by 40% in people who have high usage of ALA (20). Flax seed as source of ALA is useful for prevention of CVD (21).

2) Proteins and fibers

Hypertension is an important risk factor for CVDs. Inhibitors of angiotensin converting enzyme (ACE) are one of the main routes in controlling high blood pressure. However, these inhibitors can lead to complications such as hypotension, hyperkalemia, decreased kidney function, cough, angioedema, rash and fetal abnormality (22). Amino acids are formed by full hydrolysis of proteins. Vegetable proteins are rich in L-arginine. Arginine is a non-essential amino acid that is a precursor for producing nitric oxide helping to sympathetic coronary response as a vasodilator. In the treat-

ment of patients with hypertension who have micro-vascular angina, oral administration of L-arginine is useful for treatment (23).

Fibers are such components of the plants that are resistant against digestion and they are beneficial for digestive health. Fibers are divided into two groups of soluble and non-soluble (24). Insoluble fibers reduce colon cancers. Soluble fibers reduce blood cholesterol significantly, thus are useful in the prevention of CVDs (25). Wheat, rice and other grains contain more water-insoluble fibers. Soluble fibers are more derived from oat bran and fruit pectin. Its other sources are flaxseed and psyllium shell. Legumes, beans, peas, fruits and certain vegetables are excellent sources of soluble and insoluble fibers. Oats have more soluble fibers than other grains (26). Soy protein is an excellent source of dietary fiber (27). An analysis of 35-47 year-old men and women in 20 developed countries showed that consumption of vegetables, fruits, grains and legumes is significantly associated with reduced mortality caused by CHD (28). The relationship between fiber intake and ischemic heart disease among 859 men and women lived in southern California were also assessed and it was showed that every 6 grams increased intake of fiber per day is associated with a 25 percent reduction in mortality from ischemic heart disease (29). Totally, the soluble fibers like psyllium, oat bran, guar gum and pectin, reduce cholesterol and LDL-C. They do not have an effect on triglycerides.

3) Inulin

Recent studies have shown that reduced secretion of very low density lipoprotein (VLDL) particles from the liver and also reduced enzyme activity and expression of gene regulating the production of fatty acids, can reduce serum triglycerides (30). Chicory fructans effects on triglycerides have been studied in mice. A number of studies showed that the effect of inulin on people with high cholesterol is low. But a study was conducted on volunteers who had a slight increase in blood cholesterol, which showed a significant decrease in total cholesterol and LDL_C with consuming inulin (31). Reduced triglycerides in mice feeding high doses of oligo fructose has also been impressive, although reduced cholesterol has been observed in long-term feeding (32). Inulin can help controlling food cholesterol by the following methods: 1. direct effect on serum lipids, 2. replacement of some fatty acids in food formulations, 3. reducing the accumulation of calories by replacing the fat or sugar in foods (33). Most recent randomized crossover trials, in the case of inulin, demonstrated a significant decrease in total cholesterol and LDL_C, but it had no impact on serum triglyceride and HDL_C (31).

4) Vitamins

A study in South India showed reduction of total cholesterol and LDL with high consumption of fruit and vegetables. The reason is that grains and vegetables contain low-fat and high amount of antioxidants such as vitamin C and folate (34). Antioxidant vitamins are present in some fixed oils, fruits, vegetables and fishes, which prevent the formation of oxygen free radicals, or trap them. These vitamins reduce LDL oxidation. Supplements containing antioxidants such as vitamins E and C are useful in the prevention of CHD (4).

Of all the carotenoids, beta-carotene particularly plays an important role in trapping the proxy radicals (35), and there is collaboration between beta-carotene and vitamin E. Beta-carotene and lycopene inhibit the oxidation of LDL. Plasma carotenoids are lower in smokers (36). Taking 15-25 mg/d of this vitamin for groups that are at high risk of CVDs is necessary (36). Several epidemiological studies consider high intake of beta-carotene as a cause of reduced risk of heart attack (37).

Vitamin C acts as an antioxidant and inhibits hydroxyl, oxygen and peroxy radicals to protect the cells. If accompanied by vitamin E, it prevents peroxidation reactions on LDL particles. Vitamin C supplements in addition to vitamin E, in heart transplant patients, prevent the progression of atherosclerosis and plaque formation (38). The proposed dose of vitamin C in high risk groups is 100-150 mg/d (39). Reduced blood pressure in people who are vegetarian can be attributed to consumption of more vitamin C and folate and less salt and fat. Beneficial effects of these foods and micro-foodstuff have been proven (40). In one study on 109 vegetarians, they showed that low vitamin C and folate causes hypertension (41).

Vitamin E, as an antioxidant, protects the cells against heart disease through two mechanisms:

1. It inhibits the oxidation of lipoproteins that play an important role in carrying cholesterol (42).
2. It inhibits the formation of the blood clot (43).

Epidemiological and biochemical studies showed that prevention of CVDs in risky people needs to consume 36-100 mg/d vitamin E (37). A large epidemiological study by Harvard researchers has found that middle-aged men and women who had received vitamin E supplements in the form of unit dose (SINGLE ENTITY) equal to or greater than 100 unit of vitamin E showed a lower risk of heart disease than those who consumed less vitamin E (25). The results of this literature review are shown in Table 1.

Conclusion

Poor foodstuffs are an important risk factor for people who are at risk of CVDs. Consumption of

Table 1. Examples of Functional Food Components in preventing cardiovascular diseases.

Functional components	Source	Potential benefits
Flavones, Beta-carotene	Fruits, Vegetables	Neutralize free radicals, which may cause damage to cells
Insoluble fibre	Wheat	Lower blood cholesterol levels by inhibiting cholesterol absorption
Beta-Glucan	Oats	Reduce risk of cardiovascular disease. Protect against heart disease
Isoflavones	Soy	Menopause symptoms, such as hot flashes Protect against heart disease and some cancers; lower LDL and total cholesterol
Fatty Acids-DHA/EPA	fish oils	Reduce risk of cardiovascular disease. Improve mental, visual functions
Lignans	Flaxseeds	Prevention of cancer, renal failure
Arginine	Vegetable proteins	A precursor for producing nitric oxide helping to sympathetic coronary response as a vasodilator
Inulin	Chicory root	Help controlling food cholesterol and triglycerides
Vitamins (A,C,E)	Vegetables, Fruits, Meats and Dairy products	Antioxidants

food containing useful components such as fibers and unsaturated fatty acids could be so effective in heart health and should be taken into consideration. It is hoped that awareness in this field will be increased and these products be used as preventive and alternative treatments.

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Conflict of Interest

The authors declare no conflict of interest.

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