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Health Benefits of Plant Food

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SUMMARY
The nutrient and non-nutrient components of plant food, through a variety mechanism, reduce the risk of chronic non-infectious diseases. A higher and, most importantly, regular consumption of fruit and vegetables, whole grain products, grain sprouts, various nuts and other oil seeds, pulses and plant oils rich in minerals, trace elements, antioxidant vitamins, flavonoids, fiber, complex carbohydrates, mono- and polyunsaturated fatty acids, and nutrients together with a healthy lifestyle protect against degenerative diseases. In comparison to non-vegetarians, vegetarians had a 24% reduction in mortality from ischemic heart disease. Deaths from diabetes or many types of cancer are considerable lower in subjects with exclusive or predominant consumption of plant food. The lower values of risk lipid factors for atherosclerosis and the higher values of lipid parameters with antisclerotic properties were observed in vegetarians in comparison to general population on traditional mixed diet. Vegetarians are more insulin sensitive. They have low values of insulin resistance and the low values of high sensitivity C-reactive protein. In alternative nutrition subjects were found the lower values of products of oxidative damage of lipids, proteins and DNA as a consequence of high intake of various antioxidants. A greater incidence of mild hyperhomocysteinemia in vegetarians as a consequence of vitamin B_{12} deficiency is easily reparable by increased consumption of low fat animal food or by use of food and pharmacological additives with vitamin B_{12} content in strict vegetarians.
Key words: vegetarians, protective food commodities, lipid profile, insulin resistance, antioxidants.

Introduction

Plants are basal components of the dietary food chain in that they provide all essential mineral and organic nutrients to humans either directly, or indirectly by animal consumption. The complex diets that provide a nutrition quality (intake of all nutrients) and the nutrient concentrations in the consuming food mixture according to the recommended dietary allowances /RDAs/ (a nutrition quantity) are necessary to support human growth and health (1). Vitamins B_{12}, D and n-3 fatty acids are not contained in plant food. Contents of methionine, iodine and carnitine in plant food sources are significantly reduced in comparison to animal sources. Iron, calcium and zinc absorption is inhibited by components of plant foods. Iron deficiency causes an inhibited synthesis of n-3 fatty acids. These facts are connected with certain health risks in population consuming exclusively or predominantly plant food. From the view of prevention of risks the application of food additives or pharmacological preparations is inevitable to compensation of absent nutrients in vegans (strict vegetarians) or sufficient consumption of low fat animal food in lacto-vegetarians and lacto-ovo-vegetarians (2, 3).

On the other hand, long-term nutritional surveys have shown an inverse relationship between diet with predominantly or exclusively plant composition and incidence of cancer, cardiovascular disease and total mortality (4, 5, 6). A higher and, most importantly, regular consumption of fruit and vegetables, dark or whole grain products, grain sprouts, pulses, plant oils and oil seeds rich in minerals, antioxidant vitamins, trace elements, flavonoids, complex carbohydrates, fiber, mono- and polyunsaturated fatty acids and nutrients together with an otherwise healthy lifestyle protect against degenerative diseases. The nutrient and non-nutrient components of plant foods, through a variety of mechanisms, are know to alter the risk of chronic diseases (7).

Cardiovascular disease prevention

In comparison with non-vegetarians, vegetarians in the Oxford vegetarian study had a 24% reduction in mortality from ischemic heart disease IHD (death rate ratio DRR 0.76) (6). When the non-vegetarians were divided into regular meat eaters (meat consumption at least once per week) and semi-vegetarians (fish consumption or meat consumption less than once per week), the IHD DRRs, when compared with regular meat eaters, were 0.78 in semi-vegetarians and 0.66 in vegetarians. The reduction in IHD among vegetarians is at least partly due to a lower intake of saturated fat and cholesterol (8). Consumption of saturated fat (animal sources) has been found to be associated with hypercholesterolemia, while polyunsaturated fats (plant sources) were reported to have a cholesterol lowering effect. The hypolipidemic effect of monoene fatty acids (oleic acid – olive oil, rapeseed oil, sesame oil, hazelnuts, almonds) was discovered only quite recently (9). Consumption of cheese, eggs, total animal fat and dietary cholesterol were each strongly associated with IHD mortality (10). Compared with those who ate relatively little of these foods, the DRRs in those who ate the most were 2.47 for cheese, 2.68 for eggs, 3.29 for total animal fat and 3.53 for dietary cholesterol. The pooled analysis of five prospective studies also presented mortality data from cerebrovascular disease (6). The DRR in vegetarians compared with non-vegetarians was 0.93. Multivariate analyses of 34 192 California Seventh-day Adventists showed significant

association between beef consumption and fatal IHD in men (relative risk RR = 2.31) for subjects who ate beef 3 times/week compared with vegetarians, significant protective association between nut consumption and fatal and nonfatal IHD in both sexes (RR = 0.5 for subjects who ate nuts 5 times/week compared with those who ate nuts 1 times/week), and reduced risk of IHD in subjects preferring whole grain to white bread (5). The lifetime risk of IHD was reduced by 31% in those who consumed nuts frequently and by 37% in male vegetarians compared with non-vegetarians.

Epidemiological evidence has suggested that consumption of food high in dietary fiber is associated with a lower risk of cardiovascular disease because of the ability of soluble and insoluble fibers to reduce plasma total and LDL cholesterol (5). Plant foods such as whole grains, beans, legumes, fruits and vegetables and different types of nuts are very good sources of dietary fiber (11, 12). The hypocholesterolemic effect of fiber is due to an increase in bile-acid binding and fecal sterol excretion and fermentation of soluble fiber to produce short-chain fatty acids that inhibit hepatic cholesterol synthesis. In addition to fiber, there are components of plant food that are known to reduce cardiovascular risk. Saponins in legumes form insoluble complexes with micelle and thus interfere with cholesterol absorption; plant proteins such as those found in soy alter LDL receptor activity; antioxidant nutrients such as vitamin E, β-carotene, vitamin C, selenium, polyphenols and flavonoids (11) are potent inhibitors of LDL oxidation, a known risk factor for atherosclerosis. Nuts have a high monounsaturated and polyunsaturated fat content, they reduce both total and LDL cholesterol without adversely affecting HDL cholesterol (12). Previously, the dietary approach to reducing cardiovascular disease incidence was aimed at decreasing total and saturated fat intake avoiding meat. This alone may not be sufficient. The inclusion of a variety of plant foods is necessary to favourably modify lipid and lipoprotein profile, which in turn can reduce the risk of cardiovascular disease (7).

Dyslipidemia, hypertension and smoking are the main risk factors of atherosclerosis. The presence of obesity can increase this risk. Vegetarians have a body mass index about 1–2 kg/m^2 lower than non-vegetarians (4, 8). Vegetarians are non-smokers and they have a normal blood pressure or the incidence of hypertension is low (13). In our repeated studies significantly lower risk factors for atherosclerosis (total cholesterol, LDL-cholesterol, atherogenic index, triacylglycerols, saturated fatty acids) and the significantly higher values of parameters with antisclerotic properties (HDL-cholesterol, mono- and polyunsaturated fatty acids, linoleic acid, α-linolenic acid, vitamin E/cholesterol, vitamin E/triacylglycerols) were found (8, 14). Age-independent lipid profile was observed in vegetarians vs. significant age-dependent increase of blood lipids at maximum 60–70 years in general population (15).

Vegetarians have significantly reduced values of high sensitivity C-reactive protein (16) as a consequence of higher consumption of fruits and vegetables (14, 16), which are rich sources of dietary salicylates and perhaps other anti-inflammatory compounds (17). In subjects with exclusive or predominant consumption of plant food a greater incidence of mild hyperhomocysteinemia as a consequence of vitamin B_{12} deficiency was found (18). Vitamin B_{12} is not contained in plant sources. This fact may partly weaken the positive effects of vegetarian nutrition in prevention of cardiovascular disease. An unfavourable situation is easily reparable by increase of consumption of dairy products with low fat content or by consumption of food additives and by use of pharmacological preparations with vitamin B_{12} content.

Diabetes prevention

Subjects consuming predominantly plant food may be at lower risk of dying from diabetes than omnivores (19). Complex carbohydrates with low glycemic index are slowly absorbed and thus they have a beneficial effect on glucose control, hyperinsulinemia, insulin resistance and blood lipids (20). The type of fiber play an important role in regulation of carbohydrate and lipid metabolism. Diets from soluble fiber sources (oat, barley, legumes) had much more marked effect compared with diet containing insoluble fiber (20, 21). High fiber foods such as beans deliver more bulk with less energy, take longer to eat and increase satiety. This indirectly helps reduce the incidence of obesity, a major risk factor for type 2 diabetes.

Hyperinsulinemia and insulin resistance are critical components of the metabolic syndrome that is associated with abdominal obesity, and are the early manifestations of type 2 diabetes. The insulin resistance syndrome is composed of risk factors for cardiovascular disease including insulin resistance with hyperinsulinemia, atherogenic dyslipidemia, hypertension, and abdominal obesity (20). Diets rich in carbohydrates with a low glycemic index (whole grains, beans, legumes) and with a high fiber content produce slow carbohydrate absorption and thus flat postprandial rises in blood glucose, minimal postprandial insulin secretion and maintenance of insulin sensitivity. There was documented a decrease of insulin resistance (IR/HOMA/) from 3.44 to 2.16 in patients with coronary artery disease consuming whole grain and legume food during 16 weeks (22).

Insulin resistance predicts the incidence of age-related diseases. Significant increases in the incidence of type 2 diabetes (8-fold), hypertension (2-fold) and coronary heart disease (3-fold) were reported in the general population with the highest insulin response in less that 15 years (23). Insulin resistance IR(HOMA – homeostasis model assessment = fasting glucose. fasting insulin/22.5) was based on assumption that health subjects with normal weight aged less than 35 years have the insulin resistance of 1 and the beta cell function 100%. In our study on healthy vegetarians with normal weight aged 19–64 years was recorded the average IR (HOMA) value 0.99 (vs. 1.59 in non-vegetarian group, $P < 0.001$) and the values were independent of age (vs. significant age dependence in non–vegetarians) (21).

The composition of dietary proteins has the potential to influence the balance of glucagon and insulin activity (24). Soy protein, as well as many other plant proteins are higher in non-essential amino acids in comparison to animal protein sources (25). Glucagon promotes (and insulin inhibits) cAMP-dependent mechanisms that down-regulate lipogenic enzymes and cholesterol synthesis, while up-regulating hepatic LDL receptors (24). The fasting amino acid profile is the crucial determinant of basal glucagon secretion as fasting glucose is for insulin secretion. Essential amino acids are relatively more effective for releasing insulin, whereas non--essential amino acids – arginine and pyruvate precursors are effective in glucagon secretion. Intakes of individual amino acids (at 100–110% of RDA for proteins) in subjects with exclusive consumption of plant proteins were compared with those in subjects of general population who had plant protein intake 49 % of total protein intake (25). Vegetarians had a significantly higher intake of arginine, glycine and serine. When dietary protein is relatively high in non-essential amino acids, down-regulation of insulin and up-regulation of glucagon is a logical consequence. The effect of a chronic increase in glucagon activity means a reduction in *de novo* lipogenesis, decreasing fat storage, a reduction in cholesterol synthesis and in circulating LDL cholesterol, a reduction in triacylglycerol synthesis (26).

Cancer prevention

Death from cancer is considerably lower in subjects with exclusive or predominant consumption of plant food (5, 6). These results are true for many types of cancer. Cancers of the colon and prostate were significantly more likely in non-vegetarians (RR = 1.88 and RR = 1.54, respectively), and frequent beef consumers also had higher risk of bladder cancer (5). Fermentable fibers in legumes, fruits and vegetables increase fecal bulk and decrease transit time, thus reducing the exposure of the intestinal epithelium to mutagens (5). Intake of legumes was inversely associated with risk of colon cancer and risk of pancreatic cancer (5). Several phytochemicals such as flavonoids, isothiocyanates and allyl sulfides derived from fruit and vegetables are potent modulators of the enzyme system responsible for metabolizing carcinogens (7). Antioxidant vitamins C and E and polyphenols inhibit formation of N-nitroso compounds, which are potential carcinogens (27). Higher consumption of all fruit or dried fruits was associated with lower risks of lung, prostate, and pancreatic cancers (5). Lignins and phytoestrogens in soy have weak estrogenic activity and they have been shown to lower the risk of hormone-dependent cancers. Certain types of plant starch have growth-promoting effects on bifidobacteria that are important for the health of the colon and decreased risk of colon cancer. Phytochemicals in whole grains and legumes have the ability to block initial DNA damage and suppress post-initiation, which in turn can halt the carcinogenic process. The increased glucagon activity (as a consequence of higher intake of arginine and pyruvigenic amino acids) may lead to a decrease in IGF-I (insulin-like growth factor) activity that can be expected to retard cancer development (28).

Various antioxidant defense systems are able to eliminate the prooxidants and to quench free radicals (29). An extremely short half-life of most aggressive radical species prevents direct investigation. However, indirect information is available from the determination of antioxidants, which are the crucial in the body multilevel protection from radicals. There are indicated the threshold (limit) values of plasma essential antioxidants (30). Over-threshold (over-limit, optimal from antioxidant view) values mean a reduced risk of free radical diseases. An improved antioxidant status helps to minimize the oxidative damage a thus to delay or prevent pathological changes.

Vegetarians have a significantly higher plasma content of antioxidative vitamins (31). Over-threshold concentrations were recorded in 66–92% of vegetarians vs. 17–42% of non-vegetarians (14). In the vegetarian group, the values of oxidative damage of lipids and DNA are low (14, 32). Analyses of dietetic questionnaires have shown that the vegetarians consume daily 2.6--6.1-fold more fruit, vegetables, whole grain products, grain sprouts, oil seeds and soy products (14).

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