



Review Article

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Preventive and Therapeutic Role of Bioactive Food Components and Functional Foods in Diabetes



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Abstract

Nutraceuticals have increased in popularity because of their presumed security and potential nutritional and therapeutic effects. Pharmaceutical and dietary firms are aware of financial growth, which helps happier customers, as well as changing patterns that lead to the proliferation of these heart-healthy value-added products. Bioactive compounds present in fruits and vegetables can defend against several diseases and metabolic disorders by acting as antioxidants, anti-inflammatory, anti-carcinogenic, and anti-diabetic agents. They are excellent candidates for developing novel therapeutic foods with possible safe and prevention properties for type 1 and type 2 diabetes because of these positive effects. The most recent findings on the impact of various bioactive substances on various facets of beta-cell functioning are summarized in this paper. Bioactive compounds may be able to help diabetic phenotypes, according to research. Bioactive compounds may have direct effects, according to published data, on the increase of insulin secretion and the avoidance of beta cellular apoptosis. To decide if these compounds have any therapeutic effects, further research is required.

Key words: Nutritional Bioactive Compound; Nutraceuticals; Insulin Secretion; Flavonoids; Vitamins; Carotenoids; Antioxidants; Anti-Inflammatory Drugs; Anti-Carcinogenic Agents; Metabolic Syndromes

Introduction

Food may have health-promoting properties, despite popular belief, which go beyond its traditional nutritional value. Bioactive compounds are food additives that affect animals' or humans' metabolic or cellular processes. The bioactive compounds present in fruits and vegetables such as flavonoids, vitamins and carotenoids are antioxidants, anti-inflammatory drugs, anti-carcinogenic agents and metabolic syndromes such as diabetes and cardiovascular disease. Bioactive food components that can aid in the prevention of diabetes have recently received a lot of attention [1].

Functional foods and nutraceuticals can help to prevent and treat diseases and disorders caused by poor lifestyle choices. These foods contain nutritional components that assist in maintaining a healthier lifestyle and may also be able to cure certain diseases. When food has a major health impact that goes beyond basic diet, it is called functional [2]. Nutraceutical products, such as functional

foods, are made from foods that contain important components that have beneficial effects. Animal and aquatic sources may be used to extract and purify its beneficial components. International interest in functional foods and nutraceuticals has shaped a growing global sector. Nutraceuticals, also known as "functional diets," have stirred up the discussion so the common boundary of food and medicine is obscured.

As a result, functional foods meet the fundamental diets of the human body all of which are essential in healthy living conditions such as proteins, fats, carbohydrates and vitamins [3]. If practical foods help to avoid illnesses conditions or medications other than deficiency disorders such as anemia, they are referred to as 'nutraceutical.' Thus, nutritional food should be used as a nutraceutical by a consumer. Nutraceuticals include vitamin strengthened milk foods (e.g., milk has a nutrient of casein and citrus) (orange juice has a nutrient, and its pharmaceutical constituent is ascorbic acid) [3].

Type-2 diabetes and metabolic syndrome are on the rise globally and are becoming a major public health concern. Pancreatic beta cells fail to offset insulin resistance in diabetes of type-2, which results in hyperglycemia, lack of functional beta-cell mass and the resulting deficit of insulin [4]. In type-1 diabetes pancreatic beta-cells kill inflammatory reactions, which result in complete insulin loss and the initiation of hyperglycemia. Research into new, cost-effective prevention agents that can increase beta-cell activity is crucial to mitigate the development of type-1 and type-2 diabetes and their related complications. The pancreas may be vulnerable to high concentrations of bioactive compounds absorbed because it first occurs after enteric absorption. In this way, one of the main objectives for the effects of bioactive substances is pancreatic beta cells.

This research explores the current findings on diabetes prevention with a focus on beta-cell function and protection of flavonoids, vitamins, and carotenoids. Despite advantages, many

nutraceuticals are believed to have several medicinal effects, and there is a lack of substantial evidence. All common nutraceutical products are glucosamine, Omega-3, Echinacea, liver oil cod, folic acid, calcium-fortified oranges juices, and green tea as shown in (Figure 1). This post is devoted to enhancing nutritional knowledge focused on particular disease symptoms. Functional foods are said to contain physiologically active components that have a variety of health benefits. Any diets and dietary patterns have played a major role in the primary prevention of various illness conditions and have contributed to the discovery of suspected functional nutrients [5]. Additional testing and trials are important to affirm the possible health advantages of different functional foodstuffs not yet clinically evaluated for the linkages between diet and health. Health/functional health menus, vitamin/mineral enriched foods, dietary improvement, and even conventional medicinal products are all “functional foods” examples.

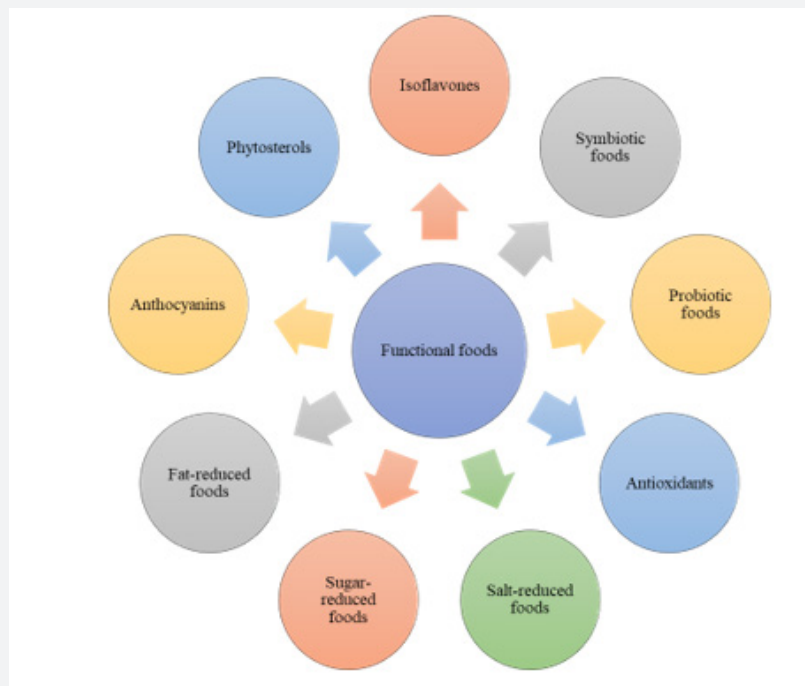


Figure 1: Components of functional foods.

Nutraceuticals

In 1989, Dr. Stephen DeFelice coined the word nutraceutical. The intersection of the food and medicinal sectors is highlighted by a hybrid of nutrients and pharmaceuticals. Nutraceuticals are dietary additives that contain nontoxic ingredients that can help treat or avoid disease [6]. The idea isn't exactly modern. “Let your diet be your medicine and your medicine be your food,”

Hippocrates, the Greek physician and father of medicine, said nearly 2000 years ago. Nutraceuticals are essential for biological processes such as cell proliferation, antioxidant resistance and gene expression. The use of nutraceuticals will all slow down the use of cancer, heart disease, hypertension, high weight, elevated cholesterol and diabetes, osteoporosis, arthritis, insomnia, and many more lifestyle-associated diseases. Nutraceuticals can

also be extracted and purified from plants, animals, and the sea. Nutraceuticals have a longer half-life, immediate operation after consumption, immediate supply, and minimal side effects. Soy life supports healthy muscles, while xangold helps maintain healthy teeth, betatene aids to improve immunity, cholestaid, oatwell aids and peptopro helps to reduce serum cholesterol levels and muscle protein synthesis [7]. A “possible beneficial function” to health is demonstrated by the collective and organized activity of nutrient

components and biologically active compounds. Bioactive ingredients are used and applied in a wide variety of industries, including nutraceuticals [8-10]. Studies were submitted on the beneficial effects of in vitro and in vivo nutritional supplements [11,12], especially animal studies [13-15]. Special botanical research [16-18] was also established, with an emphasis on the relevance of some vegetable sources (Figure 2).

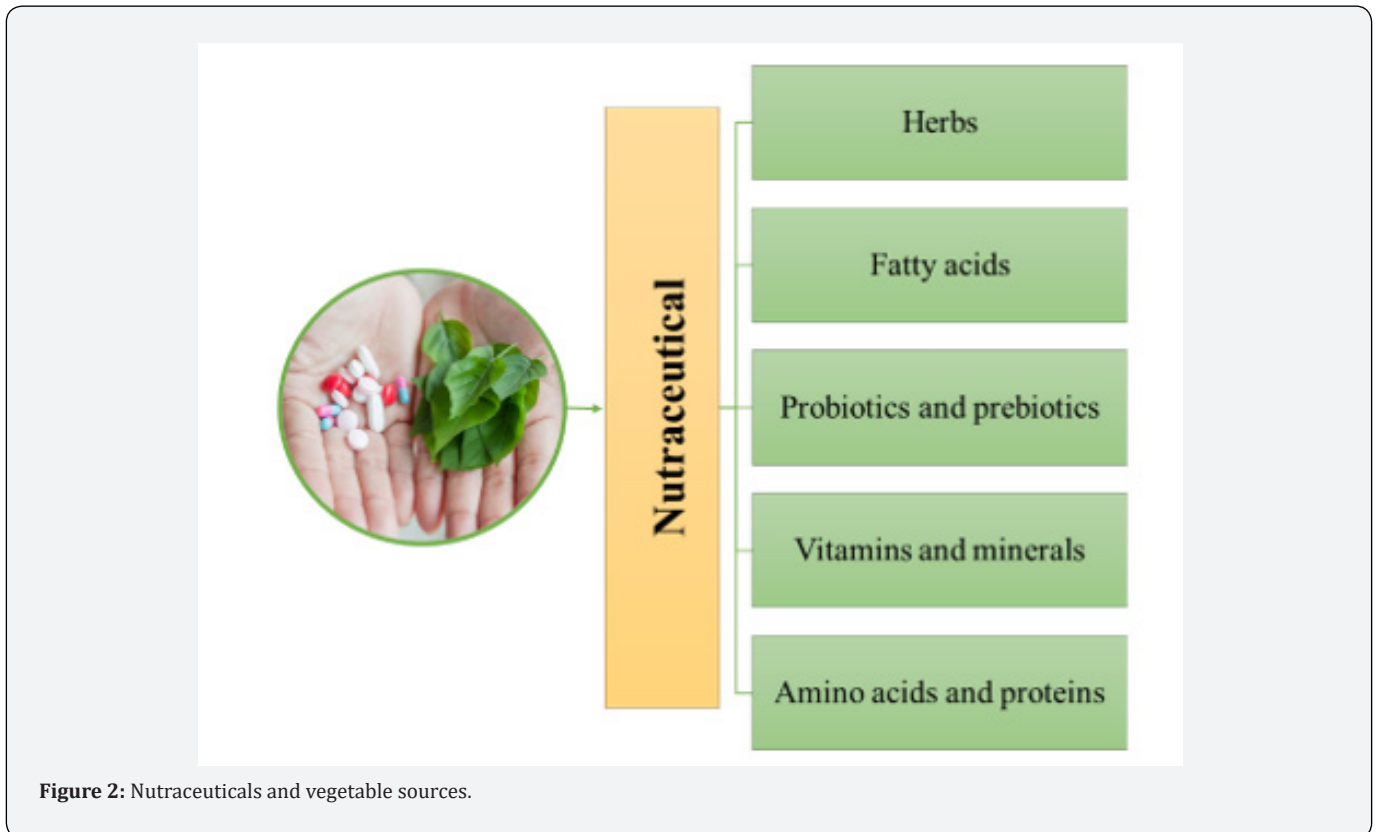


Figure 2: Nutraceuticals and vegetable sources.

Nutraceutical ingredients such as Diet, polyphenols, antioxidants, and herbs were among the common, helpful ingredients for both treatment and well-being. They contain vitamins, probiotics, and numerous unsaturated fatty acids [19]. An optimistic outlook toward free fatty acids results from the belief that functional elements can aid in disease prevention [20]. Many nutraceutical classifications have been proposed based on nutraceutical categorization criteria. Nutraceuticals are categorized into the following categories based on their developed stage [21]. Nutraceuticals are drugs that have been shown to have medicinal benefits in a variety of research/epidemiology tests but have not been shown in large-scale clinical trials.

Nutraceuticals that have been shown to have health benefits

are known as existing nutraceuticals. They are classified according to the source of nutraceuticals from which they are derived or isolated: Flavonoids, for example, are phytochemicals derived from plants or herbs. Nutrients extracted by microbes, such as vitamin A and animal nutrients. Four classifications of nutraceuticals focused on chemical properties: (i) polyunsaturated (ii) the flavonoids (iii) vitamins in prebiotics. There are some other nutraceutical products below. These nutrient supplements contain nutrients like salt alone or along with various preservatives [16]. Functional foods, such as oatmeal with soluble fiber that lowers cholesterol levels, are foods improved by promoters that encourage overall fitness and assist in reducing disease danger. They are not all nutrients; in a nutshell, they are diets that have been enriched with nutrients to provide nutritional benefits [22] (Figure 3).



Figure 3: Nutraceuticals as disease preventive.

Bioactive Compounds that Affect Beta-Cell Function and Diabetes

Polyphenolic compounds called flavonoids and isoflavonoids are widely present in fruits and vegetables. Nitrogen fixation and flower pigmentation are only a few of the functions they have in plant physiology. They account for a large portion of the human diet due to their abundance. Flavonoids are antioxidants that have the protective properties of anti-inflammatory and metabolism. Genistein is the most widely studied isoflavone in terms of diabetes [23]. Just a handful of plants that contain genistein are lupine, fava beans, soybeans, and soya oils. A polyphenol compound in grape skins and red wine, resveratrol (3,5,4 - trihydroxystilbene), has shown the level of survival in several animals [24].

The vast variety of colors in fruits, plants, and flowers, including red, brown, and purple, are the result of anthocyanin and anthocyanidin. They are plentiful in the human diet. Quercetin is a polyphenolic flavonoid present in a broad range of plant-based foods that have been shown to have anti-diabetic effects in animal studies. Green tea produces a polyphenolic compound called epigallocatechin-3-gallate (EGCG). As a dietary supplement, EGCG can provide health benefits for a variety of diseases. Because of its anti-oxidant role as well as the anti-tumor and anti-mutagenic activity of the non- oxygen scavenging function [25,26]. EGCG has a controversial anti-oxidant effect [27] (Figure 4).

Vitamins are organic molecules that an organism cannot synthesize and must thus be acquired by the diet. They have a wide range of chemical and biochemical activities. Vitamins including vitamin A, vitamin D, and vitamin C have been linked to beta-cell activity, growth, and development. The vast range of pancreatic-beta-cell functioning of flavonoids, vitamins, and carotenoid is difficult to determine. Furthermore, the results are dependent on the experimental design, concentrations measured, and the compound's basic composition. The study of animal models of induced diabetes confirms the hypothesis that bioactive compounds can boost diabetic phenotypes. Bioactive compounds may have direct effects, according to published data, on the increase of insulin secretion and the avoidance of beta cellular apoptosis. Antioxidant properties are implicated in the mechanisms of action for certain chemicals, but other processes can also be involved [28]. While several experiments indicate that beta-cells are helpful, further research is required to validate these results in a clinical environment outside of the laboratory (Table 1).

Conclusion

In conclusion, extensive research suggests that bioactive food components and functional foods play a significant preventive and therapeutic role in diabetes management. These substances, found naturally in various food sources, have shown promising

effects in controlling the level of blood glucose, improve the level of insulin, and decrease the risk of complications associated with diabetes. Additionally, functional foods fortified with specific bioactive compounds have demonstrated the potential to modulate various metabolic pathways and provide additional health benefits. However, while these findings are encouraging,

further studies are needed to establish optimal dosages, long-term effects, and individual variations in response. Nevertheless, incorporating bioactive food components and functional foods into a balanced diet holds promise for effective diabetes prevention and management strategies.

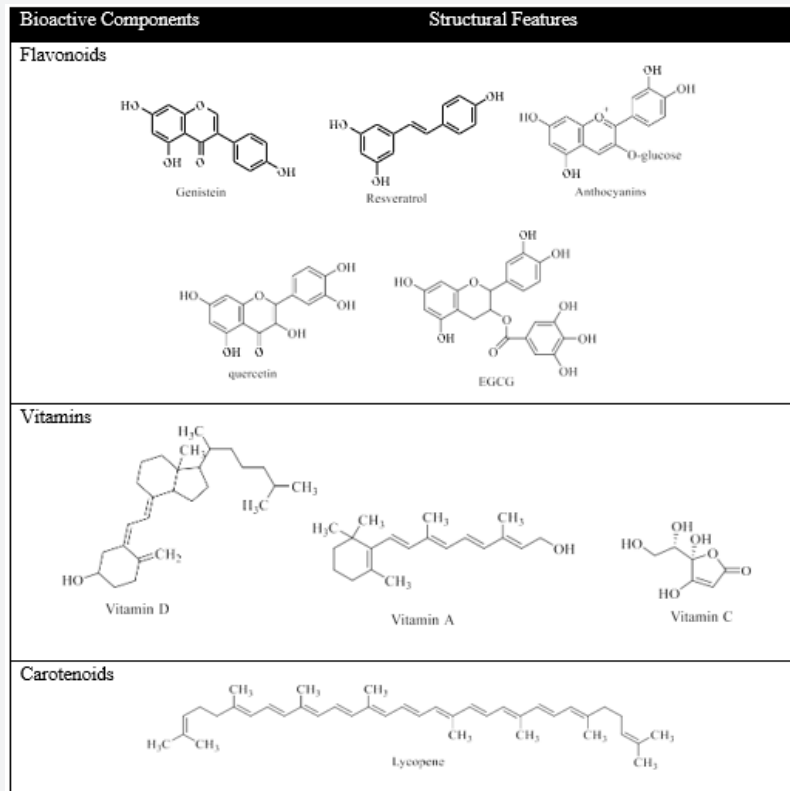


Figure 4: Bioactive foods that have beta cell and diabetes effects.

Table 1: Components of bioactive foods that cause diabetes.

Class	Bioactive Component	Dietary Sources	Effect Observed
Flavonoids	Genistein	Soybean, soy products	Insulin secretion ↑
			Beta-cell proliferation ↑
			Beta-cell apoptosis ↓
	Resveratrol	Grapes, red wine	Insulin secretion ↔
			Beta-cell apoptosis ↓
	Anthocyanins & Anthocyanidins	Fruit, vegetables	Insulin secretion ↑
			Beta-cell apoptosis ↓
	Quercetin	Fruit, vegetables	Insulin secretion ↑
			Beta-cell apoptosis ↓
	Epigallocatechin-3-gallate	Green tea	Insulin secretion ↑
Beta-cell apoptosis ↓			

Vitamins	Vitamin D	Dairy products, fish	Insulin secretion ↑
	Vitamin A	Vegetables	Beta- cell apoptosis ↔
	Vitamin C	Vegetables, fruits	Insulin secretion ↔
Carotenoids	Lycopene	Tomatoes	-

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