



REVIEW ARTICLE

Nutraceuticals: (Prevention is better than Cure)

Priyanka Khokhar*, Sumit Kumar Tarar, Umesh Kumar Singh

Kharvel Subharti College of Pharmacy, Swami Vivekanand Subharti University, Meerut, India.

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ABSTRACT

Human inquisitiveness and search for specific constituents of plants animal's minerals and microbial origin which are beneficial to our overall health have cost coining of terminologies such as functional food or nutraceuticals¹. Nutraceuticals have evolved from the recognition of the link between food and health. Thus nutraceuticals can be defined as the part of food that helps in prevention from various disease. In this context we have reached to that point which describes the utilization of nutraceuticals its source its benefits to the human body as well as to the animals. There are certain fruits and vegetables which provide a great role in healthcare like apples, oranges, cabbages, apricots, banana etc. They all are fibrous materials from which DHA, RDA (from carrots) we can easily get. There are certain Phytochemicals, vitamins, minerals, herbs which are used in the treatment of many dangerous diseases like cancer. Various nutraceuticals are now available in market as along with their brand names. The nutraceuticals market comprises two principal segments: Functional Foods and Dietary Supplements. Functional foods are similar in appearance to a conventional food or beverage, are consumed as part of a normal diet, and have been demonstrated to have physiological benefits or to reduce the risk of chronic disease beyond basic nutritional functions. Functional foods can also promote growth and development and enhance performance, and can take many forms. Some may be conventional foods with bioactive components that can now be identified and linked to positive health outcomes (e.g., soy protein, oat fiber, cranberries, tomatoes and carrot juice).

KEYWORDS

Nutraceuticals, Scope, Classification, Body Benefits, Market Brand Name, Role of Nutraceuticals in Diabetes

INTRODUCTION

Food and drugs from nature place a quite significant role in public healthcare system throughout the world¹. Human inquisitiveness and search for specific constituents of plants animal's minerals and microbial origin which are beneficial to our overall health have cost coining of terminologies such as functional food or nutraceuticals¹.

Nutraceuticals have evolved from the recognition of the link between food and health².

Greek Physician Hippocrates Known as father of medicines (said several centuries ago) "Let Food be Your Medicine" The Philosophy behind is: "Focus on Prevention" The term "Nutraceutical" was coined from "Nutrition" & "Pharmaceutical" in 1989 by Stephen De Felice, MD, Founder and Chairman of the Foundation for Innovation in Medicine (FIM). Thus, Nutraceutical can be defined as "A food or part of food or nutrient that provides health benefits

***Address for Correspondence:**

Priyanka Khokhar

Kharvel Subharti College of Pharmacy,
Swami Vivekanand Subharti University,
Meerut (U.P) India.

E-Mail Id: khokharpriyanka@yahoo.com

including the prevention and treatment of a disease.”

Nutraceuticals are available in the form of isolated nutrients, dietary supplements and specific diets to genetically engineered foods, herbal products and processed foods such as cereals, soups and beverages. Nutraceuticals provide all the essential substances that should be present in a healthy diet for the human². Nutraceuticals provides energy and nutrient supplements to body, which are required for maintaining optimal health.

Nutraceuticals are widely used in the food and pharmaceutical industries. Some Nutraceuticals are useful in maintaining healthy prostate function, remedy for restlessness and insomnia. Nutraceuticals, such as glucosamine and chondroitin sulfate, offer possible chondro-protective effects against joint injury. In the United States, the term has no meaning in the law, and "nutraceutical" products are regulated as drugs, dietary supplements, food ingredients, or food. The term is defined in Canadian law as

referring to "a product isolated or purified from foods that is generally sold in medicinal forms not usually associated with food. A nutraceutical is demonstrated to have a physiological benefit or provide protection against chronic disease."

Regulation

As with all regulatory matters, nutraceuticals are treated differently in different jurisdictions.

United States

The term "nutraceutical" has no meaning in US law.² Depending on its ingredients and the claims with which it is marketed, a product is either a drug, a food, a food ingredient, or a dietary supplement.^{3,4}

Canada

Under Canadian law, nutraceutical is "a product isolated or purified from foods that is generally sold in medicinal forms not usually associated with food. A nutraceutical is demonstrated to have a physiological benefit or provide protection against chronic disease."⁵

Scope of Nutraceuticals^{5,6}

Disease	Nutraceuticals	Source
Joint health	<ul style="list-style-type: none"> • Glucosamine • Chondroitin 	<ul style="list-style-type: none"> • Found in ligaments , • cartilages ,tissue, tendons • Proteoglycans of articular cartilage
Cardiovascular health	<ul style="list-style-type: none"> • Co Q-10 • Melatonin • DHA • Reseveratrol • Caretonoids • catechin 	<ul style="list-style-type: none"> • Soya bean, olive oil • Bone marrow, pineal glands • Fish oil • Grapes, red wine • Carrot ,sweet potato • Tea extracts
Eye health	<ul style="list-style-type: none"> • DHA • Pycnogeal • Lotein • Caretonoids 	<ul style="list-style-type: none"> • Linseed (flax oil),fish oil • Barley • Spinach • Carrot ,sweet potatoes
Cancer prevention	<ul style="list-style-type: none"> • DHA • Resveratrol 	<ul style="list-style-type: none"> • Flax seed, linseed, fish oil • Red wine, grapes

Classification of Nutraceuticals^{7, 8, 9, 10, 11, 12}

Class / components	Source	Potential benefit
Fatty acids CLA	Milk & Meat	Improve body composition, reduce cancers
n-3 FA(DHA, EPA)	Fish oils, berseem & maize fodder, mustard, linseed, rapeseed	Reduce CVD & improve mental, visual function
Saponins	Soybeans, GNC, lucerne, chick pea	Lower cholesterol, anti cancer
Probiotics / Prebiotics / Synbiotics	Dahi, yogurt	Improve GI health
Lactobacillus Fructo-oligosaccharides	Whole grains, onions, combination of Pro & Prebiotics	
Phytoestrogen Daidzein , Zenistein	Soybean, flax, lentilseed, maize, berseem, lucerne, subabulfodder	Reduce menopause symptoms, ↑ bone health
Lignans	Flax, rye, vegetables	Reduce cancer and heart diseases

Categories of Nutraceuticals^{13, 14}

- Nutraceuticals are non specific biological therapies used to promote wellness, prevent malignant process and control systems. These can be grouped into the following three broad categories:
- Substance with established nutritional functions , such as vitamins , minerals ,amino acids and fatty acids- Nutrients
- Herbs or botanicals products as concentrates and extracts – Herbals
- Reagents derived from other sources (eg. pyruvate, chondroitin sulphate, steroids hormone, precursors) serving specific functions, such as sports nutrition, weight loss supplements and meal replacements – Dietary supplements.
- Broadly can be defined as:
- Nutrients: Substances which have established
- Nutritional functions e.g. Vitamins, Minerals, Amino Acids, Fatty acids, etc.

- Herbs/ Phytochemicals: Herbs or Botanical products
- Dietary Supplements: Probiotics, Prebiotics, Antioxidants, Enzymes, etc.

Nutrients

- Most common Nutrients used/ supplemented as Nutraceutical are:
- Minerals and Vitamins ,or in combination, or in combination with other antioxidants

Vitamins

- Fat Soluble Vitamins

Vitamin A: Acts as antioxidant, essential for growth and development, maintains healthy vision, skin and mucous membranes, may aid in the prevention and treatment of certain cancers and in the treatment of certain skin disorders.

- Vitamin D: Essential for formation of bones and teeth, helps the body to absorb and use

Calcium

Vitamin E: Antioxidant, helps to form blood cells, boosts immune system

Vitamin K: Essential for blood clotting

Water Soluble Vitamins

- Vitamin C: Antioxidant, necessary for healthy bones, gums, teeth and skin. Helps in wound healing, prevent from common cold
- Vitamin B 1: Helps in carbohydrate metabolism, essential for neurological function.
- Vitamin B 2: Energy metabolism, maintain healthy eye, skin and nerve function.
- Vitamin B 3: Energy metabolism, brain function
- Vitamin B 6: Helps to produce essential proteins, convert proteins to energy
- Vitamin B 12: Help in producing genetic material, formation of RBC, maintenance of CNS, synthesis of amino acids, involved in metabolism of protein, fat and carbohydrate.

- Folic acid: Helps in RBC formation, formation of genetic material of cell, very much essential during pregnancy
- Pantothenic acid: Aids in synthesis of cholesterol, steroids, and fatty acids, crucial for intraneuronal synthesis of acetylcholine

Vitamins like Compounds

- L- Carnitine: Helps in oxidation of fatty acids, role in oxidative phosphorylation,
- Choline: Lipotropic agent, used to treat fatty liver and disturbed fat metabolism,
- Inositol: For amino acid transport and movement of Potassium and sodium,
- Taurine: Helps in retinal photoreceptor activity, bile acid conjugation, WBC antioxidant activity.

- CNS neuromodulation platelet aggregation, cardiac contractibility, sperm motility, insulin, m activity

- Cobalt: component of Vit. B 12 and B 12 coenzymes,

- Copper: Hb and collagen production, function of heart, energy production, absorption of Iron,

- Iodine: proper function of Thyroid gland,

- Chromium: with insulin it helps in conversion of carbohydrate and fat into energy, treatment of diabetes,

- Selenium: Antioxidant, functioning of heart muscle, part of GPX enzyme,

- Zinc: Essential for cell reproduction, for development in Neonates, wound healing, production of sperm and testosterone hormone,

Herbals¹⁵

- Aloe vera: Anti-inflammatory, emollient, wound healing,
- Evening Primrose oil: Dietary supplement of linoleic acid, treatment of atopic eczema,

- Garlic: Antibacterial, antifungal, antithrombotic, antiinflammatory,
- Ginger: carminative, antiemetic, treatment of dizziness
- Ginseng: Adaptogen,
- Green tea: Antioxidant, reduces risk of CVD, enhances humoral and cell mediated Immunity,
- Vegetables, fruits, whole grain, herbs, nuts and various seeds contain an abundance of phenolic compounds, terpenoids, sulphur compounds, pigments etc.
- that has been associated with protection / treatment of certain disease conditions,

Phytochemicals¹⁶

- Phytochemicals could provide health benefits as: Substrate for biochemical reactions, Cofactors of enzymatic reactions
- Inhibitors of enzymatic reactions
- Absorbents that bind to & eliminate undesirable constituent in the intestine
- Scavengers of reactive or toxic chemicals
- Enhance the absorption and / or stability of essential nutrients
- Selective growth factor for beneficial bacteria, Selective inhibitors of deleterious intestinal bacteria
- Fermentation substrate for beneficial bacteria

Various Phytochemicals¹⁶

Phytochemicals	Source	Role
Tocotrienols & Tocopherols	Grains	Suppressed the growth of diverse tumors cell lines via initiation of apoptosis and concomitant arrest of cells in the G1phase of the cell cycle
Carotenoids	Fruits & vegetables	Antioxidants, protects against uterine, prostate, colorectal, lung and digestive tract cancers, and protection to other antioxidants.
Flavonoids	Grapes, wines	Action against free radicals, free radicals mediated cellular signaling, inflammation, allergies, platelet aggregation, & hepatotoxins
Catechin & Gallic acids	Grapes, berries, cocoa, green tea, acacia spp.	Antioxidants, free radical scavenging ability, inhibition of eicosanoid synthesis, reduces CHD
Isoflavonoids	Soybeans	Treating cancers & osteoporosis
Anthocyanidins	Fruits & flowers	Antioxidants & anti-mutagenic properties
Glucosinolates	Cruciferous	Activators of liver detoxification enzymes, inhibit the neoplastic effect of various carcinogens
Indoles		Reduces estrogen-dependent cancer risk,

Health Drinks

Drinks are the fast developing area of Nutraceuticals. Some of these health drinks are fortified with the anti oxidants, vitamin A, C, E. The fruits and vegetable juices have also been shown to produce the health benefits.^{16,17} A Tropicana fruit juice fortified with calcium provides about 365mg calcium per 250 ml glass. An ideal health drinks Increases physical endurance, improves and increase concentration and reaction speed.

Almond Sharbat (Almond Soft Drink)

Ingredients

Sugar, Almond, Rose water, Cardamom.

Nutrition

Prepared of the choicest almonds and blended cardamom, saffron, and rose water. With a matchless taste, and it is full of values both for brain and body. Regular use enriches body with protein, iron, calcium, phosphorous and other proteins. It can be utilized with either hot water or cold milk.

Nutritional value per glass

Iron - 0.69mg
Protein - 2.80mg
Carbohydrate - 28.52g
Energy - 206.32cal
Vitamin - 139.631

Saffron Sharbat

Kesar is used in the preparation of kesar sharbat (saffron soft drink).

Ingredients

Sugar, Saffron, Cardamom

Nutrition

It is beneficial in the treatment of several digestive disorders, especially flatulent colic. Kesar is useful in treating skin disorders, blood purifying qualities and is also a great anti-oxidant it is a great drink for physical fitness.

Nutritional value per glass

Protein - 0.10g
Carbohydrate - 35.52g
Energy - 144.64cal
Fats - 0.24g

Orange sharbat

Ingredients

Sugar, orange juice

Nutrition

Orange fruit juice is prepared from natural orange juice which is rich source of vitamin A, B, C and calcium also contain sodium, potassium, magnesium, sulphur and chlorine. It is an ideal soft drink for all season. It can be used deliciously in various frozen deserts, pudding, custards etc. Vitamin C given energy to tried mind and refreshes it.

Nutritional value per glass

Iron - 0.6mg
Protein - 0.0924g
Carbohydrate - 36.16g
Energy - 145cal
Vitamin C - 158.18mg

Polyunsaturated Fatty Acids (PUFA)¹⁸

Human body is capable of synthesizing most of the fatty acids it needs except the two major polyunsaturated fatty acids, i.e., omega-3-fatty acid and omega-6-fatty acids. These fatty acids are required to be supplemented from the diet. The polyunsaturated fatty acids are the known precursors for arachidonic acid (AA), eicosapentaenoic acid (EPA) and docosahexanoic acid (DHA). These fatty acids have been found to regulate blood pressure, heart rate, blood clotting and immune response. Omega-3-fatty acids have been reported to be important fatty acids in the prevention of heart diseases and also in the treatment of arthritis. Omega-3 fatty acids are mostly found in cold water fishes such as tuna, salmon and macaerel. It is also present in dark green leafy vegetables, flaxseed oil and in certain

vegetable oils. The fatty acids such as AA and DHA are essential for the development of the foetus and also during the first six months after birth. The deficiency of these fatty acids may result in poor development of foetus and may also cause a variety of problems such as premature birth to underweight babies. Breast milk is a very rich source of DHA. Most of the infant formulas which are used as a substitute of breast milk should be supplemented with DHA, as per the recommendation by World Health Organization.

Herbs as Functional Food¹⁹

A great attention has nowadays been given to discover the link between dietary nutrients and disease prevention. Large numbers of herbs which had been in use since unknown time have been shown to play a crucial role in the prevention of disease. In addition to the macro and micro nutrients such as proteins, fats, carbohydrates, vitamins or minerals necessary for normal metabolism, a plant based diet contains numerous nonnutritive phytoconstituents which may also play an important role in health enhancement. A brief overview of the role of various herbs in disease prevention, with a focus on bioactive components from flaxseeds, garlic, citrus, fruits, soyabean, ginkgobiloba has been given in this part of the nutraceuticals.

Flaxseeds

Flaxseeds are the dried ripe seeds of *Linum usitatissimum*, family Linaceae. The components are of great interest as functional food. Flaxseed incorporations into the diet is particularly attractive from the perspective of specific health benefit. Flaxseed has been recorded as one of the six plant materials as cancer preventive foods. Alpha linolenic acid (ALA) has a broad spectrum of health advantages. It inhibits the production of eicosanoids, alters the production of several prostanoids, reduces blood pressure in hypertensive patients and lowers triglycerides and cholesterol. Dietary ALA may retard tumour growth and plays an important role in metastasis. It has been suggested that Ala is dietary essential for optimal neurological development of humans especially during fetal and early postnatal life.

Dietary fibres of flaxseeds contain about 6% mucilage which has nutritional value. It appears to play a role in reducing diabetes and coronary heart disease risk, preventing colon and rectal cancer and reduces the incidence of obesity.

Ginkgo biloba

Ginkgo biloba, family Ginkgoaceae, known as fossil tree is an important drug used in traditional Chinese medicine since more than 2800 years. Mainly leaves and edible seeds are used as drugs. Ginkgolides A, B, C and bilobalide are also the therapeutically active constituents. Leaf contains 6-hydroxykynurenic acid, a metabolite of tryptophan.

The leaves are recommended as being beneficial to the beneficial to the heart and lungs. Ginkgolides present in the leaves are able to alleviate the adverse effects of platelet-activating factor in a number of tissues and organs both in animals and in humans. It is also effective in the treatment of arterial insufficiency in the limbs and in the brain.

Garlic Organo Sulfur Compounds

Garlic consists of the fresh or dried bulbs of *Allium sativum*, family Liliaceae. It is a perennial erect bulbous herb indigenous to Asia but commercially cultivated in most countries. Garlic is used as an adjuvant to dietetic management in the treatment of hyperlipidaemia and in the prevention of atherosclerotic (age dependent) vascular changes. Fresh garlic juice, aged garlic extract or the volatile oil, all lowers cholesterol and plasma lipids, lipid metabolism, and atherogenesis both in vitro and in vivo. The mechanism of garlics antihyper cholesterolaemic and antihyperlipidaemic activity appears to involve the inhibition of hepatic HMG-CoA reductase and remodeling of the plasma lipoprotein and cell membrane. The overall activity of garlic is mainly due to the presence of sulfur compound such as allin, allicin, ajoene and others.

Garlic has been reported to reduce the risk of colon cancer and lung carcinoma. Consumption of one or more servings of fresh or powdered garlic per week resulted in a 50% lower risk of

cancer of the distal colon and a 35% lower risk of cancers anywhere in the colon.

Citrus Limonoids

Citrus fruit consumption has been shown to protect against a variety of human cancers. The citrus fruits such as oranges, lemons, limes and grapefruits are the principal source of important nutrients like vitamins C, folate, fibres and vitamins E, but the other monoterpene compounds known as limonoids are reported to be responsible for the anticancer activity. d-limonene, a predominant monocyclic monoterpene found in essential oil of citrus fruits has been reported to be a cancer chemopreventive agent. The mechanism of antitumour activity of limonoids include the induction of hepatic detoxification enzyme, glutathione S-transferase and uridine diphospho glucuronosyl tranferase. Limonene has little or no toxicity in humans and has been suggested as a good candidate for human clinical chemoprevention.

Soya Products

Soyabean, *Glycin max*, family Leguminoseae has clearly been a plant food in the spotlight in the 1990s. It has been recognized as an excellent source of protein, equivalent to quality to animal protein. Soya has been extensively investigated for its ability to treat and prevent a variety of chronic diseases including cancer. Soyabean meals, concentrates and isolates are used as meat substitute and have many healthful benefits. Soyabean is also a major source of lecithins which yields liposomes used to formulate stable emulsions and finds major use in food technology.

The primary isoflavones in soya, genistein and daidzein are structurally similar to the estrogenic steroids and have been reported to have estrogenic and antiestrogenic activities. Due to their weaker activity, isoflavones may act as antiestrogens by competing with the more potent naturally occurring estrogens for binding to the estrogen receptor. Due to this, soya consumption may reduce the risk for estrogen-dependent cancers. South-east Asian population who

consume 20-80 mg of genistein per day are found to have significantly lower incidence of breast and prostate cancer. Genistein has been reported to be a potent and specific inhibitor of protein tyrosine kinase. Genistein also inhibits DNA topoisomerase II activity, alters cell cycle specific events, induce apoptosis and inhibits angiogenetic process which is essential for tumour growth.

Tomato Lycopenes

Lycopene is a carotenoid principle present in *lycopersicon* family Solanaceae known throughout the world as tomato. Clinical studies have indicated that lycopene significantly lowered the risk of prostate cancer. The candidates that consumed processed tomato products about 10times per week had less than one half the risk of developing prostate cancer.

Lycopene activity is likely to be related to its antioxidant function because lycopene has been reported to be the most efficient quencher of singlet oxygen in biological system. Lycopene has also been shown to reduce risk of other types of cancers of digestive tract, pancreas, cervix, bladder and skin. Recently it has been proved that low plasma lycopene levels may be an independent risk factor for lung cancers especially in smokers.

Milk Biologically Active Components as Nutraceuticals²⁰

Milk contain components that provide critical nutritive elements, immunological protection and biologically active substances to neonates. Milk proteins are currently the main source of a range of biologically active peptides concentrates and these peptides are potential health enhancing nutraceuticals for food and pharmaceutical applications.

Several bioactive peptides may be used as nutraceuticals, for example, in the treatment of diarrhea, hypertension, thrombosis, dental diseases as well as mineral malabsorption and immuno deficiency. Minor wheyproteins such as lactoferrin lacto peroxidase, lysozyme and immuno globulins are considered as antimicrobial proteins. Milk also contain some

natural bio active substances. These include oligosaccharides, fucosylated oligosaccharides, hormones, growth factors, mucin, gangliosides and endogenous peptides which are present in milk at secretion.⁴

Bioactive Proteins/Peptides as Natural Ingredients of Milk²⁰

- Thyrotropin - releasing hormone (TRH)
- Luteinizing hormone - releasing hormone (LHRH)
- Somatostatin (SIH)
- Gastrin - releasing peptide (GRP)
- Calcitonin
- Adrenocorticotrophic hormone (ACTH)
- Insulin
- Growth factors
- Relaxin
- Prolactin
- Thyroid stimulating hormone (TSH)
- Lysozyme
- Lacto peroxidase
- Lacto ferrin
- Transferring
- Immunoglobulins (IgA, IgM, IgG)
- Enzymes (eg. Plasmin)

Melatonin Content in Grape

The discovery of melatonin in plants has opened up a new field of knowledge in the food and nutritional sciences. It has been found in edible plants, medicinal herbs and seeds. Its role in plants varies from regulation of seasonal and circadian rhythms to antioxidant defence against environmental stresses. Particularly in germ tissues of seeds and flowers and also in growth and development regulation, the same as the plant hormone auxin (indole - 3 - acetic acid) and indolic compounds. Moreover, auxins and their derivatives such as indole-3-methanol (or indolcarbinol), in addition to this role as plant

hormones, exert antioxidant, anticarcinogenic and antimutagenic properties, thus enhancing the chemo preventive potential of plant-derived food stuffs. From the nutraceutical point of view, it has significant synergistic antioxidant effect with polyphenols.

Melatonin which is also present in grape extract of some *Vitis vinifera* cultivars, particularly Nebbiolo, Croatina, Cabernet, Sauvignon, Sangiovese and Merlot. Its concentration determined with a modified high-performance liquid chromatographic (HPLC) method.

Melatonin Extraction for HPLC Analysis²¹

Kolaret. al method proved to be the most reliable in detecting melatonin. It was further improved with the following modifications.

Frozen grape skin (5g) was crushed in a mortar with liquid nitrogen, placed in 50ml polypropylene tubes with 10ml of extraction buffer [1 mol L⁻¹ Tris-Hydrochloric Acid buffer, pH 8.4, 0.4 mol L⁻¹ perchloric acid plus 0.1% EDTA, 0.05% sodium thiosulphate and 10mol L⁻¹ ascorbic acid]. Extraction was achieved by incubation on an orbital shaker for 1 hour room temperature after 15min of sonication. After centrifugation (10000'g, 10min, 4⁰C) and filtration through nylon cloth, a system of two C₁₈ Sep-Pak cartridges connected in series was utilized to purify and concentrate melatonin, which was finally eluted with methanol. Samples were stored in a freezer at -20⁰C until use.

All the above extraction steps were performed in disposable vessels, which were rinsed in concentrated nitric acid and autoclaved at 120⁰C for 15 min before use, to avoid contamination.

Market Interest of Nutraceuticals

The nutraceuticals industry is still in its formative period, and at present there is no universal agreement or legal definitions of the terms and designations used by this industry sector. According to the widely accepted definition, "A nutraceutical is any substance that is a food or a part of a food and provides medical or health benefits including the prevention and treatment of disease." Products include isolated nutrients, dietary supplements and processed

foods such as cereals, soups, soyfood, and beverages. The nutraceuticals market comprises two principal segments: Functional Foods and Dietary Supplements. Functional foods are similar in appearance to a conventional food or beverage, are consumed as part of a normal diet, and have been demonstrated to have physiological benefits or to reduce the risk of chronic disease beyond basic nutritional functions. Functional foods can also promote growth and development and enhance performance, and can take many forms. Some may be conventional foods with bioactive components that can now be identified and linked to positive health outcomes (e.g., soy protein, oat fiber, cranberries, tomatoes and carrot juice).

Some may be fortified to enhance foods or specifically created to reduce disease risk (e.g., vitamin- and mineral-fortified cereal, folate-fortified flour and grain products, calcium-enriched orange juice or milk, phytosterol-fortified spreads). Dietary supplements are foodstuffs that are intended to supplement the normal diet and that are concentrated sources of nutrients or other substances with a nutritional or physiological effect, alone or in combination, marketed in pharmaceutical dose form and administered orally. Dose forms include capsules, pastilles, tablets, pills and other similar forms, sachets of powder, ampoules of liquids, drop dispensing bottles, and other similar forms of liquids and powders designed to be taken in measured small unit quantities.¹⁰

Nutraceuticals Available in Market

Brand name	Components	Function
Betatene	Carotenoids	Immune function
Xangold	Lutein esters	Eye health
Lipoec	α-lipoic acid	Potent antioxidant
Generol	Phytosterol	CHD reduction
Premium probiotics	Probiotics	Intestinal disorder
Soylife	Soybeans phytoestrogen	Bone health
Z-trim	Wheat	Zero calorie fat replacer
Linumlife	Lignan extract flax	Prostate health
Fenulife	Fenugreek galactomannan	Control blood sugar
Teamax	Green tea extract	Potent antioxidant
Marinol	ω 3 FA, DHA, EPA	Heart health protection
Clarinol	CLA	Weight loss ingredient

Some Healthiest Fruits and Vegetables²³

Fruit	Fat/Calorie Breakdown	Body Benefits
Apples	1 medium apple: 81 calories, 0 g fat	An apple's 3 g of fiber help you meet your fiber goal of 20 g to 30 g daily. High-fiber diets can lower heart disease risk.
Apricots	3 apricots: 51 calories, 0 g fat	A good source of beta-carotene (which is converted to vitamin A by the body), providing the equivalent of 35% of the RDA for vitamin A
Bananas	1 medium: 105 calories, 0 g fat	Bananas are a great source of potassium, which plays a key role in heart health and muscle function. Plus each one has 2 g of fiber.
Blackberries	1 cup: 74 calories, 0 g fat	This fruit boasts a whopping 10 g of fiber in a single cup.
Blueberries	1 cup: 81 calories, 0 g fat	Blueberries help prevent and treat bladder infections by making it hard for bacteria to stick to urinary tract walls.
Cantaloupe	1 cup, cubed: 84 calories, 1 g fat	An antioxidant double whammy, with 68 mg of vitamin C and enough beta-carotene to cover 65% of your daily vitamin A quota.
Cherries	1 cup: 84 calories, 1 g fat	A good source of perillyl alcohol, which helps prevent cancer in animals. Heart-protective anthocyanins give cherries their color.
Cranberry juice	1 cup: 144 calories, 0 g fat	Fights bladder infections the same way blueberries do.
Grapefruits	1/2 fruit: 39 calories, 0 g fat	A good source of vitamin C and a compound called naringenin, which helps suppress tumors in animals.
Purple grapes and juice	1 cup seedless: 113 calories, 9 g fat	Offer three heart-guarding compounds: flavonoids, anthocyanins and resveratrol. (Green grapes are not rich in them)
Kiwi fruit	1 medium kiwi: 46 calories, 0 g fat	Just one little fruit packs a mean vitamin-C punch (74 mg) and an impressive 2.8 g fiber.
Mangoes	1 mango: 135 calories, 1 g fat	A single mango has enough beta-carotene to cover your RDA for vitamin A while racking up 57 mg of vitamin C.
Oranges	1 orange: 61 calories, 0 g fat	One orange provides an impressive 50 g to 70 g of vitamin C, 40 mcg of folic acid and 52 mg of calcium.
Orange juice	1 cup: 112 calories, 0 g fat	One of the richest sources of folic acid: A cup provides one-quarter of the 400 mcg RDA for folic acid and boasts 96 mg of vitamin C.

Calcium-enriched orange juice	1 cup (from concentrate): 112 calories, 0 g fat	drinking this beverage is a healthful way to make a 300-350 mg dent in your daily 1500 mg calcium requirement.
Papayas	1 cup, cubed: 55 calories, 0 g fat	Loaded with vitamin C (86 mg per cup), a healthy dose of fiber (2.5 g) and a sprinkling of beta-carotene and calcium.
Prunes	1/3 cup, stewed: 87 calories, 0 g fat	Prunes' famed laxative effect is no mystery: There are 5 g of fiber (both soluble and insoluble) in just 1/3 cup.
Raspberries	1 cup: 60 calories, 0 g fat	Teeming with 8 g of fiber per cup, they also boast vitamin C, ellagic acid and anthocyanins.
Red grapefruit	1/2 fruit: 37 calories, 0 g fat	All the goodies of white grapefruit and more: They provide up to 100% of the RDA for vitamin A and are also high in lycopene.
Strawberries	1 cup, sliced: 50 calories, 0 g fat	Strawberries have high levels of ellagic acid and anthocyanins, and are rich in vitamin C (95 mg per cup) and fiber (3.8 g per cup).
Vegetables	Fat/Calorie Breakdown	Body Benefits
Artichokes	1 medium: 60 calories, 0 g fat	In addition to their high fiber content (6 g), artichokes contain a flavonoid that has been shown to reduce skin cancer in animals.
Arugula	1 cup: 5 calories, 0 g fat	A cruciferous (cabbage family) veggie, this tangy green contains cancer-preventative compounds such as isothiocyanates.
Avocado	1/2 avocado: 170 calories, 13 g fat	Yes, they're high in fat, but fortunately half of it's the heart-healthy monounsaturated variety. And they're a good source of vitamin E.
Beets	1/2 cup, sliced: 37 calories, 0 g fat	Beta-cyanin, which gives beets their reddish-purple color, is a disease-fighting antioxidant.
Bok choy	1 cup, cooked: 20 calories, 0 g fat	This staple of Chinese cuisine contains isothiocyanates, plus lots of calcium (158 mg per cup) and vitamin C (44 mg per cup).
Mint	2 tbsp: 5 calories, 0 g fat	Spearmint, the type normally found in the fresh herb section of your grocery, is rich in covone, an antioxidant and anticarcinogen.
Mustard	1/2 tsp mustard seed: 8 calories, 0 g fat	Both prepared yellow mustard and mustard seed contain health-protective isothiocyanates.
Parsley	2 tbsp, chopped: 3 calories, 0 g fat	Parsley is a great source of several carotenoids: beta-carotene, lutein and zeaxanthin. Try it in tabbouleh.

Rosemary	1/2 tsp dried or 1 tsp fresh h:1 calorie, 0 g fat	Test-tube studies found that carnosol, a compound in rosemary, thwarts the action of carcinogens.
Tofu	1/2 cup: 97 calories, 6 g fat	A rich source of isoflavones. Studies indicate that 90 mg of isoflavones daily improves bone density; 1/2 cup of tofu has 30 g.
Textured vegetable protein	1/2 cup, rehydrated: 60 calories, 0 g fat	This is the stuff that mimics meat in vegetarian chili. TVP is one of the richest sources of isoflavones, at 40 mg per 1/2 cup.

Dietary supplements contain all products that can be purchased by the consumer without a prescription. The nutraceutical market is becoming more competitive with the entry of pharmaceutical and major food companies into the nutraceutical arena. Also, many food companies have established their nutraceutical divisions with a view toward a diversified product line. Pharmaceutical companies have also joined the race by acquiring dietary supplement producers.²² Recent years have marked the entry of major food and pharmaceutical companies into the nutraceutical marketplace, including Kellogg, Heinz, M&M, Quaker Oats, Unilever, Cargill, Hormel, Glaxo-SmithKline, Warner-Lambert, Johnson & Johnson and Wyeth.

The 2004 global nutraceuticals market at the retail level is estimated at approximately \$106 billion and is poised to grow at a compounded annual growth rate of 6.0% during 2004–2009 to exceed \$140 billion in 2009. Functional foods represent the largest and fastest growing segment worldwide, with sales estimated at \$77 billion for 2004 and projected to reach \$103 billion by 2009. The functional food segment is expected to retain its leading position to 2009.

Method to Enhance Active Components in Food

- Manipulating the diet to get maximum level of active components
- Combination of food ingredients rich in nutraceuticals

- Fortifying food with active ingredients
- By fermentation of food products
- Changing food habits to natural type of diet

Nutraceutical Resources for Diabetes Prevention--an Update²⁴

There is considerable need for safe agents that can reduce risk for diabetes in at-risk subjects. Although certain drugs--including metformin, acarbose, and orlistat--have shown diabetes-preventive activity in large randomized studies, nutraceuticals have potential in this regard as well. Natural agents which slow carbohydrate absorption may mimic the protective effect of acarbose; these include: soluble fiber--most notably glucomannan; chlorogenic acid--likely responsible for reduction in diabetes risk associated with heavy coffee intake; and legume-derived alpha-amylase inhibitors. There does not appear to be a natural lipase inhibitor functionally equivalent to orlistat, although there are poorly documented claims for Cassia nomame extracts. Metformin's efficacy reflects activation of AMP-activated kinase; there is preliminary evidence that certain compounds in barley malt have similar activity, without the side effects associated with metformin. In supraphysiological concentrations, biotin directly activates soluble guanylate cyclase; this implies that, at some sufficient intake, biotin should exert effects on beta cells, the liver, and skeletal muscle that favor good glucose tolerance and maintenance of effective beta cell function. Good magnesium status is associated with reduced diabetes risk and superior insulin sensitivity in

recent epidemiology; ample intakes of chromium picolinate appear to promote insulin sensitivity in many individuals and improve glycemic control in some diabetics; calcium/vitamin D may help preserve insulin sensitivity by preventing secondary hyperparathyroidism. Although conjugated linoleic acid--like thiazolidinediones, a PPAR-gamma agonist--has not aided insulin sensitivity in clinical trials, the natural rexinoidphytanic acid exerts thiazolidinedione-like effect in animals and cell cultures, and merits clinical examination. Other natural agents with the potential to treat and possibly prevent diabetes include extracts of bitter melon and of cinnamon. Nutraceuticals featuring meaningful doses of combinations of these agents would likely have substantial diabetes-preventive efficacy, and presumably could be marketed legally as aids to good glucose tolerance and insulin sensitivity.

A Brief List of Supplements, helps in diabetes²⁵

Yellow in color and an ingredient in the spice tumeric, **curcumin** is a potent anti-inflammatory that may reduce disease states (many diseases start with inflammation), according to Sloane. Omega 3 fatty acids – the DHA and EPA in fish oil – can lower triglycerides in high doses of 3,000 to 4,000 mg a day. “The ALA source of omega 3s (flaxseed, pumpkin seed, hemp, and walnuts) are not well absorbed by the body. They must be converted into DHA and EPA to be absorbed,” she states. “Since the diet consists of so many omega 6s, the competition is too great and the absorption from ALA is about 10 to 15%.”

Benfotiamine is B1. It may help with nerve endings. “CoQ10 doesn’t seem to have side effects. It’s a blood thinner, though,” Sloane says. “It may help with the heart, a major diabetes complication. CoQ10 is made by the body and decreases as we age, but when we take statins (cholesterol-lowering drugs) and replace the CoQ10, it is more heart protective along with the statin.”

Whey protein isolate is the higher quality form – better than whey protein concentrate and found in

protein drinks. “It may assist with weight loss (drinks that are fewer calories and filling) and lower blood sugar, depending on what the person typically eats,” Sloane says. A 10-pound weight loss may reduce blood sugar levels significantly.

Pomegranate is an antioxidant that keeps the body strong and is good for any disease state. Alpha-lipoic acid (300 to 600 mg) may reduce neuropathy symptoms and may also lower blood glucose levels somewhat.

Bitter melon may activate an enzyme that is responsible for regulating metabolism and transporting glucose from the blood into the cells.

Gogi berries may lower the oxidative stress that the eye undergoes as a result of type 2 diabetes. It is an antioxidant with high levels of zeaxanthin, lutein, polysaccharides, and polyphenolics, which have shown to improve vision. Researchers are studying the effects of gogi berries on oxidative stress, one of the factors that occurs in diabetic retinopathy.

Chromium GTF (glucose transport factor) may help balance levels with 600 to 1,000 mcg daily.

Magnesium may be depleted in diabetes and heart disease patients. Supplement with 400 mg, or have levels tested first.

SalaciaOblonga is known as Saptrangi and Ponkoranti (Indian ayurvedic herb). It may control the rise in blood sugar that follows a meal. This is the beverage made from the herb. Studies found a similar reduction in blood levels of insulin.

Gymnema Sylvestre is an Indian herb that may help support healthy blood sugar levels and glucose metabolism by mediation of insulin release and activity and augmentation of healthy pancreatic function. Data also suggests that beta cells may be regenerated/repared in type 2 diabetic patients.

Prickly pear (Nopal Cactus) cactus is a herbal hypoglycemic that can be used in combination with ginseng, cinnamon, and Gymnema Sylvestre.

Fenugreek: 4-hydroxyisoleucine (an amino acid derived from fenugreek) may help stimulate the secretion of insulin, reduce insulin resistance, and decrease blood sugar levels.

Vanadium may improve sensitivity to insulin in both type 1 and type 2 diabetes. **Warning:** Vanadyl compounds similar to those found in health food stores have been found to kill beta cells. However, the research was done with animals, and it is not known what the danger is to humans. Food sources, including pepper, dill, radishes, eggs, vegetable oils, buckwheat, and oats, might be a better option.

Barley: Whole grains and cereal-fiber containing products may reduce the risk of developing type 2 diabetes. These foods have shown to have favorable effects on intermediate markers for diabetes, particularly on blood glucose and insulin levels in non-diabetics and diabetics.

L-Carnitine supplements in a calorie-restricted diet may improve insulin resistance in patients with impaired fasting glucose and may result in significant plasma insulin changes.

DHEA-PC may slow progression of type 2 diabetes and delay onset of hyperglycemia and hypertriglyceridemia.

L-Carsonine may have an anti-glycation effect and protect against the formation of abnormal proteins when sugar aldehydes react with proteins.

Green Tea may improve glucose tolerance and insulin sensitivity by lowering fasting blood levels of glucose, insulin, triglycerides, and free fatty acids. It may also improve the ability of these fat cells to respond to insulin, along with the ability to absorb blood sugar, which may be greatly increased.

CONCLUSION

Nutraceuticals are food supplements and have nutritional value²⁶. Supplements may have medicinal properties, however, so they may enhance the actions of the medications taken. "There are many blood thinners on the market that people are unaware of. For example, ginkgo biloba, CoQ10, fish oil, aspirin, Coumadin and

vitamin E. "Using an abundance of blood thinners may possibly lead to hemorrhagic stroke if taken with a prescribed blood thinner like Coumadin.

Some multi-vitamins contain vitamin K, so people taking Coumadin should take a multi-vitamin without vitamin K. Those taking niacin to raise HDL cholesterol may raise blood sugar slightly. Individuals trying Gymnema Sylvestre and taking glyburide or glipizide might have a dramatic lowering effect. "This is why it is critical not to self-medicate with supplements without speaking with a pharmacist,"

Supplements can also interfere with the absorption of another supplement. There are some that are shown to not have side effects, and particular doses are recommended as being safe by reputable sources such as the NIH or ADA, for example. The benefits of treating more naturally might be fewer side effects and a more diluted form of the "medicine."

The present junk foods will not provide any nutritional value, rather it adversely effect the body. Hence it is concluded that nutraceuticals can be recommended as a regular part of the diet.

Nutraceuticals are present in most of the food ingredients with varying concentration

- Concentration, time and duration of supply of nutraceuticals influence human health
- Manipulating the foods, the concentration of active ingredients can be increased
- Diet rich in nutraceuticals along with regular exercise, stress reduction and maintenance of healthy body weight will maximize health and reduce disease risk²⁷

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