

A Review On : Phytochemicals as Nutraceuticals

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ABSTRACT

Nutraceuticals are food product that provides health as well as medical benefits; including the prevention and treatment of disease. Few nutraceuticals are being used as pharmaceutical and a number of other being used and purchased by the general public as self-medication. Such products may range from dietary supplements to genetically engineered foods, herbal products and processed foods. Phytochemicals of nutraceuticals importance are bioactive constituents that sustain or promote health and occurs at the intersection of food and pharmaceutical industries. Such substances may range from isolated nutrients, dietary supplements and specific diets to genetically engineered designer foods, herbal products, processed foods and beverages. Phytochemicals are broadly described as polyphenols, flavonoids, isoflavonoids, anthocyanidins, terpenoids etc.,. They have tremendous impact on the health care system and may provide medical health benefits including the prevention and/ or treatment of diseases and physiological disorders. Majority of foods, such as whole grains, beans, fruits, vegetables and herbs contain phytochemicals. Amongst these, fruits and vegetables contribute to the significant sources of phytochemicals. These phytochemicals, either alone and/or in combination, have tremendous therapeutic potential in curing various ailments. The respective health benefits are based on science and ethics, for health claims, for functional foods, and presence of certain phytochemicals. They play certain pharmacological effects in human health as antioxidants, antibacterial, antifungal, anti-inflammatory, anti-allergic, antispasmodic, chemopreventive, hepatoprotective, hypolipidemic, neuroprotective, hypotensive, prevent aging, diabetes, osteoporosis, DNA damage, cancer and heart diseases, induce apoptosis, diuretic, CNS stimulant, analgesic, protects from UV induced carcinogenesis, prevent, immuno-modulator and carminative.

Keywords: Nutraceuticals, Phytochemicals, Polyphenols, Flavonoids, Isoflavonoids

I. INTRODUCTION

The term nutraceuticals, coined by Dr. Stephen de Felice, is derived from the words “nutrition” and “pharmaceutical”, is a food or food product that provides health and medical benefits, including the prevention and treatment of disease ⁽¹⁾. Such products may range from isolated nutrients, dietary supplements and specific diets to genetically engineered foods, herbal products, and processed foods such as cereals, soups, and beverages. A nutraceutical is demonstrated to have a physiological benefit or provide protection against chronic disease. Their bioactive ingredients, the phytochemicals, sustain or promote health and occur at the intersection of food and pharmaceutical industries. Such substances may range from isolated nutrients, dietary supplements and specific diets to genetically engineered designer foods, herbal products, processed

foods and beverages ^(2, 3). They play a crucial role in maintaining optimal immune response, such that deficient or excessive intakes can have negative impact on health.

II. METHODS AND MATERIAL

Nutraceutical is a combination of 2 words:

Nutrition and Pharmaceutical. Nutraceuticals are food product that provides health as well as medical benefits; including the prevention and treatment of disease. Phytochemicals and antioxidants are two specific types of nutraceuticals. Research has proved that foods with phytochemicals may help to provide protection from diseases such as cancer, diabetes, heart disease, and hypertension, e.g. carotenoids found in carrots. Antioxidants may be helpful in avoiding chronic

diseases, by preventing oxidative damage in our body⁴ Over the last 20 years, numbers of Nutraceuticals are available for self-medication or for sale⁵ There has been a boom in sale of Nutraceutical because of -

1. Adverse effects of pharmaceuticals
2. Increased tendency of patients for self-medication
3. Aging population e.g. – arthritis

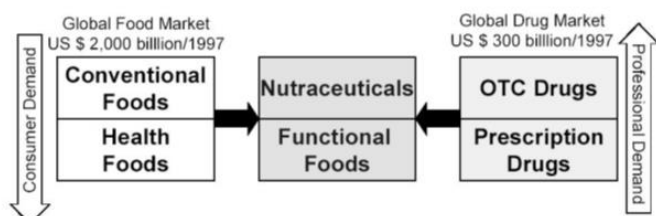


Figure 1 : Demand of Nutraceuticals

Dietary intake of phytochemicals may promote health benefits, protecting against chronic degenerative disorders, such as cancer, cardiovascular and neurodegenerative diseases. Majority of foods, such as whole grains, beans, fruits, vegetables and herbs contain phytochemicals. Amongst these, fruits and vegetables contribute to the significant sources of phytochemicals. These phytochemicals, either alone and/or in combination, have tremendous therapeutic potential in curing various ailments. Phytochemicals with nutraceutical properties present in food are of enormous significance due to their beneficial effects on human health since they offer protection against numerous diseases or disorders such as cancers, coronary heart disease, diabetes, high blood pressure, inflammation, microbial, viral and parasitic infections, psychotic diseases, spasmodic conditions, ulcers, etc. Epidemiological and animal studies suggest that the regular consumption of fruits, vegetables and whole grains, reduces the risk of chronic diseases associated with oxidative damage (6-8). Carotenoids, tocopherols, ascorbates, lipoic acids and polyphenols are strong natural antioxidants with free radical scavenging activity. Endogenous antioxidants enzymes like super oxide dismutase (SOD), catalase, glutathione peroxidase, glutathione reductase, minerals like Se, Mn, Cu, Zn, vitamins A, C and E, carotenoids, limonoids and polyphenols exert synergistic actions in scavenging free radicals. Synthetic antioxidants such as butylatedhydroxy anisole (BHA) and butylatedhydroxytoluene (BHT) play a useful role in food and pharmaceutical industries (9). The natural antioxidant system is mainly classified into two categories namely in-vitro and in-vivo antioxidants. The present review summarizes evidence for protective and healthbeneficial effects of phytochemicals, which have the potential of being incorporated into foods or food supplements as nutraceuticals, or into pharmaceuticals,

and to propose implications of the explosion in information for the future development, discovery use of phytochemicals as nutraceuticals. A nutraceutical is any non-toxic food extract supplement that has scientifically confirmed health benefits for both disease treatment and prevention. The protective effects of fruits and vegetables are manifested for cancers of the esophagus, lung, oral cavity, pharynx and stomach, endometrium, pancreas and colon. Among the phytonutrients mentioned as potentially providing the fortification are polyphenols, flavonoids, isoflavonoids, anthocyanidins, terpenoids etc.

CLASSIFICATION OF NUTRACEUTICALS:-

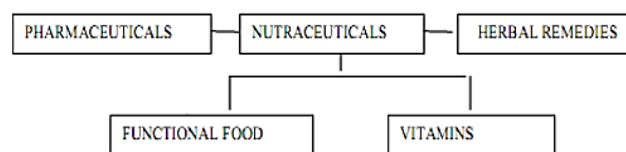


Figure 2: Classification of Nutraceuticals

Dietary Supplements: A dietary supplement is a product that contains nutrients derived from food products. The "dietary ingredients" present in these products are: metabolites, vitamins, minerals, vitamins, herbs, and amino acids.

Functional Foods: Functional foods are designed foods which provide enriched foods close to their natural state to consumer, rather than manufactured dietary supplements in liquid or capsule form. A process of making enriched food is called Nutrification. Functional foods provide required amount of vitamins, fat, carbohydrate, amino acid etc to body. Established requirement that functional food should possess are-

- 1) Functional foods should be in their naturally-occurring form,
- 2) Functional foods should be an essential part of our daily diet,
- 3) Functional foods should regulate a biological process in hopes of preventing or controlling disease.

NUTRIENTS

Substances which have established Nutritional functions e.g. Vitamins, Minerals, Amino Acids, Fatty acids, etc

• Most common Nutrients used/ supplemented as Nutraceutical are:

Minerals and Vitamins or in combination or in combination with other antioxidants

Herbals

- Herbals/ Phytochemicals: Herbs or Botanical products
- Aloe vera: Anti-inflammatory, emollient, wound healing,
- Evening Primrose oil: Dietary supplement of linoleic acid, treatment of atopic eczema,
- Garlic: Antibacterial, antifungal, antithrombotic, antiinflammatory, (e.g.allicin)
- 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,

Phytochemicals

Phytochemicals: Phytochemicals obtained from plants provide health benefits as:

1. Substrate for biochemical reactions
2. Cofactors of enzymatic reactions
3. Inhibitors of enzymatic reactions
4. Absorbents that bind to & eliminate undesirable constituent in the intestine
5. Scavengers of reactive or toxic chemicals
6. Enhance the absorption and / or stability of essential nutrients
7. Selective growth factor for beneficial bacteria
8. Fermentation substrate for beneficial bacteria
9. Selective inhibitors of deleterious intestinal bacteria

HEALTH BENEFITS OF NUTRACEUTICALS

Health Benefits of different common nutraceuticals are as follows-

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.(e.g.Retinol and retinal)

- Vitamin D: Essential for formation of bones and teeth, helps the body to absorb and use calcium (e.g.Ergocalciferol and choleclciferol)
- Vitamin E: Antioxidant, helps to form blood cells, boosts immune system (e.g.Tocopherol)
- Vitamin K: Essential for blood clotting (e.g.Phyllloquinone)

Water Soluble Vitamins

- Vitamin C: Antioxidant, necessary for healthy bones, gums, teeth and skin. Helps in wound healing, prevent from common cold (e.g.Ascorbic acid)
- Vitamin B 1: Helps in carbohydrate metabolism, essential for neurological function. (e.g.Thiamine)
- Vitamin B 2: Energy metabolism, maintain healthy eye, skin and nerve function.(e.g.Riboflavin)
- Vitamin B 3: Energy metabolism, brain function(e.g.Niacin)
- Vitamin B 6: Helps to produce essential proteins, convert proteins to energy (e.g.Pyridoxine)
- 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.(e.g.Cobalamine choline)
- 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

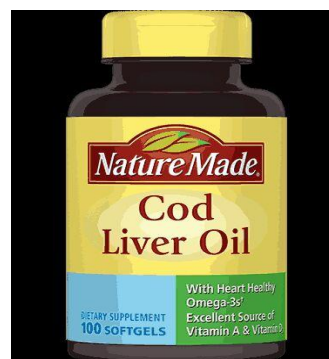
- L- Carnitine: Helps in oxidation of fatty acids, role in oxidative phosphorylation,
- Choline: Lipotropic agent, used to treat fatty liver and disturbed fat metabolism,
- Inositol: For amino acid transport and movement of Potassium and sodium,
- Taurine: Helps in retinal photoreceptor activity, bile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

Minerals:

- Calcium: essential for bone and teeth, maintaining bone strength, nerve, muscle and glandular function, blood clotting,
- Iron: energy production, Hb, oxygen transport,
- Magnesium: for healthy nerve and muscle function, bone formation,
- Phosphorous: energy production, phosphorylation process, bone and teeth, for genetic material,
- 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.



3. **Additional Supplements**-supplements other than vitamin and minerals which have beneficial effect on health for example-cod liveroil, primrose oil, flaxseed oil (omegapure) etc.



Examples of Nutraceuticals Currently Available In Market

1. **Fortified Cereals**-various cereals contain vitamins and minerals.



2. **Vitamin and Mineral Supplements**-Vitamin A (Beta-Carotene), lycotenforte (lactonovaindia)

4. **Energy Drinks and Tablets**- Tropicana fruit Juice, Minute Maid Pulp, Frooti





5. **For Healthy Heart**-Abcor by Nutri-pharma, claimed to reduce cholesterol by 15-20% in 4 months, novomega, carnicare, coq10, lycotenforte (lactonovaindia).



6. **Protein Powder** –Nutral-P ,Nutral-D ,Nutral-G (Lactonova India)



7. **Pro-Biotics & Prebiotics** -Bacteria containing foods that believed to improved health. For example- coloncare capsules & Sachets, A blend oprobiotics, 2prebiotics along with colostrum



8. **Sports Products** - Glucon-D (Heinz), Glucose D (Dabur).



PHYTOCHEMICALS FROM VEGETABLES:

Vegetables contain various types of biologically active plant substances, so-called phytonutrients or phytochemicals that are produced by the plants to protect themselves against stress. Health experts believe that these natural substances are also beneficial for human health¹⁰. Natural compounds found in vegetables protect against many life threatening conditions like heart disease, arterial damage, cancer, as well as against premature ageing^{11,12}. The natural pigments that give vegetables and fruits their characteristic colours are one of the important group of phytochemicals. Some of the pigments in vegetables, for example beta carotene in carrots and sweet potatoes; dehydrotomatine, α -tomatine, lycopene in tomatoes and lutein in spinach, have

antioxidant properties¹³. Antioxidants have the ability to reduce damage of cell's DNA from harmful free radicals produced in the body. Each colour group has a unique combination of nutrients and phytochemicals that have been associated with specific health benefits¹⁴. Some phytochemicals, like Indoles, which are found in cabbages, stimulate enzymes that make the estrogen less effective and could reduce the risk for breast cancer. Allyl sulfides, another group of phytochemicals found in onion and garlic, stimulate enzymes that help the body to get rid of harmful toxins and strengthen the immune system.

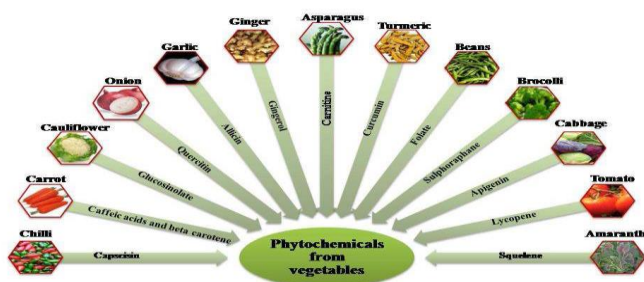


Figure 3: Different phytochemicals derived from vegetables used as nutraceutical

III. RESULT AND DISCUSSION

Table 1: List of some common chemical compounds (Nutraceuticals) isolated from vegetables

S. No.	Chemical Compounds	Plant Source	Properties
1.	Allicin (organosulfur compound)	Garlic, onion, parsnip	Antifungal; antibacterial; antioxidant; used to treat arteriosclerosis
2.	Apigenin	Cabbage, celery, lettuce	4',5,7-trihydroxyflavone is a flavone that is the aglycone of several glycosides
3.	Beta carotene	Carrots, pumpkins, sweet potatoes, winter squash, broccoli, spinach and kale	Anti aging; anti cancerous; improve lung function; reduce complications associated with diabetes
4.	Saponin	Soybeans, beans, other legumes	Reduces blood cholesterol levels and the risk of cancer
5.	Curcumin	Turmeric	Anticancerous; antioxidative
6.	Tocopherol	Broccoli, carrot, celery, onion	It is a fat-soluble antioxidant that stops the production of reactive oxygen species formed when fat undergoes oxidation
7.	Omega-3 Fatty Acids	Linseed	Omega-3 fatty acids have been associated with positive eye health; lowers cholesterol levels

Effectiveness And Safetyregulation:

Nutraceutical products also required same level of scrutiny and regulation as "dietary supplements". Companies which involved in nutraceuticals production invest more on scientific research to substantiate their manufacturing standards, products by keeping the view in mind consumer benefits and differentiate their products from "dietary supplements". Now a day many international companies move within the industry, professional organizations, academia, and health regulatory agencies to add specific legal and scientific criterion to the definition and standards for nutraceuticals.

Safety and Efficacy:

Nutraceuticals hold great potential, as an alternative to substance obtained by plant. Yet, some time they also cause harmful effect as seen with ephedrine, a widely used botanical ingredient in weight-loss products. Now days peoples are more conscious about their health and these products offer the promised health benefits. But danger is associated with some product due to lack of solid information about interaction and side effect.

IV. CONCLUSION

Nutraceutical is growing health care industry in India. Nutraceuticals is playing important role indevelopments of future therapeutics but it depends on control of purity, efficacy and safety. Nutraceutical products are used in prevention of disease not in cure of disease. Nutraceutical Products is collaborative research effort of pharma, food and chemistry.As healthcare industry is growing in India, growth of nutraceutical is also increase because people want treat their disease by improving their health with the help of Fast Moving Healthcare Goods.Nutraceuticals are present in most of the food ingredients as well as in dietary supplements with varying concentration. Concentration, time and duration of supply of nutraceuticals influence human health.Nutraceuticals, have distinctively defined the promising role in health preservation in the future to make it easier and accessible to people all over the world of all walks of life. Therefore, Nutraceuticals in Nutrition and Pharmaceuticals indeed will be positively sustaining better future in therapeutics.

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