Importance of Nutraceuticals as an Alternative for Pharmaceuticals

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Abstract :

Nutraceutical is the hybrid of pharmaceuticals and nutrition. They are products, which other than nutrition are also used as medicine. Nutraceuticals may be defined as substances that provide protection against chronic disease and may be used to improve health, delay the aging process, prevent chronic diseases, increase life expectancy by supporting the various functions of the body. Nutraceuticals, in broad, are food or part of food playing a significant role in modifying and maintaining normal physiological function that maintains healthy human beings. They have received considerable interest due to the potential nutrition they provide as also the safety and therapeutic effects.

The food products used as nutraceuticals can be categorized as dietary fibre, prebiotics, probiotics, polyunsaturated fatty acids, antioxidants and other different types of herbal/ natural foods. These nutraceuticals help in combating some of the major health problems of the century such as obesity, cardiovascular diseases, cancer, osteoporosis, arthritis, diabetes, cholesterol etc. Nutraceuticals has lead to the new era of medicine and health, in which the food industry has become a research oriented sector.

Keywords : Nutraceuticals, human diet, dietary fibres, probiotics and prebiotics, disease modifiers, herbal nutraceuticals.

Intoduction :

The term Nutraceutical is derived from the terms “nutrition” and “pharmaceutical” and is applied to products that are isolated from herbal products, dietary supplements, cereals, soups and beverages which are used as medicine besides providing nutrition.A dietary supplement is considered as a product that bears or contains one or more of ingredients such as minerals, vitamins, amino acids herbs and dietary substances. Thus a nutraceutical product may be defined as a substance, which has physiological benefit and provides protection

against chronic diseases and may be used to improve health, delay the aging process, prevent chronic diseases, increase life expectancy and supports the structure or function of the body. In recent years a set of ideas have come up which places more emphasis on the positive aspects of diet.

Recent studies have shown promising results for these compounds in various pathological complications. Most of these nutraceuticals have antioxidant activity. They are considered as sources of health promotion especially for the prevention of life threatening diseases such as diabetes, infections, renal and gastrointestinal disorders.The present review emphasizes on herbal nutraceuticals effectiveness on hard curative disorders related to oxidative stress, including allergy, alzheimer, cardiovascular, cancer, diabetes, eye, immune, inflammatory and Parkinson's diseases, as well as obesity.Several of these nutraceuticals have the potential of being incorporated as foods.

Categories of Nutraceuticals :

The most common categorization of nutraceuticals can be based on food sources, chemical nature and mechanism of action etc. The food sources used as nutraceuticals are all natural and can be categorized as dietary fibres, pro and pre biotics, polyunsaturated fatty acids, antioxidants, vitamins, polyphenols and spices.

1) **Dietary Fibres** : These dietary fibres mostly obtained from plants which are not hydrolysed by the enzymes secreted by the digestive tract but digested by the microflora present in the gut. They mostly include non starch polysaccharide (NSP) such as cellulose, hemicellulose, gums and pectins, resistant dextrins and starches and lignins. Chemically dietary fibres mean carbohydrate polymers.

2)**Polyunsaturated Fats (PUFA)** : These are also known as “essential fatty acids” and are crucial for the body’s function. They are introduced externally through the diet. PUFA’s are categorized into omega-3 fatty acids and omega-6 fatty acids. The omega-3 fatty acid is commonly found in fatty fishes such as mackeral, salmon , herring, trout and fish oils. Omega-6 fatty acid is found mainly in meat poultry and eggs. Omega-3-fatty acids is seen to prevent anti-arrhythmic cardiovascular disease (alleviating irregularities in the force or rhythm of the heart), it is hypolipidemic (promoting the reduction of lipid concentrations in the serum) and is antithrombotic (decreased arteriosclerosis. There are research evidences showing the benefits of omega-3-oils in other areas of health including pre-mature infant health, asthma, bipolar and depressive disorders, dysmenorrhea and diabetes.

3) **Probiotics :**The history of probiotics dates back to almost 2,000 years when fermented milk was taken for the first time. A probiotic can be defined as live microbial feed supplement, which when administered in adequate amounts beneficially affects the host animal by improving its intestinal microbial balance. Probiotics generally include the following categories of bacteria: -

1. Lactobacilli such as *L. acidophilus*, *L.casei, L.delbrueckii* subsp. *bulgaricus*, *L.brevis*, *L.cellobiosus.*

2. Gram-positive cocci such as *Lactococcus lactis*, *Streptococcus salivarius* subsp. *thermophilus*, *Enterococcus faecium*

3. Bifidobacteria such as *B.bifidun*, *B.adolescentis, B.infantis, B.longum, B. thermophilum.*

Probiotics are available in various forms as powder form, liquid form, gel or paste or granule forms, capsule forms etc. Specific probiotics are used generally to treat gastrointestinal (GI) conditions such as lactose intolerance, acute diarrhea and antibiotic-associated GI side effects These agents possess the properties of non-pathogenic, non-toxic, resistance to gastric acid, adherence to gut epithelial tissues producing antibacterial substances .There are evidences that administration of probiotics decreases the risk of systemic conditions, such as allergy, asthma, cancer and several other infections of the ear, urinary tract .

4**) Prebiotics** :The prebiotics are dietary ingredients that affect the host by selectively altering the composition or metabolism of the gut microbiota. These short-chain polysaccharides have unique chemical structures and are not digested by humans. Some fructose-based oligosaccharides exist naturally in food or are added in the food. Consumption of prebiotics helps in metabolism by enhancing the growth of Lactobacillus and Bifidobacterial in the gut. Vegetables like chicory roots, banana, tomato, alliums are rich in fructo-oligosaccharides. The oligosaccharides raffinose and stachyose are found in beans and peas.

The health benefits of the prebiotics include improved lactose tolerance, antitumor properties, neutralization of toxins, and stimulation of intestinal immune system, reduction of constipation, blood lipids and blood cholesterol levels. A daily intake of prebioticsnpromote the growth of bifidobacteria but consumption of large amounts of such oligosaccharides causes diarrhea, abdominal distension and flatulence.

5) **Selenium :**Selenium is an essential trace element involved in the defense of the body against the toxicity of reactive oxygen species, the regulation of the redox state of cells and in the regulation of thyroid hormone metabolism. Brazil nuts are the richest known source of selenium; one ounce contains approximately 200 mcg. Deficiency of Selenium has seious health effects in human. Keshan's disease is a potentially fatal form of cardiomyopathy (disease of the heart muscle) that affects young women and child is caused by low selenium levels. The most important role of selenium is in the form of antioxidant selenoproteins or selenoenzymes such as glutathione peroxidase, thioredoxin reductase.

Glutathione peroxidase is an enzyme that plays a protective role in cells against oxidative damage from reactive oxygen species (ROS) and reactive nitrogen species (RNS), which include superoxide, hydrogen peroxide, hydroxyl radicals and nitric oxide and peroxynitrite. The pentose phosphate pathway assists glutathione peroxidase to protect erythrocytes against haemolysis. The antioxidant activity of selenium aids in prevention of cardiovascular diseases and helps in maintenance of proper immunity. It has been reported that the antioxidant activity of selenoenzymes prevents the formation of oxidized LDL hence reducing the incidence of heart diseases. Diet rich in Se has been found to reduce the effects of reperfusion and deficient selenium significantly impairs intrinsic myocardial tolerance to ischemia. Selenium has also been found to act as a chemoprevention agent reducing oxidative stress, limiting DNA damage, inducing apoptosis, cell-cycle arrest. Selenium levels and cancer risks in human populations have deep relationship, a decrease in the cancer death rate was observed in patients who were put on high selenium intake. Se also plays an important role in the immune system by increasing the activity of natural killer (NK) cells by the production of interferonγ. It stimulates vaccine-induced immunity and impairment of thyroid immunity involving the action of glutathione peroxidase and thioredoxin reductase thereby removing ROS and excess H_2O_2 produced by thyrocytes during thyroid hormone synthesis.

However high blood levels of selenium may lead to a condition called selenosis which has symptoms like gastrointestinal upsets, hair loss, white blotchy nails, fatigue, garlic breath odour, irritability, and mild nerve damage.

6) Antioxidant Vitamins : Vitamins C, vitamin E and carotenoids are collectively known as antioxidant vitamins. These vitamins act both singly and also in combination for the prevention of oxidative reactions leading to several degenerative diseases including cancer, cardiovascular diseases, cataracts etc. Vitamin C or ascorbic acid donates hydrogen atoms to lipid radicals, quenches singlet oxygen radicals and removes the molecular oxygen. Scavenging of aqueous radicals by the combination of ascorbic acid and tocopherol supplementation is known as

antioxidant mechanism. Vitamin C is abundantly found in many fruits and vegetables and exert their protective action by free-radical scavenging mechanisms.

Vitamin E which comprises of tocopherols together with tocotrienols transfer hydrogen atom and scavenge singlet oxygen and other reactive species thus protecting the peroxidation of PUFA within the biological membrane and LDL . Tocotrienols are more mobile within the biological membrane than tocopherols because of the presence of the unsaturated side-chain and hence penetrate tissues with saturated fatty layers, i.e. in brain and liver more efficiently. They have more recycling ability and are a better inhibitor of liver oxidation.The scavenging of aqueous radicals by the combination of ascorbic acid and tocopherol supplementation is a well known antioxidant mechanism

Carotenoids like lycopene, β-carotene, lutein, zeaxanthin are known to be the most efficient singlet oxygen quencher in the biological systems without the production of any oxidizing products. β-carotene traps peroxy free radicals in tissues at low oxygen concentrations. Hence β-carotene complements the antioxidant properties of vitamin E.

7) **Polyphenol :**

Polyphenols form a large group of phytochemicals, produced by plants as secondary metabolites to protect them from photosynthetic stress and reactive oxygen species. The most important polyphenols are flavonols, flavones, flavan-3-ols, flavanones and anthocyanins. The highly branched phenylpropanoid pathway synthesizes majority of polyphenols. The most commonly occurring polyphenols in food include flavonoids and phenolic acids. Dietary polyphenols are of current interest because substantial evidence in vitro have suggested that they can affect numerous cellular processes mainly gene expression.

These apart, polyphenols also possess antioxidant, anti-inflammatory, anti-microbial, cardioprotective activities and play a role in the prevention of neurodegenerative diseases and diabetes mellitus. Polyphenols are mostly acknowledged for their antioxidant activities on the basis of their structural chemistry. Polyphenols have been more effective antioxidants in vitro than vitamin E and C. Flavenoids are found play an important rate-limiting enzyme involved in glutathione synthesis. The most common sources of polyphenols are :-

1) Tea (*Camellia sinensis)* is a rich source of the polyphenol Epigallocatechin gallate(EGCG) such as catechins, which include (-)-epicatechin, (-)-epigallocatechin, (-)-epicatechin-3-gallate (ECGC), with ECGC being the major catechin. These apart, tea also constitutes of flavonols like quercetin and myricetin. Tea, mainly consumed in the form of black tea and green tea has been found to have cancer-preventing activities. Experiments indicate that black tea has a broad inhibitory activity against lung carcinogenesis and plays a significant role in inhibition of carcinogenesis in organ sites in skin, lung, esophagus, stomach, liver, small intestine, pancreas, colon, bladder, and mammary gland. ECGC has been considered by several authors as The active component of green tea is ECGC. The anticarcinogenic activity of green tea consumption is associated with a lower incidence of oesophagal cancer, especially among nonsmokers and nonalcohol-drinkers. Green tea has also been found to be associated with lower risk of cardiovascular diseases through decreased serum cholesterol and triglyceride and provides protection against peroxidation of lipids in kidney.
2) Legumes are consumed worldwide as an alternative source of proteins, since they are rich in amino acids like lysine and tryptophan. Studies have revealed that in addition to complex carbohydrates, soluble fibers, essential vitamins, and metals, legumes also supply the diet with polyphenols like flavonoids, isoflavones and lignans. Soyabean is most significant source of dietary isoflavones viz. genistein and diadzein, which are generally considered as phytoestrogens. These compounds have been shown to inhibit the growth of most hormone-dependent and independent cancer cells, especially breast, prostate and skin cancer. Several other **legumes like the commonly consumed cowpea *Vigna unguiculata (lobhia)* and underutilized legumes *Cajanus cajan* (Arhar) and *Sphenostylis sternocarpa* (African** yam bean)also possess higher antioxidant activity due to their relative higher phenol content and play an active role in combating degenerating diseases along with their traditional role of preventing malnutrition.

8) **Spices :**Spices have been used for thousands of years to enhance the sensory quality of foods. The variety of the spices consumed in the tropical countries are particularly extensive. They impart characteristic flavor, aroma, a sharp aroma and colour to foods, stimulating appetite and as well as modify the texture of food. Dietary spices in their minute quantities has an immense influence on the human health by their antioxidative, chemopreventive, antimutagenic, anti-inflammatory, immune

modulatory effects on cells and a wide range of beneficial effects on human health by the action of gastrointestinal, cardiovascular, respiratory, metabolic, reproductive, neural and other systems.

Conclusion: Pharmaceuticals are mostly considered as medications which are used mainly to treat diseases, however nutraceuticals are the substances which are mostly considered to cure and prevent diseases. Nutraceuticals might be defined as substances that have physiological benefits and provide protection against chronic diseases by improving health, delaying the aging process, prevent chronic diseases, increase life expectancy and support the function of the body. Nowadays, nutraceuticals have received considerable interest due to potential nutritional, safety and therapeutic effects and modifies the indications related to oxidative stress including allergy, Alzheimer, cardiovascular, cancer, diabetes, eye, immune, inflammatory and Parkinson's diseases as well as obesity

Nutraceuticals have received high interests in the present days due to their potential nutritional and safety profile, other than therapeutic capability. Most nutraceuticals possess multiple therapeutic benefits. Pharmaceuticals are mostly medications used to treat diseases, nutraceuticals on the other hand are considered to be the substances which cure and prevent diseases at the same time. Herbal foods are basically medicinal foods with specific category of therapeutic agents that are considered for the nutritional management of a specific disease. These foods are designed to manage inflammatory conditions, cancer, hyper homo cysteinemia, pancreatic exocrine insufficiency and other diseases and also play a substantial protection against numerous age-related or chronic diseases. Due to the health benefits of nutraceuticals, they might regularly be taken to cure or reduce the risk factors such as high cholesterol, high blood pressure and diabetes.

With the rapid increase in the nutraceutical consumption, substantial research is necessary to warrant the safe use of these compounds. The mechanism of nutraceuticals are not clear however they might be involved in a wide variety of biological processes, including activation of signal transduction pathways, antioxidant defenses, gene expression, cell proliferation, differentiation and preservation of mitochondrial integrity. The present review is to devote a better understanding of nutraceuticals based on their pharmaceutical and therapeutic indications.

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