



## A REVIEW ON NUTRACEUTICALS: CLASSIFICATION AND ITS ROLE IN VARIOUS DISEASES

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### ABSTRACT

Nutraceutical is the hybrid of 'nutrition' and 'pharmaceutical'. 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. 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 used in various diseases such as obesity, cardiovascular diseases, cancer, osteoporosis, arthritis, diabetes, cholesterol etc. In whole, 'nutraceutical' has lead to the new era of medicine and health, in which the food industry has become a research oriented sector. This article aim to provide the knowledge of nutraceutical with its uses in various diseases.

**Key Words:-** Dietary Fiber, Prebiotics, Probiotics, Polyunsaturated Fatty Acids, Antioxidants.

### INTRODUCTION

The term 'nutraceutical' was coined from 'nutrition' and 'pharmaceutical' in 1989 by DeFelice and was originally defined as 'a food (or part of the food) that provides medical or health benefits, including the prevention and/or treatment of a disease (Kalra EK, 2003). A nutraceutical may be a naturally nutrient- rich food such as spirulina, garlic, soy or a specific component of a food like omega-3 oil from salmon. They are also known as medical foods, nutritional supplements and dietary supplements. It ranges from isolated nutrients, dietary supplements, genetically engineered 'designer' foods, herbal products, and processed products such as cereals and soups. They have received considerable interest because of their presumed safety and potential nutritional and therapeutic effects (Rajeseckaran A *et al.*, 2008).

The role of dietary active compounds in human nutrition is one of the most important areas of

investigation with the findings having wide-ranging implications for consumers, healthcare providers, regulators and industry (Bagchi D, 2006). Foods and nutrients play a vital role in the normal functioning of the body. They help to maintain the health of the individual and to reduce the risk of various diseases. Worldwide acceptance of this fact formed a recognition link between "nutrition" and "health", and thus the concept of "nutraceuticals" evolved (Rama CS *et al.*, 2006).

### Classification of Nutraceuticals

The food sources used as nutraceuticals are all natural and can be categorized as

1. Dietary Fiber
2. Probiotics
3. Prebiotics
4. Polyunsaturated fatty acids
5. Antioxidant vitamin
6. Polyphenols
7. Spices (kalia AN, 2005)

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### Dietary fiber

Dietary fiber (DF) consists of non-digestible carbohydrates and lignins that are intrinsic and intact in plants. Functional fiber (FF) consists of isolated, non-digestible carbohydrates that have beneficial physiological effects in humans as shown in table-1. Total fiber is the sum of dietary and functional fiber. These definitions broaden the category and allow resistant starches, oligosaccharides and other non-digestible carbohydrates to be classified as functional fibers. The adequate intake for fiber defined by the Dietary Reference Intake (DRI) is 38 grams/day for adult men and 25 grams/day for adult women. There was insufficient evidence to set a tolerable upper intake level for dietary or functional fiber.

Probiotics are live bacteria and yeasts that are good for your health, especially your digestive system. We usually think of bacteria as something that causes diseases. But your body is full of bacteria, both good and bad. Probiotics are often called "good" or "helpful" bacteria because they help keep your gut healthy. Probiotics are naturally found in your body. You can also find them in some foods and supplements.

It's only been since about the mid-1990s that people have wanted to know more about probiotics and their health benefits. Doctors often suggest them to help with digestive problems. And because of their newfound fame, you can find them in everything from yogurt to chocolate.

### Lactobacillus

This may be the most common probiotic. It's the one you'll find in yogurt and other fermented foods. Different strains can help with diarrhea and may help with people who can't digest lactose, the sugar in milk.

### Bifidobacterium

You can also find it in some dairy products. It may help ease the symptoms of irritable bowel syndrome (IBS) and some other conditions.

Probiotics help move food through your gut. Researchers are still trying to figure out which are best for certain health problems. Some common conditions they treat are:

- Irritable bowel syndrome
- Inflammatory bowel disease (IBD)
- Infectious diarrhea (caused by viruses, bacteria, or parasites)
- Antibiotic-related diarrhea

There is also some research to show they help with problems in other parts of your body. For example, some people say they have helped with:

- Skin conditions, like eczema
- Urinary and vaginal health

- Preventing allergies and colds
- Oral health

Prebiotics are substances that induce the growth or activity of microorganisms (e.g., bacteria and fungi) that contribute to the well-being of their host. The most common example is in the gastrointestinal tract, where prebiotics can alter the composition of organisms in the gut microbiome. However, in principle it is a more general term that can refer to other areas of the body as well. For example, certain hand moisturizers have been proposed to act like prebiotics to improve the activity or composition of skin microbiota (Patrick L *et al.*, 2014).

In diet, prebiotics are typically non-digestible, fiber compounds that pass undigested through the upper part of the gastrointestinal tract and stimulate the growth or activity of advantageous bacteria that colonize the large bowel by acting as substrate for them (Gibson GR *et al.*, 1991). As a functional food component, prebiotics, like probiotics, are conceptually intermediate between foods and drugs. Depending on the jurisdiction, they typically receive an intermediate level of regulatory scrutiny, in particular of the health claims made concerning them.

Although all prebiotics are fiber, not all fiber is prebiotic. Classification of a food ingredient as a prebiotic requires scientific demonstration that the ingredient (Jacob RA, 1995):

- Resists gastric acidity, hydrolysis by mammalian enzymes, and absorption in the upper gastrointestinal tract;
- Is fermented by the intestinal microflora;
- Selectively stimulates the growth and/or activity of intestinal bacteria potentially associated with health and well-being.

### Health benefit of prebiotics

The health outcome data for prebiotic intake is substantially more limited than for dietary fiber. However, it has been suggested that prebiotic intake may:

- Reduce the prevalence and duration of infectious and antibiotic-associated diarrhea;
- Reduce the inflammation and symptoms associated with inflammatory bowel disease;
- Exert protective effects to prevent colon cancer;
- Enhance the bioavailability and uptake of minerals, including calcium, magnesium, and possibly iron;
- Lower some risk factors for cardiovascular disease; and
- Promote satiety and weight loss and prevent obesity.

### Polyunsaturated fatty acids

The group of poly-unsaturated fatty acids (PUFAs) is divided into two groups: omega-3 (n-3) and omega-6 (n-6) polyunsaturated fatty acids (PUFA), differing in the position where the first double C-bound is located. Two PUFAs are called essential fatty acids since they cannot be synthesized in the human body and are vital for physiological integrity. Therefore, they must be obtained from the diet. One is linoleic acid (LA) and belongs to the n-6 family. The other one is  $\alpha$ -linolenic acid (LNA) belonging to the n-3 family. These essential parent compounds can be converted in the human body to long-chain (LC) fatty acid but humans cannot interconvert n-3 and n-6 fatty acids.

### Antioxidants

Damage to cells caused by free radicals is believed to play a central role in the aging process and in disease progression. Antioxidants are our first line of defense against free radical damage, and are critical for maintaining optimum health and wellbeing. Oxygen is a highly reactive atom that is capable of becoming part of potentially damaging molecules commonly called “free radicals.” Free radicals are capable of attacking the healthy cells of the body, causing them to lose their structure and function. Antioxidants are capable of stabilizing, or deactivating, free radicals before they attack cells. Antioxidants are absolutely critical for maintaining optimal cellular and systemic health and well-being.

Humans have evolved a highly sophisticated and complex antioxidant protection system. It involves a variety of components, both endogenous and exogenous in origin, that function interactively and synergistically to neutralize free radicals (Liu LI *et al.*, 2009).

These components include:

- **Nutrient-derived antioxidants** like ascorbic acid (vitamin C), tocopherols and tocotrienols (vitamin E), carotenoids, and other low molecular weight compounds such as glutathione and lipoic acid.
- **Antioxidant enzymes**, such as superoxide dismutase, glutathione peroxidase, and glutathione reductase, which catalyze free radical quenching reactions.
- **Metal binding proteins**, such as ferritin, lactoferrin, albumin, and ceruloplasmin that sequester free iron and copper ions that are capable of catalyzing oxidative reactions.
- **Numerous other antioxidant phytonutrients** present in a wide variety of plant foods.

Additional physiological antioxidants are –

### Endogenous Antioxidants

- a. Bilirubin
- b. Thiols, e.g., glutathione, lipoic acid, N-acetyl cysteine

- c. NADPH and NADH
- d. Ubiquinone (coenzyme Q10)
- e. Uric acid
- f. Enzymes:
  - copper/zinc and manganese-dependent superoxide
  - iron-dependent catalase
  - selenium-dependent glutathione peroxidase

### Dietary Antioxidants

- a. Vitamin C
- b. Vitamin E
- c. Beta carotene and other carotenoids and oxycarotenoids
  - b) such as lycopene and lutein
- a. Polyphenols, e.g., flavonoids, flavones and flavonols
- c) Proanthocyanidins

### Metal Binding Proteins

- a. Albumin (copper)
- b. Ceruloplasmin (copper)
- c. Metallothionein (copper)
- d. Ferritin (iron)
- e. Myoglobin (iron)
- f. Transferrin (iron)

Polyphenols are natural phytochemical compounds in plant-based foods, such as fruits, vegetables, whole grains, cereal, legumes, tea, coffee, wine and cocoa; more than 8000 polyphenolic compounds, including phenolic acids, flavonoids (Ndiaye M *et al.*, 2008), tilbenes, lignans and polymeric lignans have been identified in whole plant foods . These compounds are secondary metabolites of the plants that act as a defense against ultraviolet radiation, oxidants and pathogens (Wang L *et al.*, 2010). Polyphenols may be classified into several categories based on the number of phenol rings and structural elements that bind these rings to one another (Moreno T *et al.*, 2010). Phenolic acids are approximately a third of the polyphenolic compounds in the diet and include two main classes-

- a) hydroxybenzoic acid derivatives (protocatechuic acid, gallic acid, *p*-hydroxybenzoic acid) and
- b) hydroxycinnamic acid derivatives (caffeic acid, chlorogenic acid, coumaric acid, Ferulic acid, sinapic acid); berry fruits, kiwi, cherry, apple, pear, chicory and coffee are the foods with high content of these phenolic acids .

There are six subclasses of flavonoids including anthocyanins, flavonols, flavanols, flavanones, flavones and isoflavones; anthocyanins (cyanidin, pelargonidin, delphinidin, malvidin) are found in the berries family, red wine, red cabbage, cherry, black grape and strawberry (Ndiaye M *et al.*, 2004, Wang L *et al.*, 2010, Moreno T *et al.*, 2010).

Spices have been virtually indispensable in the culinary art of flavoring foods since antiquity. Spices are aromatic vegetable substances, in the whole, broken or ground form, whose significant function in food is seasoning rather than nutrition. These spice ingredients impart characteristic flavor, aroma and pungency to foods. Volatile oil spices responsible for aroma, flavor and oleoresin contribute the pungency.

Apart from flavoring and seasoning, spices are widely used in indigenous medicines, pharmaceuticals, Nutraceuticals, aroma therapy, preservatives, beverages, natural colors, perfumes, dental preparations, cosmetics and botanicals as pesticide and thus, play a significant role in the economy of the producing country. These properties are due to diverse array of chemicals synthesized by these spices. Growing demand from the emerging segment of nutraceuticals is driving the global consumption of Indian spices further to meet the needs of traditional food sector. Non-traditional use of spices including nutraceuticals now accounts for nearly 15 per cent of spice production in the country.

Chawanprash is one, the highest marketing nutraceutical product in India. It contains spice ingredients such as cinnamon, clove, curcuma spp., saffron and long pepper. As these are good source of vitamin C and rich in antioxidants, helps in increasing the immunity, increases digestion and prevents cough, asthma, fever, heart disease, impotency and coarseness speech.

Neurodegenerative diseases are a group of progressive neurological disorders (Alzheimer's disease, Parkinson's disease, multiple sclerosis, brain tumor and meningitis) that damage or destroy the function of neurons. Spices like turmeric, red pepper, black pepper, clove, ginger, garlic, coriander, rosemary, saffron and cinnamon has been shown to exert its activity against neurodegenerative diseases (Ramaswamy, 2011).

The concept of beauty and cosmetics is as ancient as mankind and civilization. Herbs and spices have been used in maintaining and enhancing human beauty since time immemorial. For example turmeric is used for skin care. The anti-ageing and cosmeceuticals is gaining importance in the beauty, health and wellness sector. Spices like turmeric, cardamom, clove, aniseed, coriander, basil, saffron, garlic and sage are used mainly in beauty and cosmetic industry (Shweta KG *et al.*, 2011).

Application of turmeric extract cream (0.5%) regulates sebum in human skin, person with excessive oily skin or suffering from acne will have great benefit from this property. Saffron (*Crocus sativus*) as complexion promoter in skin care and reported that 0.3% of saffron used in cream and lotion will be giving brighter and shiny skin, this effect is mainly due the crocin and cicrocrocin

content of saffron, regulates the melanin biosynthesis in skin (Rissanen TH *et al.*, 2010).

## **Nutraceuticals and Diseases**

### **Cardiovascular diseases**

Anti-oxidants, Dietary fibres, Omega-3 poly-unsaturated fatty acids, Vitamins, minerals for prevention and treatment of CVD. Polyphenol (in grape) prevent and control arterial diseases Flavonoids (in onion, vegetables, grapes, red wine, apples, and cherries) block the ACE and strengthen the tiny capillaries that carry oxygen and essential nutrients to all cells. Rice bran lowers the serum cholesterol levels in the blood, lowers the level of (LDL) and increases the level (HDL) in cardiovascular health. Higher the ratio more will be the risk of coronary heart diseases. Rice bran contains both Lutein and Zeaxanthin, which improves eyesight and reduces the chance of cataracts. The essential fatty acids, omega-3, omega-6, omega-9 and folic acid in rice bran are also promoting eye health. It is reported that low intake of fruits and vegetables is associated with a high mortality in CVD (Temple WJ *et al.*, 2003; Vyas LK *et al.*, 2010).

### **Diet related diseases**

In Western societies, the incidence of diet-related diseases is progressively increasing due to greater availability of hyper caloric food and a sedentary lifestyle. Obesity, diabetes, atherosclerosis, and neurodegeneration are major diet-related pathologies that share a common pathogenic denominator of low-grade inflammation. Functional foods and nutraceuticals may represent a novel therapeutic approach to prevent or attenuate diet-related disease in view of their ability to exert anti-inflammatory responses. In particular, activation of intestinal T regulatory cells and homeostatic regulation of the gut microbiota have the potential to reduce low-grade inflammation in diet-related diseases.

### **Heart attack and lung cancer**

Corn's contribution to heart health lies not just in its fiber, but in the significant amounts of folate that corn supplies. Corn maintains the homocysteine, an intermediate product is an important metabolic process called the methylation cycle. Homocysteine is directly responsible for damage of blood vessel heart attack, stroke, or peripheral vascular disease. It has been estimated that consumption of 100% of the daily value (DV) of folate would, by itself, reduce the number of heart attacks suffered by 10%. Corn also contains cryptoxanthin, a natural carotenoid pigment. It has been found that cryptoxanthin can reduce the risk of lung cancer of 27% on daily consumption

### Diabetes

Ethyl esters of n-3 fatty acids may be beneficial in diabetic patients. Docosahexaenoic acid modulates insulin resistance and is also vital for neurovisual development. Lipoic acid, an antioxidant, for treatment of diabetic neuropathy. Dietary fibers from psyllium have been used for glucose control in diabetic patients and to reduce lipid levels in hyperlipidemia.

### Obesity

Obesity is a global public health problem and is defined as accumulation of unhealthy amount of body fat. It is a well-established risk factor for many disorders like angina pectoris, congestive heart failure (CHF), hypertension, hyperlipidemia, respiratory disorders, renal vein thrombosis, osteoarthritis, cancer and reduced fertility (Caterston ID *et al.*, 2002).

### Cancer

Flavonoids which block the enzymes that produce estrogen reduce the estrogen-induced cancers. Prevent prostate/breast cancer a broad range of phyto-pharmaceuticals with a claimed hormonal activity, called "phytoestrogens" is recommended. Soyfoods source of isoflavones, curcumin from curry and soya isoflavones possess cancer chemopreventive properties. Lycopene concentrates in the skin, testes, adrenal and prostate where it protects against cancer.

### Anti-inflammatory activities

Curcumin (diferuloylmethane) which is a polyphenol of turmeric possesses anticarcinogenic, antioxidative and anti-inflammatory properties. Top of Form Beet roots, cucumber fruits, spinach leaves, and turmeric rhizomes, were reported to possess anti-tumor activity. Gamma linolenic acid (found in green leafy vegetables, nuts, vegetable oils i.e. evening primrose oil, blackcurrant seed oil and hemp seed oil, and from spirulina, cyanobacteria) are used for treating problems with inflammation and auto-immune diseases. Glucosamine and chondroitin sulfate are used against osteoarthritis and regulate gene expression and synthesis of PGE2. Cat's claw acts as a potent anti-inflammatory agent. The two known species of cat's claw are *Uncaria guianensis*, used traditionally for wound healing; and *Uncaria tomentosa*, which has numerous medicinal uses & is most commonly found in supplements. Cat's claw is a rich source of phytochemicals 17 alkaloids, glycosides, tannins flavonoids, sterol fractions and other compounds (Balch SA *et al.*, 2003).

### Alzheimer's disease

$\beta$ -carotene, curcumin, lutein, lycopene and turmerin may exert positive effects on specific diseases by neutralizing the negative effects oxidative stress mitochondrial dysfunction, and various forms of neural degeneration.

### Parkinson's disease

Vitamin E in food may be protective against Parkinson's disease. Canadian researchers indicated that vitamin E in food may be protective against Parkinson's disease. Creatine appeared to modify Parkinson's disease features as measured by a decline in the clinical signs (Brower V, 2005). Nutritional supplements have shown some promising results in preliminary studies, it is important to remember that there is not sufficient scientific data to recommend them for Parkinson's disease at present. The patients should be cautioned that over-the-counter medications do have side effects and interactions with other drugs and are also expensive.

### Osteoarthritis

Osteoarthritis (OA), a debilitating joint disorder, is the most common form of arthritis in the United States, where it affects an estimated 21 million people. In 2004, the direct and indirect health care costs associated with all forms of arthritis were approximately 86 billion dollars. Joint discomfort from OA and other joint disorders may reduce physical activity in individuals experiencing this condition, resulting in energy imbalance and weight gain. Increased weight can exacerbate existing problems, through additional stress on joints (Kaliora AC *et al.*, 2006). Glucosamine (GLN) and chondroitin sulfate (CS) are widely used to alleviate symptoms of OA. These nutraceuticals have both nutrient and pharmaceutical properties and seem to regulate gene expression and synthesis of NO and PGE2, providing a plausible explanation for their anti-inflammatory activities.

### Adrenal Dysfunction

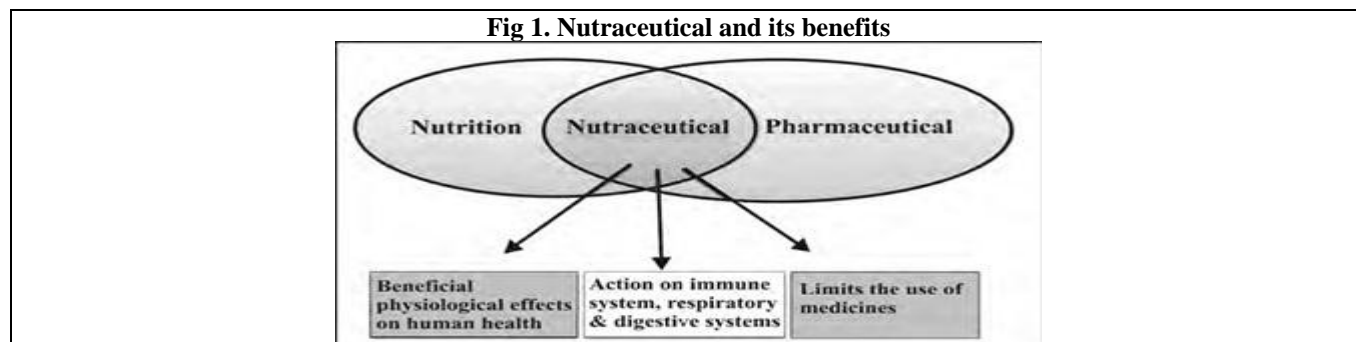
Adaptogens are natural herbs that have nonspecific, normalizing effects on physiology; they influence normal body functions only enough to encourage non-specific resistance to stressors. Adaptogens include herbs *Eleutherococcus senticosus*, *Ginkgo biloba*, *Ocimum sanctum*, *Panax ginseng* and *Withania somnifera* and the mushroom *Cordyceps sinensis*. Following is a short description of each.

*Ginkgo biloba* has been used for several thousand years by the Chinese for various maladies, including vertigo, short-term memory loss, and lack of attention or vigilance. Standardized extracts of ginkgo have been

shown to possess antioxidant and neuroprotective properties, including slowing the progression of dementia (Sembulingam K *et al.*, 1997).

*Ocimum sanctum* (Holy basil or tulsi) is used in Ayurvedic medicine and has been shown to have antistressor effects. Sembulingam *et al.*, subjected rats to acute or chronic

noise stress, with and without *Ocimum* administration. Those rats that had been pretreated with *Ocimum*, whether exposed to acute or chronic noise, had significantly reduced levels of corticosterone (Sembulingam K *et al.*, 1997). Here is the Table-2 below showing nutraceuticals and their uses.



**Table 1. Physiological properties of dietary fibers and proposed health benefits**

Physiological property	Proposed effect	Health benefits
Soluble dietary fiber	Delays gastric emptying and prolonging intestinal phase	Contribute to safety.
	Prevent or delays nutrients uptake in small intestine	Lower blood cholesterol level.
	Prevent the reabsorption of bile acid	Prevents breast cancer.
	Prevent the digestive enzymes from reaching lipid substrates, inhibits enzyme activity	Lowers glucose, insulin and lipid level after meal.
Interaction/binding	Binding to bile acids	Lower blood cholesterol level.
	Interaction with digestive enzymes	Lowers glucose, insulin and lipid level after meal.
Fermentation	Growth of health promoting bacteria	Protect against inflammation and colorectal cancer.
	Production of short chain fatty acids	Lowers blood cholesterol level and protect against cancer.
Insoluble dietary fiber	Increase stool weight	Reduce the incidence of colorectal cancer and intestinal diseases.
	Accelerate transit time	Reduce time for nutrients to absorb, lowers glucose, insulin and lipid level.

**Table 2. Common nutrients and their associated health benefits**

Nutrients	Health benefits
<b>Fat Soluble Vitamins</b>	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 A	
Vitamin D	Essential for formation of bones and teeth, helps the body absorb and use calcium
Vitamin E	Antioxidant, helps form blood cells, muscles, lung and nerve tissue, boosts the immune system
Vitamin K	Essential for blood clotting
<b>Water Soluble Vitamins</b>	Antioxidant, necessary for healthy bones, gums, teeth and skin, helps in wound healing,

Vitamin C	may prevent common cold and attenuate its symptoms
Vitamin B1	Helps to convert food in to energy, essential in neurologic functions
Vitamin B2	Helps in energy production and other chemical processes in the body, helps maintain healthy eyes, skin and nerve function
Vitamin B3	Helps to convert food in to energy and maintain proper brain function
Vitamin B6	Helps to produce essential proteins and convert protein in to energy
Vitamin B12	Helps to produce the genetic material of cells, helps with formation of red blood cells, maintenance of central nervous system and synthesizes amino acids and is involved in metabolism of fats, protein and carbohydrates
Folic acid	Necessary to produce the genetic materials of cells, essential in first three months of pregnancy for preventing birth defects, helps in red blood cell formation, protects against heart disease
Pantothenic acid	Aids in synthesis of cholesterol, steroids and fatty acids, crucial for intra-neuronal synthesis of acetylcholine
<b>Minerals</b>	
Calcium	Essential for building bones and teeth and maintaining bone strength, important in nerve, muscle and glandular functions
Iron	Helps in energy production, helps to carry and transfer oxygen to tissues
Magnesium	Essential for healthy nerve and muscle function and bone formation, may help prevent premenstrual syndrome (PMS)
Phosphorous	Essential for building strong bones and teeth, helps in formation of genetic material, energy production and storage
<b>Trace elements</b>	
Chromium	With insulin helps to convert carbohydrates and fats into energy
Cobalt	Essential component of vitamin B12, but ingested cobalt is metabolized <i>in vivo</i> to form the B12coenzymes
Copper	Essential for hemoglobin and collagen production, healthy functioning of the heart, energy production, absorption of iron from digestive tract
Iodine	Essential for proper functioning of the thyroid
Selenium	Antioxidant, essential for healthy functioning of the heart muscle
Zinc	Essential for cell reproduction, normal growth and development in children, wound healing, production of sperm and testosterone
<b>Vitamin like compounds</b>	
Biotin	Required for various metabolic functions
L- Carnitine	Oxidation of fatty acids, promotion of certain organic acid excretion and enhancement of the rate of oxidative phosphorylation
Choline	Lipotropic agent used to treat fatty liver and disturbed fat metabolism
Vitamin F	Involved in proper development of various membranes and synthesis of prostaglandins, leukotrienes and various hydroxyfatty acids
Inositol	Lipotropic agent necessary for amino acid transport and movement of potassium and sodium
Taurine	Aids in retinal photoreceptor activity, bile acid conjugation, white blood cell antioxidant activity, CNS neuromodulation, platelet aggregation, cardiac contractility, sperm motility, growth and insulin activity

**Table 3. Nutraceuticals and their uses**

Chemical constituents	Source	Uses
<b>Carotenoids</b>		
Lycopene	Guava, papaya, water melon, Tomatoes, pink colored grape fruit.	They reduces cholesterol levels, antioxidants, protects against cancer

$\beta$ -Carotene	Vegetables, fruits, oats, Carrots..	Antioxidants, protection of cornea against UV light
Lutein	Spinach, corn, avocado, egg yolk	Protect eyes against age related muscular degenerations, cataracts, anticancer activity(colon)
Tocotrienol	Palm oil, different grains	Improves cardio vascular health, fight against cancer (breast cancer)
Saponins	Beans like soya beans, chickpeas	Very effective against colon cancer, reduces cholesterol level
<b>Polyphenolic Compounds</b>		
Flavonones	All citrus fruits	Different types of anti-oxidant and anticancer activity
Flavones	Different types of fruits, soya beans, vegetables.	Different types of anti-oxidant and anti-cancer activity
Flavonols	Broccoli, tea, onions, fruits like apple	Antioxidant activity
Curcumin	Turmeric root	Strongly anti-inflammatory and strongly antioxidant ,effective anti-clotting agent
Glucosinolates	Cauliflower, cruciferous vegetables	Anticancer activity, protect against bladder cancer
<b>Phytoestrogens</b>		
Isoflavones	Legumes, beans like soy beans	It Lowers LDL cholesterol, antioxidants, protects against prostate, breast, bowel and other cancers
Lignans	Vegetables, rye and flaxseed	Protect against development of cancer like colon and breast cancer
<b>Dietary fibre</b>		
Soluble fibre	Beans like Legumes, cereals like oats,barley, some fibrous fruits	They help in maintenance of a healthy digestive tract & have anticancer activity
Insoluble fibre	whole grain foods wheat and cornbran, nuts	They help in maintenance of a healthy digestive tract, and have Anticancer (colon) activity.
Sulphides/Thiols	Present in Cruciferous vegetables	Help in maintenance of healthy immune function
<b>Fatty Acids</b>		
Omega 3 fatty acids	Present in salmon and flax seed	They are the Potent controllers of the inflammatory processes, help in Maintenance of brain function & Reduce cholesterol disposition.
Monosaturated fatty acids	Present in tree nuts	Reduce the risk of coronary heart disease
Prebiotics/Probiotics	Lactobacilli, bifidobacteria present in yogurt, other dairy and nondairy applications	They help to improve gastrointestinal health and systematic immunity
Minerals like zinc, calcium, selenium, copper, potassium	Food	They are the important constituents of balanced diet
Polyols sugar alcohols (xylitol, sorbitol)	Present in foods	They may reduce the risk of dental caries(cavities)

## CONCLUSION

Nutraceuticals has proven their health benefits and disease prevention capability, which should be taken according to their acceptable recommended intake. In the present scenario of self-medication nutraceuticals play major role in therapeutic development. But their success depends on maintaining on their quality, purity, safety and

efficacy.

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**CONFLICT OF INTEREST:**

The authors declare that they have no conflict of interest.



**REFERENCES**

- Anwar F, Latif S, Ashraf M and Gilani AH. Moringa oleifera: a food plant with multiple medicinal uses. *Phytother Res*, 21(1), 2007, 17-25.
- Bagchi D. Nutraceuticals and functional foods regulations in the United States and around the world. *Toxicology*, 221(1), 2006, 1-3.
- Balch SA, Mckenney CB and Auld DL. Evaluation of gamma-linolenic acid composition of evening primrose (*Oenothera*) species Native to Texas. *Hort Science*, 38, 2003, 595-598.
- Brower V. A nutraceutical a day may keep the doctor away. *EMBO reports*. 6(8), 2005, 708- 711.
- Caterson ID and Gill TP. Obesity: epidemiology and possible prevention. *Best Pract Res Clin Endocrinol Metab*, 16(4), 2002, 595-610.
- De Pascual-Teresa S, Moreno DA and García-Viguera C. Flavanols and anthocyanins in cardiovascular health: a review of current evidence. *Int J Mol Sci*, 11(4), 2010, 1679-1703.
- Fu Z and Liu D. Long-term exposure to genistein improves insulin secretory function of pancreatic beta-cells. *Eur J Pharmacol*, 616(1-3), 2009, 321–327.
- Gibson GR and Roberfroid MB. Dietary modulation of the human colonic microbiota: introducing the concept of prebiotics. *J Nutr*, 25 (6), 1991, 1401–1412.
- Jacob RA. The integrated antioxidant system. *Nutr Res*, 15(5), 1995, 755-766.
- Kalia AN. Textbook of Industrial Pharmacognosy. CBS Publisher and Distributor, New Delhi, 2005, 204–208.
- Kaliora AC, Dedoussis GV and Schmidt H. Dietary antioxidants in preventing atherogenesis. *Atherosclerosis*, 2006, 187(1), 1-17.
- Kalra EK. Nutraceutical- definition and introduction. *AAPS PharmSci*. 5(3), 2003, E25.
- Kanappan R, Gupta SC, Kim JH, Reuter S and Aggarwal BB. Neuroprotection by spice derived nutraceuticals. *Mol Neurobiol*, 44(2), 2011, 42-59.
- Le Bars PL, Keiser M and Itil KZ. A 26- week analysis of a double-blind, placebo-controlled trial of the ginkgo biloba extract EGb 761 in dementia. *Dement Geriatr Cogn Disord*, 11(4), 2000, 230-237.
- Magrona T, Heredia FP, Jirillo E, Morabito G, Marcos A and Serafini M. Functional foods and nutraceuticals as therapeutic Tools for the treatment of diet related diseases. *Can J Physiol Pharmacol*, 91(6), 2013, 387-396.
- Ndiaye M, Chataigneau T, Chataigneau M and Schini-Kerth VB. Red wine polyphenols induce EDHF-mediated relaxations in porcine coronary arteries through the redox-sensitive activation of the PI3-kinase/Akt pathway. *Br J Pharmacol*, 142(7), 2004, 1131–1136.
- Rajasekaran, A, Sivagnanam, G and Xavier R, Nutraceuticals as therapeutic agents. *A Review. Res J Pharm Sci Technol*, 1(4), 2008, 328-340.
- Rama CS, Shirode AR, Mundala AS and KadamVJ. Nutraceuticals an emerging era in the treatment and prevention of cardiovascular diseases. *Curr Pharm Biotechnol*, 7(1), 2006, 15-23.
- Rice-Evans C. Flavonoid antioxidants. *Curr Med Chem*, 2(8), 2001, 797-807.
- Rissanen TH, Voutilainen S, Virtanen JK, Venho B, Vanharanta M, Mursu J and Salonen JT. Low intake of fruits, berries and vegetables is associated with excess mortality in men: The kuopio ischaemic heart disease risk factor (KIHD) study. *J Nutr*, 133(1), 2003, 199-204.
- Schloss PD. Microbiology. An integrated view of the skin microbiome. *Nature*, 514 (7520), 2014, 44-45.
- Sembulingam K, Sembulingam P and Nanasivayam A. Effect of *Ocimum sanctum* Linn on noise induced changes in plasma corticosterone level. *Indian J Physiol Pharmacol*. 41(2), 1997, 139-143.
- Shweta KG, Rajan BM, Urvashi KP, Blessy M and Hitesh NJ. Herbal plants: used as cosmetic. *J Nat Prod Plant Resour*, 2011, 1(1) 24-32.
- Temple WJ and Gladwin KK. Fruits, vegetables and the prevention of cancer: research challenges. *Nutrition*, 19(5), 2003, 467-470.
- Vyas LK, Tapar KK and Nema RK. Study of *Crocus sativus* as complexation promoter in skin care. *Int J Pharm Clinl Res*, 2010, 2(2), 76-79.
- Wang L, Zhu LH, Jiang H, Tang QZ, Yan L, Wang D, Liu C, Bian ZY, Li H. Grape seed proanthocyanidins attenuate vascular smooth muscle cell proliferation via blocking phosphatidylinositol 3-kinase-dependent signaling pathways. *J Cell Physiol*, 223(3), 2010, 713–726.