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## **Full Length Research Article**

### **PLEIOTROPIC EFFECTS OF NUTRACEUTICALS**

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#### **ABSTRACT**

In the recent years there is growing interest in nutraceuticals. These are natural products and provide alternative to medicines. Risk of toxicity or adverse effect of allopathic and ayurvedic drugs has shift more emphasis on the safe use of nutraceuticals. Nutraceuticals provide health benefits and helps in the prevention or treatment of various diseases. These fall under various categories such as Dietary fiber, Probiotics, Prebiotics, Polyunsaturated fatty acids, Antioxidants. It has been noted that people consuming healthy diet can lower the risk of various diseases such as cardiovascular diseases, diabetes, obesity, cancer, allergy and alzheimer's disease. The present study focused on the multiple health benefits of nutraceuticals.

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#### **INTRODUCTION**

Nutraceutical, a portmanteau of the words "nutrition" and "pharmaceutical", is a food or food product that reportedly provides health and medical benefits, including the prevention and treatment of disease. It may also be defined as a non-drug substance which is produced in a unified or extracted form and administered orally to a patient to provide agents required for normal body structure and function and administered with the intent of improving the health and well being of humans. Such products may range from isolated nutrients, dietary supplements, and diets to genetically engineered foods, herbal products and processed foods such as cereals, soups and beverages (Kalra, 2003). Nutraceuticals sometimes referred as "functional foods" which means when food is being cooked or prepared using "scientific intelligence" with or without the knowledge of how or why it is being used. Thus functional food provides the body with the required amount of vitamins, fats, proteins, carbohydrates necessary for health survival (Wildman, 2001 and Myeong *et al.*, 2010). When functional food aids in the prevention and/or treatment

of diseases/disorders other than deficiency conditions it is called a "nutraceutical" (Zeisel, 1999). Thus a functional food for one consumer can act as a nutraceutical for another, example in fortified milk products milk as such is a nutrient and its product casein is pharmaceutical, citrus fruit/orange juice is nutrient and its constituent ascorbic acid is pharmaceutical. Functional foods must not be confused with "medical foods". Medical foods aren't available as an OTC product to consumers. FDA considers medical foods which are formulated to be consumed or administered internally under the supervision of a physician. They are intended for the specific dietary management of a disease or condition for which distinctive nutritional requirements, on the basis of recognized scientific principles which are established by medical evaluations (FDA, 1999). Nutraceuticals and supplements do not meet these requirements and are not classified as medical foods. Medical foods are regulated by the FDA and will be prescribed or monitored by medical supervision.

#### **Classification**

On the basis of natural source, it can be classified as products obtained from plants, animals, minerals or microbial sources. It is noted that substances with established nutritional functions such as vitamins, minerals, amino acids, fatty acids

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known as nutrients moreover herbs or botanical products or concentrates or extracts known as herbals. Regents derived from other sources example pyruvate, steroid hormone precursors serving specific functions such as weight loss supplements, fortified conventional foods and meal replacements known as dietary supplements. 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) Antioxidants 6) phytochemicals. Dietary fibers can be defined as those parts of plants, seeds, leaves which our bodies cannot digest and absorb (Fujita, 2000). They are categorized as water soluble fibers and water insoluble fibers. Water soluble fibers dissolve in water and form a gel that binds the stool and inhibit the non-propulsive colon contractions, helps in bulking of stool and their quick passage through digestive tract (Fuja, 2010). They also have the function of slowing down the absorption of glucose and reducing blood cholesterol level such as oats, dried beans, legumes and chicory. Water insoluble fibers absorbs water to a certain extent but mainly contribute to bulking of stool and allows quick passage of wastes such as brown rice, banana, vegetables and whole grains (Zeisel, 1999).

Dietary fibers are used in health food products for normalization of intestinal transit time (Kligler, 2007). They have dual effect on intestinal transit; first effect is on bulk faeces which are often increased. This action is concerned with insoluble fibers. Second effect is on duration of transit which gets normalized in 48 hours. Long transit time gets shorter and short transit time gets longer.

**Probiotics-** It is a Greek word which means “for life”. It refers to microorganism supplements intended to improve health or treat a specific disease (Lara, 2007). Approximately 95% of all bacteria found in human body are located in colon, some harmful and other desirable. The natural balance between these two groups of microbes plays an important role in health and functioning of large intestine (Eamonn, 2010). This balance changes with diet, antibiotic treatment and age which contribute to constipation, liver damage, and colon cancer (Collins and Gibson, 1999). Normal balance can be restored through oral introduction of live helpful bacteria- a basis for the concept of probiotics. Probiotics protect the intestinal mucosa by competing with pathogens for attachment sites. Various probiotic bacterial species include Lactobacilli, Lactobacillus Rhamnosus, Lactobacillus Reuteri, Lactobacillus Case, Bifidobacterium, Bifidobacterium Lactis, Bifidobacterium Longum, Bifidobacterium Infantis, Streptococcus, Lactococcus, Lactococcus Reuteri, Enterococcus.

Characteristics of Probiotic bacteria are:

- 1) Generally recognized as safe
- 2) Invitro resistant to HCl and pancreatic juice.
- 3) Compete with bad bacteria to adhere to gut wall.
- 4) Alter intestinal micro flora balance.
- 5) Inhibit growth of harmful bacteria.
- 6) Promote good digestion.
- 7) Increase resistance to infection.

**Prebiotics-** These are the substances which reach the colon in intact form that is without getting depleted by gastric pH and digestive acids (Wang *et al.*, 2012). These prebiotics also selectively promote the growth of colonic probiotic bacteria; hence they act as fertilizers for these bacteria such as bifidobacteria, lactobacilli. It is important to note that live probiotic bacteria will have to survive the rigours of digestive enzymes and acid in upper gut before reaching the colon, where they have to compete for attachment sites with established microflora. Such difficulties have shifted emphasis into alternative ways of achieving same aim. This resulted in a new concept known as prebiotics (DeDeckere, 1999).

**Polyunsaturated fatty acids (PUFA) -** Our body is capable of synthesizing essential fatty acids which are needed for normal growth and development. But there are two main types of PUFA that our bodies cannot synthesize Omega-3 Fatty acids and Omega-6 Fatty acids. These fatty acids are precursors for arachidonic acid (AA), eicosapentaic acid and docosahexanoic acid (DHA), which possess distinct physiological properties required by the body (Mickleborough, 2012). These fatty acids have been found to regulate BP, heart rate, blood clotting and immune response (Gibson and Makrides, 2000). Omega-3 fatty acid has important function in prevention of heart disease and treatment of arthritis (Dixon, 1999). Both AA and DHA are essential for development of foetus and development after 6 months of birth, deficiency may result in poor development and can cause a variety of problems ranging from premature birth to under weight babies. Breast milk is an extremely rich source of DHA (Adom and Liu, 2002). It is recommended by WHO that all breast milk substitutes be supplemented with DHA. The natural vegetable oils and marine animal oils contains PUFA which helps to reduce cholesterol formation/deposition and prevent thromboxane formation, such as safflower oil, corn oil, soybean oil, mustard oil, evening primrose oil, flax oil, hemp seed, borage seed. Following are the diseases for which PUFA are preferred- heart disease, stroke, rheumatoid arthritis, inflammatory arthritis, inflammatory bowel disease, asthma, cancer, chronic lung failure, kidney transplant.

**Antioxidants-** Antioxidants are substances, which retard or prevent deterioration, damage or destruction caused by oxidation (Baublis *et al.*, 2000). During oxidation free radicals are generated, these free radicals are reactive molecules used by immune system to fight off invading bacteria and viruses. When produced in excess they start damaging human cells and tissues. Free radicals are capable of reacting with our genes, altering the genetic codes and thus leading to mutations (Chiang *et al.*, 2006). Free radicals have also been implicated in the aetiology of many other diseases including heart diseases, atherosclerosis, arthritis, and age related disorders. Antioxidants oppose the process of oxidation largely by neutralizing free radicals at relatively small concentration and rendering them inactive and have the potential to inhibit the oxidants chain reactions and ultimately reconstitute the damaged membranes (Naik, 2003). Commonly known antioxidants are vitamin A, E, C, beta carotene. Antioxidants are found in soybean oil, canola oil, corn oil, oat oil, wheat germ oil, palm oil, tea, wine, dark chocolate foods.

**It is well known that elevated levels of LDL- Cholesterol** are a risk factor for heart diseases (Shahidi, 2000). Furthermore evidence suggests that oxidation of LDL-Cholesterol markedly increase atherosclerosis and are major cause of heart diseases (Devasagayam *et al.*, 2004). Studies have shown that antioxidants particularly vitamin E may reduce the ability of platelets to adhere to surfaces and so prevent participation in thrombus formation. Vitamin C and vitamin E may also play protective role in cancer prevention (Dillard and German, 2000). Following are some examples of antioxidants apigenin, apigenin-7-glucoside, artichoke extract, bearberry extract, blueberry leaf extract, bitter citrus extract, grape skin extract, green tea extract, green olive leaf extract, olive leaf extract, oreganum extract, rosemary extract, citroflavin, garlic extract, grape fruit extract.

**Phytochemicals-** Some of the important phytochemicals are flavonoids, isoflavonoids, biflavonoids which has potential benefits in breast, uterus and prostate cancer (Hertog *et al.*, 1993). Carotenoids have important use in eye diseases. Fish oils, berseem, maize fodder, mustard linseed helps to reduce cardiovascular diseases and improve mental and visual function (Hertog *et al.*, 1993). Tea, babul pods, mustard cake, salseed neutralizes free radicals and also reduces the risk of cancer. Proanthocyanidine in cocoa, chocolate, tea helps to reduce various cardiovascular diseases. Saponins in soyabeans, chick pea lowers cholesterol. Diadzein and zenistein found in soyabean, flax, maize and berseem has useful benefits in reducing menopause symptoms and increase bone health. Zeoxanthine found in eggs, citrus fruits, corn helps to improve the vision. Lycopene in tomatoes helps to reduce prostate cancer (Alexander *et al.*, 2004).

#### **Role of nutraceutical in various disease conditions**

**Cancer-** Foods rich in lutein such as chicken eggs, spinach, tomatoes, oranges and leafy greens reduces the incidence of colon cancer (Bickford *et al.*, 2006). Flavonoids which act as antioxidant and are found in citrus fruit protect against cancer. Curcumin from curry has cancer chemopreventive properties (Suzuki *et al.*, 2008). Saponins are phytochemicals which can be found in peas, soybeans, spinach, tomatoes, potatoes are reported to possess antitumour and anti mutagenic activities and can lower the risk of human cancers, by preventing cancer cells from growing. Ellagic acid is a proven anti-carcinogen (Klatte *et al.*, 2003) is used in alternative medicine and to prevent cancer and it is present in strawberries, cranberries, walnuts, pecans, pomegranates and the best source, red raspberry seeds. Alzheimer's disease- Oxidative stress play chief role in neurodegenerative diseases (Wettstein, 2000). Oxidative stress is accelerated by ageing process along with lack of dietary antioxidants. Alpha lipoic acid is a potent antioxidant used for Alzheimer disease (Mukherjee *et al.*, 2006). Gingko biloba is most studied herb with reference to memory, overall brain performance and certainly Alzheimer disease.

**Type 2 diabetes-** Nutraceutical containing chlorogenic acid and caffeic acid such as coffee berry reduces the gene expression of key enzymes involved in glucose production from glycogen stored in liver. Methyl hydroxy chalcone polymer from cinnamon up regulates the expression of genes

involved in activating cell membranes insulin receptors thus increasing glucose uptake and lower blood glucose level. Ethyl esters of n-3 fatty acids have potential benefits in diabetic patients (Rama *et al.*, 2006).

**Cardiovascular diseases (CVD) -** Nutraceuticals in the form of antioxidants, dietary fibers, PUFA's, vitamins and minerals are recommended together with physical exercise for prevention and treatment of CVD. Flavonoids in onion, black grapes, red wine, apples, cherries, berries play major role in prevention of CVD (Biesalski, 2001). Milk and eggs are important sources of nutraceuticals like proteins, essential fatty acids which are required for production and rebuilding of cells, reduce BP, lower cholesterol and triglycerides, help prevent arrhythmias and other CVD. Obesity- A tolerable and effective nutraceutical that increase energy expenditure and decrease calorie intake is desirable for body weight reduction (Whitman, 2001). Herbal stimulants such as ephedrine, caffeine, chitosan and green tea have proved effective in facilitating weight loss. 5-hydroxytryptophan and green tea extract may promote weight loss, while the former decreases appetite, the later increases the energy expenditure.

**Immune Boosters-** Various nutrients in the diet play a crucial role in maintaining an optimal immune response on the organism immune status and susceptibility to a variety of disease conditions. Allergy- Quercetin (QR) belongs to a group of polyphenolic substances known as flavonoids. QR is a member of the class of flavonoids called flavonols (DeFelice, 1992). Especially rich sources of QR include onions, red wine and green tea. QR is a natural antihistamine and opposes the actions of the histamine in the body (Lee *et al.*, 1993). Histamines are responsible for allergic and inflammatory reactions (William, 2003). It can help reduce the inflammation that results from hay fever, bursitis, gout, arthritis, and asthma.

#### **Conclusion**

The importance of nutraceuticals in today's world is that they provide with all the essential substances that should be present in a healthy diet. In this modern world with modern lifestyle all leads to unhealthy way of life. Nutraceuticals provides better quality of life, healthy life. Toxicity and side effects can be reduced with nutraceuticals. Thus, in the era there is a need of nutraceutical to treat various diseased conditions such as CVD, diabetes, obesity, cancer, allergy, alzheimer's disease. The present is concluded that the use of nutraceuticals, is an attempt to accomplish desirable therapeutic outcomes with less side effects, as compared with other therapeutic agents. This review summarized the beneficial effects and strategy of the world towards nutraceuticals should be in future for living life healthy and improve quality of life.

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