



RESEARCH ARTICLE

NUTRACEUTICALS AND FUNCTIONAL FOODS: AN APPROACH TO IMPROVE THE HUMAN HEALTH

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ABSTRACT

Functional foods and nutraceuticals provide an opportunity to improve the human health, reduce health care costs and support economic development in rural communities. The tenet "Let food be thy medicine and medicine be thy food," espoused by Hippocrates nearly 2,500 years ago, is receiving renewed interest. Within the last decade, however, the term functional as it applies to food has adopted a different connotation—that of providing an additional physiological benefit beyond that of meeting basic nutritional needs. In particular, there has been an explosion of consumer interest in the health enhancing role of specific foods or physiologically- active food components, so-called functional foods (Hasler, 1998). While nutraceuticals, sometimes referred to as natural health products, are often used in medicinal forms as tablets, capsules or liquid. Among diseases of concern, cancer and coronary heart disease (CHD) are high on the list. In this respect, phenolics of plant origin, as an example, have been found to act as free radical scavengers, inhibitors of cholesterol oxidation and DNA breakage, among others, thus serving as potential cancer preventing agents. On the other hand, marine foods have often been considered as "heart food" because of the role of their omega-3 fatty acid constituents in lowering of triacylglycerol and cholesterol levels and hence the incidence of CHD. This review article focused on some examples of the functional foods and nutraceuticals and their health benefits, like probiotics and prebiotics, proteins and peptides, oils and fatty acids, carbohydrates and fibers, catchine and lycopene.

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INTRODUCTION

The principle, "Let food be thy medicine, and medicine be thy food", advocated by Hippocrates (460–377 BC), the well recognized father of modern medicine, emphasize the association between nutrition and human health, and conceptualized the relationship between the use of appropriate foods for health and their therapeutic benefits. 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, health care providers, regulators, food producers, processors and distributors. Thus, the concept of 'adequate nutrition' is beginning to be replaced by 'optimal nutrition' with consumer belief increasing at an unprecedented pace. Scientists and food manufacturers have coined several terms to describe these physiologically active components and health benefits of these foods. None have clear and generally accepted definitions. Epidemiological evidence has pointed to the benefits of

increased consumption of fruits and vegetables as well as marine foods in human health promotion and disease prevention (Block *et al.*, 1992; Shahidi and Ho, 2000). While plant foods contain a variety of bioactives that exert their health benefits through synergistic action of the many classes of compounds involved, marine lipids are known to influence health through their omega-3 fatty acid constituents. While initial research had concentrated on examining the benefits of plant-based foods through research into their vitamin C, vitamin E and carotenoid components, more recent work has confirmed that correlations of benefits with individual compounds, such as β -carotene, may contradict their perceived effects if used in the pure form. Hence β -carotene, when used as such, was found to increase the incidence of cancer in smokers (Omenn *et al.*, 1996). Thus, the effects are found to be related to the co-operative and synergistic action of the cocktail or soup of bioactives presents in source materials. These findings have created the foundation for exploration and development of *functional foods* and *nutraceuticals*.

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In particular, there has been an explosion of consumer interest in the health enhancing role of specific foods or

physiologically- active food components, so-called functional foods (Hasler, 1998). Clearly, all foods are functional, as they provide taste, aroma, or nutritive value. Within the last decade, however, the term functional as it applies to food has adopted a different connotation—that of providing an *additional* physiological benefit beyond that of meeting basic nutritional needs. This Scientific Status Summary reviews the literature for the primary plant and animal foods that have been linked with physiological benefits. In the past few years, many bioactive constituents of food have been commercialized in the form of pharmaceutical products (pills, capsules, solutions, gels, liquors, powders, granulates, etc.) that incorporate food extracts or phytochemical-enriched extracts to which a beneficial physiological function has been directly or indirectly attributed. This range of products cannot be truly classified as “food” or “pharmaceutical”, and a new hybrid term between nutrients and pharmaceuticals, ‘nutraceuticals’, has been coined to designate them. No official definition exists for the term “nutraceutical”, though it is often used to describe a broad list of products sold under the premise of food components with an expressed intent of treatment or prevention of disease and for enhancing the health and wellbeing of an individual. The modern nutraceuticals and functional foods market have begun to develop in Japan during the 1980. In contrast to the natural herbs and spices used as folk medicine for centuries throughout Asia, the nutraceuticals and functional foods industry has grown alongside the expansion and exploration of modern technology, new research conducted among food scientists has shown that, there is more to Food Science than what was understood just a couple decades ago. Until just recently, analysis of food was limited to the flavor of food (sensory taste and texture) and its nutritional value (composition of carbohydrates, fats, proteins, waters vitamins and minerals). However, there is growing evidence that other components of food may play an integral role in the link between food and health. Consumers are increasingly interested in the health benefits of foods and have begun to look beyond the basic nutritional benefits of food to the disease prevention and health enhancing compounds contained in many foods. This combined with a more widespread understanding of how diet affects disease, health-care costs and aging populations have created a market for functional foods and natural health products. Functional foods and nutraceuticals provide an opportunity to improve the health, reduce health care costs and support economic development in rural communities. They also offer a way for some producers to diversify their agriculture and marine-based crops. According to market statistics, the global functional foods and nutraceuticals market is growing at a rate that is outpacing the traditional processed food market.

MATERIALS AND METHODS

Objective of the study

The overarching objective of this study is to identify concepts that should be included in a broadly accepted nutraceutical and functional food definition and their health benefits.

The key objectives of this study are

1. To identify key concepts found in the various definitions of nutraceutical and functional food

2. To identify the basic difference between nutraceutical and functional food
3. To know about the challenges and opportunities of nutraceutical and functional food
4. To analyze the benefits of pre-determined nutraceutical and functional food on human health

To attain these objectives, the following methodological steps are taken

1. Refer to the relevant literature in order to identify various key components of nutraceuticals and functional food.
2. Analyze relevant literature to identify and develop principles that would contribute to illustrate the health benefits of nutraceuticals.

Search criteria

The objective was to collect information on nutraceutical and functional food cited in the literature from various sources.

1. Websites of regulatory agencies and government departments responsible for regulating standards of food and related products like nutraceuticals (www.fssai.gov.in, www.fda.gov, www.hc-sc.gc.ca, www.efsa.europa.eu, www.fao.org, www.emea.europa.eu, and www.foodstandards.gov.au);
2. Digital archives and databases of biomedical and life sciences journal literature (PubMed (www.ncbi.nlm.nih.gov/pubmed), (<http://direct.bl.uk/bld>), Google Scholar (<http://scholar.google.com>) and Scirus (www.scirus.com).
3. Academic journals;
4. Legal texts and literature (e.g. Lexis-Nexis (www.lexisnexis.com) and Global Legal Information Network (www.glin.gov));
5. Internet search (www.google.com, www.altavista.com, and www.bing.com).

The search terms used were: “Nutraceutical and functional food”, “Nutraceuticals”, “Nutraceutical Definition” “Definition of Nutraceutical and functional food”, “Nutraceutical and functional food benefits”, and “Nutraceutical Claims”.

Differences in the Definition Between Functional Foods and Nutraceuticals

Today the exploration and exploitation of the disease fighting properties of a multitude of phytochemicals found in both food and nonfood plants have created a renaissance in human health and nutrition research. At the same time, many opportunities for the development of novel dietary products have been created. With all new fields of study come new terms. “*Nutraceuticals*” and “*functional foods*” are two new terms used to describe health-promoting foods or their extracted components. Although debate continues regarding the exact meaning of these terms, it is convenient to consider *nutraceuticals* as healthful products that are formulated and taken in dosage form (capsules, tinctures, or tablets). *Functional foods*, on the other hand, are products that are

consumed as foods and not in dosage form. The term "nutraceutical" was coined from "nutrition" and "pharmaceutical" in 1989 by Stephen DeFelice, MD, founder and chairman of the Foundation for Innovation in Medicine (FIM), Cranford, NJ. According to DeFelice, nutraceutical can be defined as, "a food (or part of a food) that provides medical or health benefits, including the prevention and/or treatment of a disease." However, the term *nutraceutical* as commonly used in marketing has no regulatory definition and Kalra redefined *functional foods and nutraceuticals*. When food is being cooked or prepared using "scientific intelligence" with or without knowledge of how or why it is being used, the food is called "functional food". Thus, *functional food* provides the body with the required amount of vitamins, fats, proteins, carbohydrates, etc, needed for its healthy survival. When functional food aids in the prevention and/or treatment of disease(s) and/or disorder(s) other than anemia, it is called a nutraceuticals. (Since most of the functional foods act in some way or the other as anti-anemic, the exception to anemia is considered so as to have a clear distinction between the two terms, *functional food and nutraceuticals*). Thus, a functional food for one consumer can act as a nutraceuticals for another consumer. Examples of nutraceuticals include fortified dairy products (milk) and citrus fruits (orange juice). A *functional food* is similar in appearances to or may be conventional food that consumed as a part of unusual diet and is demonstrated to have physiological benefit and/or reduce the risk of chronic diseases beyond basic nutritional function. In another definition, a nutraceuticals is a product isolated or purified from foods that is generally sold in medicinal forms not usually associated with foods. When a nutraceuticals is demonstrated to have a physiological benefit or provide protection against chronic disease, the functional foods are defined broadly as foods that provide more than simple nutrition; they supply additional physiological benefit to the consumer.

Benefits

From the consumers' point of view, functional foods and nutraceuticals may offer many benefits:

- May increase the health value of our diet.
- May help us live longer.
- May help us to avoid particular medical conditions.
- May have a psychological benefit from doing something for oneself.
- May be perceived to be more "natural" than traditional medicine and less likely to produce unpleasant side-effects.
- May present food for populations with special needs (e.g. nutrient-dense foods for the elderly).

Bridging the gap between food and medicine

Nutraceuticals are foods or food ingredients that provide medical or health benefits. This emerging class of products blurs the line between food and drugs. They do not easily fall into the legal categories of food or drug and often inhabit a grey area between the two. Within European Union (EU) law the legal categorization of a nutraceutical is, in general, made

on the basis of its accepted effects on the body. Thus, if the substance contributes only to the maintenance of healthy tissues and organs it may be considered to be a food ingredient. If, however, it can be shown to have a modifying effect on one or more of the body's physiological processes, it is likely to be considered to be a medicinal substance. Within European Medicines law a nutraceutical can be defined as a medicine for two reasons:

- 1) It can be used for the prevention, treatment or cure of a condition or disease or
- 2) It can be administered with a view to restoring, correcting or modifying physiological functions in human beings.



Classification of nutraceuticals

Regarding the promise of nutraceuticals, they should be considered in two ways:

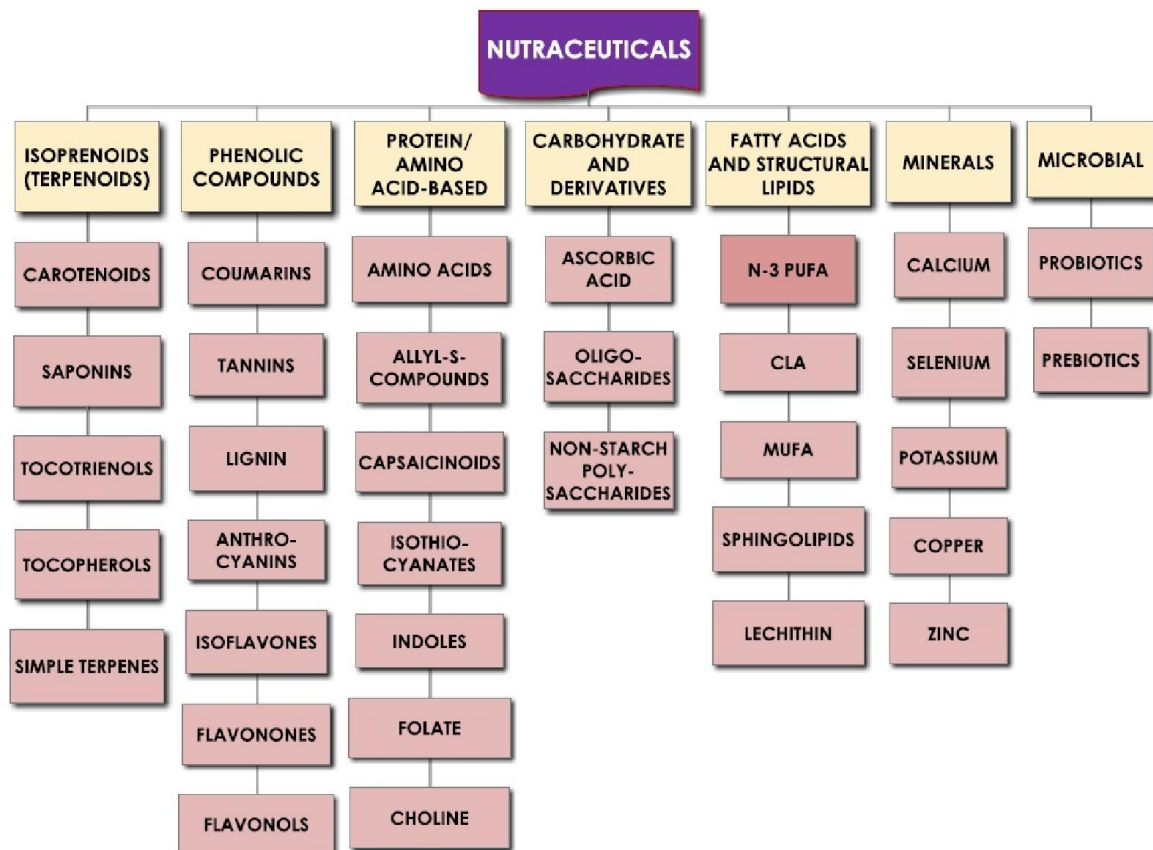
- Potential nutraceuticals
- Established nutraceuticals

A potential nutraceutical is one that holds a promise of a particular health or medical benefit; such a potential nutraceutical only becomes an established one after there are sufficient clinical data to demonstrate such a benefit. It is disappointing to note that the overwhelming majority of nutraceutical products are in the 'potential' category, waiting to become established. The food products used as nutraceutical are categorized as:

- Prebiotic and Probiotic
- Proteins and Peptides
- Carbohydrates and Fibres
- Lipids and Fatty acids
- Lycopenes
- Catechins
- Vitamins

Prebiotic and Probiotic

We have bacteria living in our gut. Some of them could make me sick; however there are also bacteria that are actually beneficial. These "friendly" bacteria help keep bad bacteria and yeast from growing in the intestinal tract. Bacteria also help make vitamin K and keep immune system functioning properly.



Normally we have an abundance of friendly bacteria, however antibiotic therapy, stress and poor dietary choices may all cause intestinal dysbiosis, which is a bacterial imbalance that results in overgrowth of bad bacteria and yeast. A common cause of dysbiosis is antibiotic therapy. The antibiotics that we take for killing an infection will also kill the healthy bacteria in the digestive tract. Prebiotics and probiotics can restore the balance of bacteria in our digestive tract. Probiotics are beneficial bacteria that can be found in various foods. When we eat probiotics, we will add these healthy bacteria to our intestinal tract. Common strains include *Lactobacillus* and *Bifidobacterium* families of bacteria. Probiotics bacteria like *lactobacilli* are naturally found in fermented foods like sauerkraut and yogurt. Some foods will have added probiotics as healthy nutritional ingredients, which will be evident on the label. Prebiotics are non-digestible foods that make their way through our digestive system and help good bacteria grow and flourish. Prebiotics keep beneficial bacteria healthy. Prebiotics that feed the beneficial bacteria in the gut mostly come from carbohydrate fibers called oligosaccharides. Sources of oligosaccharides include fruits, legumes and whole grains. Fructo -oligosaccharides may be taken as a supplement or added to foods. Many studies have demonstrated the potentially extensive impact of prebiotics on the composition of the gut micro biota, stimulating directly or indirectly putative beneficial gut commensal other than lactic acid bacteria. Consequently, these findings open other exciting areas of research for the discovery of new probiotic strains and symbiotic combinations. Well-designed clinical studies in humans are still needed to further investigate the optimal dose, duration and specific effects of each probiotic strain and/or

prebiotic when embedded in food matrices, for different populations such as infants and elderly that have a different gut microbial composition and immune status. By elucidating the mechanisms of probiosis and prebiosis, scientists can design enhanced functional foods tailored to improve host health.

Proteins and Peptides

Proteins are long-chain polymers of amino acids while peptides represent the shorter forms. Proteins in our foods can act as health promoters in 2 ways, firstly, by acting as indigestible substances in our digestive tract, they trap and expel (through feces) toxins and bile, thereby reducing the re-absorption of cholesterol from the large intestine. Buckwheat and soybean proteins are known to contain substantial amounts of indigestible proteins and their increased consumption is beneficial to maintaining a clean and healthy gut. Secondly, proteins can be converted into peptides during digestion and are then absorbed into the blood circulatory system. Some of these bioactive peptides, especially from soybean proteins, have been shown to be capable of preventing the production of cholesterol by liver cells, which can lead to lower levels of cholesterol in the blood. Most food derived bioactive peptides thus far have been isolated from milk-based products. A wide range of activities has been described for bioactive peptides including antimicrobial and antifungal properties, blood pressure-lowering effects, cholesterol-lowering ability, antithrombotic effects and enhancement of mineral absorption, immunomodulatory effects and localized effects on the gut. Although there is still considerable research to be performed in the area of food-derived bioactive peptides, it is clear that the

generation of bioactive peptides from dietary proteins during the normal digestive process is of importance. Therefore, it will become necessary when determining dietary protein quality to consider the potential effects of latent bioactive peptides that are released during digestion of the protein. Peptides can also be made by custom-designed enzyme digestion of proteins in a reaction vessel. Ingestion of such peptides either as part of a food or drink or in pill forms has been shown to reduce blood pressure in hypertensive patients. A sour milk drink product that contains bioactive peptides is widely sold in Japan and some European countries.

Carbohydrates and Fibres

Carbohydrates take the form of sugars, oligosaccharides, starches and fibers and are one of the three major macronutrients which supply the body with energy (fat and protein being the others). There is now good evidence that at least 55% of our daily calories should come from carbohydrates. Whereas it is important to maintain an appropriate balance between calorie intake and expenditure, scientific studies has suggested that a diet containing an optimum level of carbohydrates may help to prevent body fat accumulation; starch and sugars provide readily accessible fuel for physical performance; dietary fibers, which is a carbohydrate, helps keep the bowel functioning correctly. Apart from the direct benefits of carbohydrates for the body, they are found in a wide range of foods which themselves bring a variety of other important nutrients to the diet. For this reason it is recommended that carbohydrates be supplied from diverse food sources to ensure that the overall diet contains adequate nutrients. Fructose oligosaccharide and galactose oligosaccharide fortified infant formulas are currently on the market; these are intended to support the developing immune systems of neonates. Fructans are an important ingredient in functional foods because evidence suggests that they promote a healthy colon (as a prebiotics agent) and help reduce the incidence of colon cancer. Carbohydrates in all shapes and forms are good for our health. They can help to control body weight, especially when combined with exercise, are vital for proper gut function and are an important fuel for the brain and active muscles. The most important messages for the public recommended by the recent report from the World Health Organization and the Food and Agriculture Organization of the United Nations on carbohydrates in human are: An optimum diet contains at least 55% of energy from carbohydrates and 20-35 g dietary fiber/day for all those over two years of age, a wide range of carbohydrate-containing foods should be consumed so that the diet is sufficient in essential nutrients and dietary fiber. Dietary fiber is found in plant foods (fruit, vegetables and whole grains) and is essential for maintaining a healthy digestive system. Fiber cannot be fully digested and is often called bulk or roughage. The two types of fiber found in food are soluble and insoluble. Soluble fiber, which can dissolve in water, is found in beans, fruits and oat products and can help to lower blood fats and maintain blood sugar. Insoluble fiber cannot dissolve in water, so passes directly through the digestive system. It's found in whole grain products and vegetables and it increases the rate at which food passes through the gut. High-fiber foods take longer to digest, so keep you feeling fuller for longer. The slow and steady

digestion of food through the gut helps control blood sugar and assists with weight maintenance. Fiber helps in the digestive process and can help lower blood cholesterol. Fiber promotes bowel regularity and keeping the gastrointestinal tract clean to help reduce the risk of developing diverticular disease and constipation. A high-fiber diet may reduce the risk of developing diabetes and colorectal cancer. Dietary intake of plant fibers is important for maintaining a healthy gut and reducing glucose absorption, which can be beneficial to diabetic patients. Consumption of insoluble fibers such as cellulose and hemicelluloses, as found in bran, leafy vegetables or fruit skins (e.g. apples and pears), serve as roughage and help to reduce the caloric value of diets, which is important in obese and diabetic conditions. Soluble fiber (also called gums and pectin) is abundant in whole grain barley and oats, as well as in fruits such as ripe strawberries and bananas; this type of fiber forms a viscous indigestible mass in the gut and helps trap digestive enzymes, cholesterol, starch, glucose and toxins that are then expelled through the feces. In this way, soluble fiber can help obese people reduce the amount of calories they absorb from their food and help diabetics by reducing the rate of starch digestion and glucose absorption. Fibers and phytochemicals have long been recognized as the active nutrients responsible for the health benefits of fruits and vegetables to humans. Interest in incorporating bioactive ingredients such as dietary fiber and phenolic antioxidants into popular foods like bread has grown rapidly, due to the increased consumer health awareness. The added bioactive ingredients may or may not promote the development of bread dough. They have different functional properties that may affect perceived taste or use in different food applications. Spreadbury reported that, a diet of grain-free whole foods with carbohydrate from cellular tubers, leaves and fruits may produce a gastrointestinal microbiota consistent with our evolutionary condition, potentially explaining the exceptional macronutrient-independent metabolic health of non-Westernized populations and the apparent efficacy of the modern "Paleolithic" diet on satiety and metabolism. Galacto-oligosaccharides (GOS) as functional food constituents play a special role as prebiotics in gastrointestinal tract. Zoetendal *et al.* suggested that rapid uptake and fermentation of available carbohydrates contribute to maintaining the micro biota in the human small intestine.

Lipids and Fatty acids

Fish oil has long been recognized as a functional food because of its ability to reduce blood pressure and lower the risk for other cardiovascular disorders such as abnormal heart beat and blockage of blood vessels by cholesterol. The health-promoting effect of fish oil is now known to be due to the omega-fatty acids, especially omega-3 and omega-6. The main omega-3 fatty acids in fish oil are docosahexaenoic (DHA) and eicosapentaenoic acids (EPA). DHA in particular has been shown to be an important structural component of the brain and contributes to improved memory functions. Recently, increased incorporation of DHA into margarines and baby foods has been promoted to enhance brain memory development; a role in reducing the severity of Alzheimer's disease has been suggested for DHA. Other omega-fatty acids such as linoleic and linolenic acids also provide increased

cardiovascular benefits; they are abundant in fish oil, vegetable oils (canola, soybean and sunflower) and nuts such as peanuts and almonds. Consumption of nuts is highly recommended since they are also packed with high levels of antioxidants that help maintain integrity of organs, blood vessels and genes. Apart from the omega fatty acids, conjugated linoleic acid (CLA) is another important lipid that has been shown to positively impact human health. CLA is found mostly in dairy products or meat products derived from ruminant animals (cow, goats and sheep). Several studies reported possible anti-cancer effects of *n-3* fatty acids (particularly breast, colon and prostate cancer). Omega-3 fatty acids reduce prostate tumor growth slowing histopathological progression and increased survival. Among *n-3* fatty acids [omega-3], neither long-chain nor short-chain forms were consistently associated with breast cancer risk. Lands and William suggested that, the in-vitro anti-inflammatory activity of *n-3* acids translates into clinical benefits. Cohorts of neck pain patients and rheumatoid arthritis sufferers have demonstrated benefits comparable to those receiving standard non-steroidal anti-inflammatory drugs (NSAIDs). Those who follow a Mediterranean-style diet tend to have less heart disease; higher HDL ("good") cholesterol levels and higher proportions of *n-3* in tissue highly unsaturated fatty acids. Overall, omega-3 PUFA supplementation was not associated with a lower risk of all-cause mortality, cardiac death, sudden death, myocardial infarction, or stroke based on relative and absolute measures of association. Also, Mickleborough reported that, Omega-3 polyunsaturated fatty acids (PUFAs) have been shown to decrease the production of inflammatory eicosanoids, cytokines and reactive oxygen species, possess immunomodulatory effects and attenuate inflammatory diseases. Avocado oil carefully prepared and stored, contains components which can bring many health benefits, while also providing the sensory and culinary benefits expected of food oil. The oil because of its nutritional benefits is an excellent contributor to a healthy and balanced diet and is of particular benefit in diets which help to prevent coronary heart disease, diabetes and possibly prostate problems. The greatest exponent of monounsaturated fat is olive oil and it is a prime component of the Mediterranean Diet. People who consumed 25 milliliters (ml)-about 2 tablespoons-of virgin olive oil daily for 1 week showed less oxidation of LDL cholesterol and higher levels of antioxidant compounds, particularly phenols, in the blood.

Catechins (Proanthocyanides)

Catechin is a very abundant component in green tea, although black tea also contains sufficient quantities. For tea drinkers to reap maximum benefits, it is important that the tea is boiled for several minutes to extract high quantities of catechins into the liquid beverage. Catechins are strong antioxidants that inhibit damage to DNA and blood vessels, thereby reducing the risks of cancer development and cardiovascular diseases, respectively. Cranberry juice contains high levels of epicatechin polymers that prevent adhesion of viruses and bacteria to the urinary tract; regular consumption of cranberry juice or cranberry concentrate tablets has been shown to reduce antibiotic requirements in women experiencing urinary tract infection. Murphy *et al.* reported that, cocoa flavanol and

procyanidin supplementation for 28 days significantly increased plasma epicatechin and catechin concentrations and significantly decreased platelet function.

Lycopene

This is a compound that is very abundant in tomatoes and other brightly colored foods such as papaya, watermelon, carrot, pink guava and pink grapefruit. For the best source of lycopene, consumption of concentrated tomato products such as tomato paste, canned pizza sauce, spaghetti sauce, barbecue sauce and ketchup are highly recommended. In addition, consumers should note that cooked tomato products provide better availability of lycopene than raw tomato products. Lycopene provides health benefits by neutralizing hazardous waste products such as reactive oxygen species (ROS) that our bodies normally produce during conversion of nutrients into energy. ROS are dangerous compounds that can damage DNA and promote cancer formation. They also damage lipids that are vital to keeping our hearts and blood vessels functioning properly; such damage can lead to development of hypertension. Increasing consumption of lycopene-containing food products can reduce blood pressure in hypertensive patients by reducing plaque development (hardening of blood vessels). Also Previous studies have also shown that men who ate 10 or more servings of tomato products (pizza sauce, tomato sauce) per week or those with high levels of lycopene in their blood were substantially less likely (about 34%) to develop prostate cancer than those who consumed little or no tomato products. Tomato purée revealed a much stronger, dose-dependent, anti-mutagenic effect compared with corresponding doses of pure lycopene. Results indicated that lycopene has anti-mutagenic effects, although the effects are lower than that of tomato purée, which contains a complex mixture of bioactive phytochemicals. The anti-mutagenic effect is connected with the chemoprotective role of lycopene, tomatoes and tomato products in the prevention of carcinogenesis. Lycopene-the carotenoid responsible for the red color of tomatoes-has attracted attention because of its role in the prevention of chronic diseases in which oxidative stress is a major etiological factor, such as cancer, cardiovascular and neurodegenerative diseases and hypertension, among others. Antioxidants, including lycopene, interact with reactive oxygen species, can mitigate their damaging effects and play a significant role in preventing these diseases, also Palozza *et al.* reported that, the experimental basis of lycopene for such health benefits is not fully understood. One of the possible mechanisms for its protective activities is by down-regulation of the inflammatory response.

Vitamins

Mankind has been relatively unsuccessful in the search for the ultimate panacea for all ills; however, in the field of functional foods, few nutritional components have so many fundamental and diverse biological properties as folic acid and related B group vitamins. B vitamins, particularly folate, may give considerable protection against serious diseases such as cancer, heart disease and birth defects. Micronutrient malnutrition, the so-called hidden hunger, affects more than half of the world's population, especially women and preschool children in

developing countries. Even mild levels of micronutrient malnutrition may damage cognitive development, lower disease resistance in children and increase the incidence of childbirth mortality. The costs of these deficiencies, in terms of diminished quality of life and lives lost, are enormous. The clinical and epidemiological evidence is clear that select minerals (iron, calcium, selenium and iodine) and a limited number of vitamins (folate, vitamins E, B6 and A) play a significant role in the maintenance of optimal health and are limiting in diets. Folic acid fortification appears to have had a positive effect on the incidence of neural tube defects. The new dietary recommendation for folic acid takes into account the benefits of protecting against these birth defects, but makes no recommendation on the benefits of protecting against heart disease. Vitamin D can contribute not only to prevention of osteoporosis but also to a reduction in certain cancers and multiple sclerosis and to an improvement in the prognosis of patients with osteoarthritis. Research on the role of vitamin E in protecting against heart disease is equivocal. Vitamin E supplementation of at least 100 IU per day for 2 or more years reduced adverse outcomes related to heart disease by 37% in men and 41% in women. Also vitamin C plays an important role in providing antioxidant protection; vitamin C supplementation for 10 or more years was associated with a substantial reduction in risk of cataracts. Higher vitamin C intake among elderly people might also provide some protection against both cognitive impairment and cerebrovascular disease.



Bridging the gap between food and medicine

Nutraceuticals are foods or food ingredients that provide medical or health benefits. This emerging class of products blurs the line between food and drugs. They do not easily fall into the legal categories of food or drug and often inhabit a grey area between the two. Within European Union (EU) law the legal categorization of a nutraceutical is, in general, made on the basis of its accepted effects on the body. Thus, if the substance contributes only to the maintenance of healthy tissues and organs it may be considered to be a food ingredient. If, however, it can be shown to have a modifying effect on one or more of the body's physiological processes, it is likely to be considered to be a medicinal substance. Within European Medicines law a nutraceutical can be defined as a medicine for two reasons:

- 1) It can be used for the prevention, treatment or cure of a condition or disease or
- 2) It can be administered with a view to restoring, correcting or modifying physiological functions in human beings.

Challenges and Opportunities

The field of nutraceuticals and functional foods is new and many gaps exist in the knowledge base, for example, it is widely accepted that the health-promoting properties of foods are not necessarily due to single components, but rather a few or several active ingredients. This creates a significant paradigm shift from the pharmaceutical model, which is based on the efficacy of single agents. Many of the bioactive phytochemicals under investigation have long been ignored, thus methods for their handling and measurement are lacking. Manufacturers wish to make specific claims of health benefits on their product labels. Clearly such claims must be based on solid scientific evidence, which to date is often lacking. Government regulatory bodies also face challenges in this new category of health products, which lies between foods and drugs. However, all parties share the desire to improve personal and public health through diet modification, to reap the consequent social and economic benefits. The field of nutraceuticals and functional foods is at times confused, or at least lumped together with the field of biotechnology and genetic modification. The two areas are distinctly different, although there is some potential for overlap. Techniques in genetic modification may be applied to enhance the phytochemical content of food and nonfood plants. Although the complex series of biochemical reactions used by plants to synthesize specific phytochemicals is often not well understood, there is tremendous potential to harness the plant's sophisticated biochemical machinery to synthesize valuable compounds and ultimately enhance human health. There are numerous challenges in getting a new product into the food market. Currently, more and more people understand the significant correlation between diet, consumption of quality food and good health and those people are the best targets. Furthermore, customers are looking for name-brand products to assure superior quality, even if the price may be a little higher.

Conclusion

The beneficial effects of functional foods and nutraceuticals can be concluded that: Reduced risk of cardiovascular diseases, reduced risk of cancer, weight loss/management, reduced osteoporosis, improved memory, quicker reaction time, improved fetal health and reduced risk of other many diseases.

Functional foods and nutraceuticals will be hopeful to good health in the future; it has been convincingly demonstrated to be beneficial for their intended purposes when consumed as part of a generally well-balanced and healthful diet. Also, more information and evidences must be available to assist consumer for the correct choosing and using the functional foods and / or nutraceuticals to achieve the promised health benefits.

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