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A Literature Review of the Functional foods and Health

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ABSTRACT

A functional food is a food given an additional function (often one related to health-promotion or disease prevention) by adding new ingredients or more of existing ingredients. Functional foods can be considered to be those whole, fortified, enriched or enhanced foods that provide health benefits beyond the provision of essential nutrients (e.g., vitamins and minerals). Functional food components are potentially beneficial components found naturally in foods or added to them as functional ingredients, and include carotenoids, flavonoids, fatty acids, dietary fiber, isothiocyanates, phenolic acids, plant stanols and sterols, polyols, prebiotics and probiotics, phytoestrogens, soy protein, vitamins and minerals. At present, professionals are recognizing that some functional components of foods have a major role in health enhancement. In fact, the big importance of these "bioactive" present in many foods, either naturally or added, has lead many scientists of different fields to conduct studies aimed for establishing the scientific basis that supports and validates the benefits of a particular food or component for the human health. It appears that people should strive to consume a wide variety

of foods such as to assure the ingestion of compounds such as carotenoids, flavonoids, specific fatty acids, fiber, minerals, prebiotics and probiotics, phytoestrogens, soy protein and vitamins, among others, in order to reduce the risk of developing some diseases, or even to help curing others. In the present work, to study the characteristics of these functional foods compounds and repercussions of these "bioactive" allied to their ability to prevent and/or cure certain diseases will be object of study, based on recent evidence published in the medical journals.

Keywords: Functional foods, nutrition, functional ingredient, bioactive.

INTRODUCTION:

In the last decade, preventive medicine has undergone a great advance, especially in developed countries. Research has demonstrated that nutrition plays a crucial role in the prevention of chronic diseases, as most of them can be related to diet. Functional food enters the concept of considering food not only necessary for living but also as a source of mental and physical well-being, contributing to the prevention and reduction of risk factors for several diseases or enhancing certain physiological functions. A food can be regarded as functional if it is satisfactorily demonstrated to affect beneficially one or more target functions in the body, beyond adequate nutritional effects, in a way which is relevant to either the state of well being and health or reduction of the risk of a disease. The beneficial effects could be either maintenance or promotion of a state of well being or health and/or a reduction of risk of a pathologic process or a disease. Whole foods represent the simplest example of functional food. Functional food components are potentially beneficial components found naturally in foods or added to them as functional ingredients, and include carotenoids, flavonoids, fatty acids, dietary fiber, isothiocyanates, phenolic acids, plant stanols and sterols, polyols, prebiotics and probiotics, phytoestrogens, soy protein, vitamins and minerals.

1. Carotenoids:

Of the various classes of pigments in nature, the carotenoids are among the most widespread and important ones, especially due to their varied functions. These are fat-soluble pigments found mostly in plants, fruits, flowers, algae, and photosynthetic

bacteria, but they also occur in some non-photosynthetic bacteria, yeasts, and molds. The most abundant carotenoids in natural consumed foods are beta-carotene, alpha-carotene, gamma-carotene, lycopene, lutein, beta-crpytoxanthin, zeaxanthin, and astaxanthin. Carotenoids have extensive applications as anti-oxidants indietary supplements, and as colors in food sand beverages as well as pigments in poultry and fish. The carotenoids used as food ingredients includeastaxanthin, beta-apo-carotenal, canthaxanthin, beta-carotene, lutein, zeaxanthin and lycopene.Carotenoids are important for human health, but its structure ultimately determines the potential biological function(s). The essential role of beta-carotene and others as the main dietary source of vitamin A has been known for many years (Carlier, 1993). More recently, protective effects of carotenoids against serious disorders such as cancer, heart disease and degenerative eye disease (Mozaffarieh, 2003) have been recognized, and have stimulated intensive research into the role of carotenoids as antioxidants and as regulators of the immune response system.

2. Flavonoids:

Flavonoids, a large family of polyphenolics synthesized by plants, can be divided into many different sub classes, each comprising hundreds of different compounds: anthocyanidins, flavones (apigenin, chrysin, luteolin, rutin); flavanones (eriodictyol, hesperidin, isosakuranetin, naringenin, naringin, taxifolin); Flavonols(isorhamnetin, kaempferol, myricetin, quercetin); Flavononols (astilbin, engeletin, genistin, taxifolin); isoflavones (biochanin A, daidzein, daidzin, formononentin, genistein, glycitein). Anthocyanins are glycosidically bound anthocyanidins found in many flowers and fruits, in the form of water-soluble pigments, conferring the coloration tones of red, blue and violet. Chalcones and flavones are yellow, while catechins and epicatechins are colorless (Shahidi, 2004). Anthocyanins and catechins are two importantgroups of flavonoids, together known as flavans. Many flavonoids are polymerized into large molecules, generically called tannins, which include the proanthocyanidins (or condensed tannins), and the hydrolysable tannins (Beecher, 2003). They act as free radical acceptors and chain breakers, but the antioxidant activity of flavonoids depends on their chemical structure. The potential benefits to

human health of flavonoids include antiviral, antitoxic, anti-fungal, antibacterial, anti-allergic (Kawai, 2007), anti-inflammatory and antioxidant activities (Shahidi, 2004). Many recent studies have confirmed the protective role of flavonoids regarding heart diseases, eye diseases (Osakabe,2004; Zhang, 2006), diabetes, neurodegenerative diseases, like Alzheimer's or Parkinson's and others like gout, hemorrhoids, and periodontal disease. Flavonoids exert a positive effect on the prevention and/or treatment of many different types of cancer, namely: ovarian (Gates, 2007), colon, lung, laryngeal, prostate, pancreatic etc.

3. Dietary fibers:

Dietary fibers include cellulose, hemicellulose, polyfructoses, galactooligosacharides, gums, mucilages,pectins, lignin and resistant starches, and are classically divided into soluble or insoluble. More recently, some are proposing the use of the terms "viscous" and "ferment ability" in place of soluble and insoluble to describe the functions and health benefits of dietary fiber. Both soluble and insoluble fibers pass through the stomach and small intestine undigested, but when they reach the large intestine they are fermented by colonic bacteria in different extensions. As a result of the fermentation process short chain fatty acids are produced, providing the important health benefits of fiber.Functional fiber is something that manufacturers deliberately add to food products to provide similarhealth benefits to those of dietary fiber, without adding significant calories. Some examples of functional fibersare cellulose, maltodextran, polydextrose, and insulin, and these are isolated from foods where they occur naturally. The consumption of dietary and functional fibers has many potential health benefits, namely the ability to lower the incidence of constipation (Castillejo, 2006) and irritable bowel syndrome (Malhotra, 2004), lower cholesterol and diminish the incidence of coronary and cardiovascular heart diseases, prevent obesity (Murakami, 2007) and diabetes, avoid colon cancer and increase survival in breast cancer. However, excessive intake of dietary fiber may have some adverse effects like intestinal obstruction (insusceptible individuals), dehydration (due to a fluid imbalance), increase in intestinal gas, resulting in distention and flatulence, and reduced absorption of vitamins, minerals, proteins, and calories from the gut (Slavin, 2003).

4. Fatty acids:

Essential fatty acids (EFAs) are long-chain polyunsaturated fatty acids, which play an important role on human health promotion, and since they cannot be synthesized by the human body they must be obtained through diet. They are "good fats" that compete with "bad fats", such as trans fats and cholesterol, and they increase the levels of high density lipoprotein (HDL), or "good cholesterol", and decrease the levels of low-density lipoprotein (LDL), the "bad cholesterol". The omega-3 fatty acids are derived from linolenic acid, the omega-6 from linoleic acid, and the omega-9 fatty acids from oleic acid. This last is not properly "essential", since the human body can manufacture a small amount on its own from other EFAs. The number following "omega-" represents the position of the first double bond, counting from the terminal methyl group on the molecule. The three major types of omega-3 fatty acids are alpha linolenic acid (ALA), which is the basic omega-3 fatty acid, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). The human body converts ALA into EPA and DHA, which are more readily used. The primary omega-6 fatty acid is linoleic acid (LA), which is converted by the human body into gamma linolenic acid (GLA), being latter broken down into arachidonic acid (AA).The EPA synthesized from omega-3and the GLA synthesized from omega-6 acids are later converted into eicosanoids, which are hormone-like compounds having an important role in many bodily functions, including vital organ function and intra cellular activity (Holub, 2002). It is important to maintain an appropriate balance of the two types of fatty acids, omega-3 and omega-6, since these two works together to promote health. EFA deficiency and omega 6/3 imbalance is linked with serious health conditions, such as heart attacks, cancer, insulin resistance, asthma, lupus, schizophrenia, depression, postpartum depression, accelerated aging, stroke, obesity, diabetes, arthritis, attention deficit Hyperactivity disorder (ADHD), and Alzheimer's disease, among others.Omega-3 deficiencies are linked to decreased memory and mental abilities, tingling sensation of the nerves, poor vision, increased tendency to form blood clots, diminished immune function, increased triglycerides and "bad" cholesterol (LDL) levels, impaired membrane function, hypertension, irregular heart beat, learning disorders, menopausal

discomfort, itchiness on the front of the lower legs, and growth retardation in infants, children, and pregnant women. Some omega-6 fatty acids improve diabetic neuropathy, rheumatoid arthritis, premenstrual syndrome (PMS), skin disorders (e.g. Psoriasis and eczema), and aid in cancer treatment. Monounsaturated oleic acid (omega-9) lowers heart attack risk and arteriosclerosis, and aids in cancer prevention. EFAs help in the absorption of essential nutrients and expelling of harmful waste products, support the cardiovascular, reproductive, immune, and nervous systems, and are important for proper growth in children, particularly for neural development and maturation of sensory systems. Besides, EFAs increase the production of prostaglandins, which regulate body functions such as heart rate, blood pressure, blood clotting, fertility, conception, and play a role in immune function by regulating inflammation and encouraging the body to fight infection. EFAs are beneficial for those suffering from rheumatoid arthritis (RA) and reduce tenderness in joints, swelling and diminish morning stiffness. The importance of EFAs has also been proved to many diseases: asthma, attention deficit disorder (ADD) or attention deficit hyperactivity disorder (ADHD), burns, photo dermatitis, acne or psoriasis, cholesterol, obesity, insulin sensitivity, depression; bipolar disorder, schizophrenia, hypertension

5. Isothiocyanates:

Isothiocyanates are a group of phytochemicals containing sulphur that occur naturally as glucosinolate conjugates in cruciferous vegetables such as broccoli, cauliflower, kale, Brussels sprouts, cabbage, and others. The glucosinolates present in cruciferous vegetables are precursors of isothiocyanates, each of which forming adifferent isothiocyanate when hydrolised by the enzyme myrosinase (Fahey, 2001). Despite the high amounts of glucosinolates present in cruciferous vegetables (McNaughton, 2003), their bioavailability is highly affected by food processing operations such as boiling or microwaving at high power (Rouzaud;2004). Studies have shown that isothiocyanates and their metabolites help to lower the risk of developing different types of cancer, namely lung, breast, liver, esophagus, stomach, small intestine and colon (Hecht, 2004;Conaway, 2002). As to the effect on the bacteria Helicobacter pylori, associated with an increase in the risk of developing gastric cancer (Normark,

2003), sulforaphane (SFN) was found to kill or inhibit the growth of multiple strains (including some resistant to antibiotics), and leading in some cases to eradication (Haristoy, 2003).

6. Phenolic acids:

Phenolic acids occur in food plants either as esters or glycosides conjugated with other natural compounds such as flavonoids, alcohols, hydroxyl fatty acids, sterols and glucosides. They include the hydroxycinnamic acids, which occurs in various conjugated forms (esters of hydroxyacids such as quinic,shikimic and tartaric acid; and their sugar derivatives), being the most common the p-coumaric, caffeic, ferulicand sinapic acids; and the hydroxybenzoic acids, which derive directly from benzoic acid, being the most common the phydroxybenzoic, vanillic, syringic, and protocatechuic acids (Häkkinen, 2000).Phenolic acids have gainned attention due to their potential protective role against oxidative damage diseases, such as coronary heart disease, stroke, and cancers (Robbins, 2003).

7. Phytoestrogens:

Phytoestrogens (PEs) are plant compounds similar to estrogenic (or estrogens), which have roles in the metabolism of carbohydrates, proteins, lipids and minerals in the human body, and in the reproductive cycle in women (Gardiner, 2001). The main estrogens found in mammals are estradiol and estrone. Estrogens are used to avoid contraception and as a therapy for women at menopause. Phytoestrogens are divided into three main categories: isoflavones (genistein, daidzein, glycitein orequol), lignans (enterolactone or enterodiol) and coumestans (coumestrol). They have a structure similar to that of estradiol, and may act in the body either with estrogenic or anti estrogenic effects. They act as natural selective estrogen receptor modulators (SERMs), and bind to certain estrogen receptors in some tissues, either activating or down-regulating cellular responses. Phytoestrogens have beneficial effects on the skeleton and the cardiovascular system, reduce the incidence of osteoporosis and attenuate menopausal symptoms. The role of phytoestrogens in cancer includes a preventive action, a cancer cell proliferation inhibiting factor and a therapy aid. They proved to be positive to breast cancer, prostate cancer (Bosland, 2005; Raffoul, 2006), endometrial cancer, thyroid cancer, skin cancer

(Widyarini, 2006), and colorectal cancer (Cotterchio, 2006).

8. Vitamin B12 helps in the prevention of some diseases, namely concerning neural tube defects (Mills,1996), cardiovascular disease (Quinlivan, 2002), cancer (Donaldson, 2004), depression, Alzheimer's disease and dementia (Clarke, 1998).

9. **Vitamin C** (ascorbic acid or L-ascorbate) is important to prevent some diseases like scurvy (Sauberlich,1997), lead toxicity, cancer (Michels, 2001), cataracts and cardiovascular diseases such as coronary heart diseaseand stroke (Huang, 2001). Besides, it is used therapeutically in some cardiovascular disease pathologies (vasodilatation and hypertension), cancer, diabetes and cold (Mossad, 1998).

10. Vitamin D is essential for the prevention of orteoporosis, autoimmune diseases, heart diseases, diabetes,hypertension and cancer (Guyton, 2003; Holick, 2004).

11. Vitamin E (tocopherol), besides a role on skin healing, also helps prevent cardiovascular disease(Keaney, 1996), cancer (Zhang, 2002), cataracts and enhances specific aspects of the immune response (Wang,2004). It is also used to treat diabetes (Jain, 1996) and dementia (Khanna, 2005).

12. Vitamin K plays a role in the prevention of osteoporosis (Shearer, 1997; Vermeer, 1998), vascular calcification (Schurgers, 2001) and cardiovascular disease.12.2.

13. Dietary minerals- Calcium is the most common mineral in the human body, and its role in the human body includes some beneficial effects on the prevention and treatment of some diseases: osteoporosis (together with vitamin D) (Nordin, 1990), colorectal cancer (Peters, 2004), kidney stones (Curhan, 1997; Hall, 2002), preeclampsia(Kulier, 1998), and lead toxicity (Bruening, 1999).

14. Magnesium is important to prevent and/or treat diseases such as hypertension and heart diseases (Liao,1998), diabetes (Paolisso, 1992), osteoporosis (Sojka, 1995; Tucker, 1999), migraine headaches (Mauskop,1998) and asthma (Cydulka, 1996).

15. Potassium helps preventing osteoporosis (Sebastian, 1994), strokes (Bazzano, 2001) and kidney stones(Curhan, 1997). Moreover, has a role in the treatment of high blood pressure (Barri, 1997).

16. Fluorine is important for bones and teeth, and helps in the prevention of dental

caries (dePaola, 1999)and in the treatment of osteoporosis (Riggs, 1990).Iodine is required by humans for the synthesis of thyroid hormones, and its deficiency may constitute an important health problem. Potassium iodide is an ally in case of radiation exposure, and can significantly reduce the risk of radiation-induced thyroid cancer (Zanzonico, 2000).

17. Chromium has been reported to help preventing cardiovascular diseases (Kobla, 2000) and treat diabetes (Anderson, 1997).Copper is known to play an important role in the development and maintenance of immune system function and osteoporosis (Eaton-Evans, 1996).

18. Iron deficiency is associated with development of severe anemia, decreased cognitive function(Grantham-McGregor, 2001) as well as an increase in the risk of lead poisoning (Wright, 1999). Low iron concentrations in the brain also contribute to increasing the appearance of restless legs syndrome (Allen, 2001).Selenium has been identified as a protective factor against some types of cancer: lung, prostate (Brooks, 2001; Nomura, 2000; Yoshizawa, 1998), liver (Yu, 1999), colon , esophageal and gastric (Mark, 2000) as well as against the human immunodeficiency virus (HIV). Manganese, like other minerals, helps in the prevention of osteoporosis. Both selenium and manganese can be toxic to humans when ingested in large amounts.

19. Zinc deficiency is associated with a number of disorders, leading ultimately, among others, to disturbances of normal physiology and cessation of growth and development. Zinc supplementation was found to significantly diminish the risk of advanced macular degeneration (Clemons,2004).

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