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Review Article

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Functional Food (Animal Origin) & Human Health: Brief Review

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ABSTRACT

A fortified food which delivers all health benefits along with vitamins and minerals is defined as "Functional Food". Nutrition is important for body maintenance and protection from diseases. There should be a scientific relevance between benefits of function food and human health. In recent era, functional food is becoming significant and vital area. Researches have started to find out physiologically active components in foods known as phytochemicals and zoochemicals. However, all the functional foods do not full fill this criterion of scientific relevance. Diet is only one part of essential nutrient to good health. How much amount to be consumed, is also important regarding functional food? Recently consumer are taking deep interest in functional food containing physiologically/ biologically active components in addition to the nutrients. In this brief review, functionality of functional food according to scientific relevance and recommended eating has been reviewed.

Key words: *Functional food, Biologically active, Phytochemicals, Zoochemicals*

INTRODUCTION

Food fills human stomach and protects from various diseases due to presence of bioactive components. These foods are known as "functional foods". Good nutrition and access to an adequate diet and health are essential for human growth and development. Diet, food habits and lifestyle are contributory in global health. Human knew the medicinal supremacy of foods even before the 2,500 years when Hippocrates stated "Let food be thy medicine and medicine be thy food." For proper national development; adequate nutrition and a healthy productive population are necessary. Food nutrient are essential in improvements in heath of whole family. Functional foods affect children's health, intelligence and educational performance and thus their economic status in adulthood. Physiologically active ingredient in foods like phytochemicals and zoo chemicals are useful to reduce risk for many chronic diseases. All foods are functional, as they provide taste, aroma, or nutritive value. Within the last decade, however, the term functional food has adopted a different meaning that of providing an additional physiological benefit beyond that of meeting basic nutritional needs[1].

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The interest in functional foods has increased in developed countries as people look for safer way to improve general health and living. This brief article includes definition of functional foods, safety consideration along with future of this new food group.

Definition and Concept of Functional Foods

Human knew the medicinal supremacy of foods even before the 2500 years when Hippocrates stated "Let food be thy medicine and medicine be thy food." The term 'functional or health food' is used for foods and drinks which are augmented with particular nutrients and are essential for good health. Functional foods are routinely eaten foods that are eaten as part of our normal diet. A functional ingredient can be defined as a dietary ingredient that influence heath of consumer in positive manner. So, functional foods are foods that have health approving qualities over and above their nutritional value.

Ideally the functional food should fulfill the following conditions:

A. Such product that is labelled as a "Functional Food should be in the form of powders, granules, tablets, capsules, liquids, jelly meant for oral intake;

B. Such product does not include a drug as defined in clause (b) and ayurvedic, sidha and unani drugs as defined in clauses (a) and (h) of section 3 of the Drugs and Cosmetics Act, 1940 and rules made there under;

C. Does not assert to cure or diminish any specific disease, disorder or condition (except for certain health benefit or such promotion claims) as may be permitted by the regulations made under this Act;

D. Does not include a narcotic drug or a psychotropic substance as defined in the Schedule of the Narcotic Drugs and Psychotropic Substances Act, 1985 and rules made thereunder and substances listed in Schedules E and EI of the Drugs and Cosmetics Rules, 1945[2].

It is essential to establish the safe amount or permissible intake for functional foods to avoid harmful effect of over consumption. For example proper amount of garlic reduces the risk of heart disease and cancer while excess can result in gastrointestinal bleeding.

Functional food full of therapeutic value (animal origin)-

Human diets were abundant in seafood and other sources of omega-3 long chain fatty acids (EPA & DHA), but relatively low in omega-6 seed oils since hominid evolution. Ideal ratio of omega-6 and omega-3 fats in a proper proportion is roughly 1:1 in a proper diet. This proper ration in food help to control inflammatory diseases like cancer, diabetes and heart disease[3]. In present era there is marked shift in the ratio of n-6 to n-3 fatty acids in the diet. Omega-3 fatty acid id ideal for human haelth.Omega-3 fatty acids are an essential class of polyunsaturated fatty acids (PUFA). The major PUFAs are eicosapentaenoic acid (EPA, C20:5, n-3) and docosahexanoic acid (DHA, C22:6, n-3). DHA is an essential component of the phospholipids of cellular membranes, especially in the brain and retina of the eye, and is necessary for their proper functioning. DHA is particularly important for the development of these two organs in infants and there are recommendation for use of DHA and arachidonic acid for use in formula for full-term infants[4]. The role of the omega-3 fatty acids in the human body are the followings: i reduction the blood cholesterol and triglicerid levels, ii reduction inflammation symptoms, iii improvement of the efficiency of the immune system , iv good effects on digestion, v reduction of the risk of gastro- intestinal tumours, vi prevention premature birth , vii better retina function ,viii control of blood pressure ,ix more effective digestion with increasing bile output , x control of allergic diseases , xi prevention of diabetes and prevention of depression.

This has prompted researchers to examine the role of n-3 fatty acids in a number of diseases –particularly cancer and cardiovascular diseases and more recently, in early human development. There are physiologic effects of n-3 fatty acids in chronic conditions such as cancer, rheumatoid

arthritis, psoriasis, Crohn's disease, cognitive dysfunction and cardiovascular disease[5].

Metaanalysis of 11 randomised control trials suggests that intake of n-3 fatty acids reduces overall mortality, mortality due to myocardial infarction and sudden death in patients with CHD[6]. Nowadays the daily omega-3 amount is only the 8-12 % of the recommended daily intake, and the omega-6 amount is 1000-2000 % of the recommended-which is really harmful and unhealthy to human organs. This imbalance could be changed by eating omega-3 rich foods: salmon, tuna, mackerel, sardines, herring, eel, trout, and some other fish. Omega-3 rich pork meat, and meat products, omega-3 rich milk, omega-3 rich freshwater fish and omega-3 enriched eggs are being produced by modified nutrition by adding 11% of flaxseed. Feeding strategies have been successfully used to produce eggs, beef and chicken with up to 20 times the normal level of DHA, 7 times the normal level of vitamin E and 6 times the normal omega-3 content of their traditional counterparts[7].

The ability of omega-3 fatty acids in fish or conjugated linoleic acid in milk and meat products to alter several physiological processes raises questions about what intakes and proportions of animal foods are needed to optimize health and well-being.

Dairy & **fermented dairy products**

Use of food as medicine is as old as Hippocrates. Functional foods include dairy products which plays very important role in progress of various disease in human. They are one of the best sources of calcium and essential nutrient which can prevent osteoporosis and possibly colon cancer. Food processing and preparation procedures impact the physiological value of food. Gastrointestinal flora and circulating cholesterol are influenced by fermented dairy food products. Fermented dairy foods are good sources of protein, calcium, riboflavin and vitamin B12. Fermented dairy foods are also a good source of folic acid due to microbial synthesis. The absorption of lactose in yogurt is enhanced by the presence of bacterial lactase. Fermented and low fat milk products contain only forty to sixty-three calories per 100 grams, whereas sweet cream, is high in fat and contains over two hundred calories per 100 grams. Some fermented dairy foods have antibiotic or antitumor activity in vitro or in laboratory rats. However, the significance of these findings are still unknown in humans[8].

Fermented foods and beverages possess various nutritional and therapeutic properties. Lactic acid bacteria (LAB) play a major role in determining the positive health effects of fermented milks and related products. Cultured products sold with any claim of health benefits should meet the criteria of suggested minimum number of more than 10^6 cfu/g at the time of consumption. Yoghurt is redefined as a probiotic carrier food. Several food powders like yoghurt powder and curd (dahi) powder are manufactured taking into consideration the number of organisms surviving in the product after drying. Such foods, beverages and powders are highly acceptable to consumers because of their flavor and aroma and high nutritive value. Antitumor activity is associated with the cell wall of starter bacteria and so the activity remains even after drying. Other health benefits of fermented milks include prevention of gastrointestinal infections, reduction of serum cholesterol levels and antimutagenic activity. The fermented products are recommended for consumption by lactose intolerant individuals and patients suffering from atherosclerosis. The formulation of fermented dietetic preparations and special products is an expanding research area[9, 10, 11]. Relatively less attention has been focused on the consumption of fermented milk products and breast cancer risk, although an inverse relationship has been observed in some studies[12]. Probiotics are live microbial food supplements and assist in maintaining superb stability and composition of the intestinal microbiota and thus enhancement the resistance against infection by pathogens. Probiotics are now recognized as a hopeful category of food supplement. It is

scientifically proved that probiotics are useful management of different types of diarrheal diseases, the modulation of immune function, the prevention of colon cancer, and other chronic gastrointestinal inflammatory disorders. In recent years, researcher are investigating the use of probiotics in a wide range of neurological diseases[13]. Functional foods are also called as biotherapeutics and nutriceuticals. Probiotics are the ideal examples for functional foods[14]. In the recent past, Ice cream, flavored liquid milk, fermented milk, baby food, milk powder, frozen dairy desserts, cheese, buttermilk, whey-based beverages, and normal and sour cream have produced with probiotic bacteria. Several non-diary probiotic products such as Vegetarian-based products, fruit juices, soya-based products, oat-based desserts, baby foods, and breakfast cereal have been produced due to lactose intolerance[15, 16].

The technique by which probiotics expresses its decent effects on health is still not clear. Probiotics prevent pathogen growth by synthesizing antimicrobial compounds. They also produce lactase, modifying gut pH, challenge the binding of pathogens and receptor sites as well as existing nutrients and growth factors, and excite immunomodulatory cells[17].

One should be very careful while adding probiotic microbes to the food products to maintain the product quality or the sensory characteristics. [18] Human bodies have several groups of microorganisms which boost food consumption and digestion thus reduce the steps required to modify complex food structures to simpler ones[19]. In 1994, the World Health Organization considered probiotics to be the next-most significant immune defense system. The use of probiotics in antibiotic resistance is called as microbial interference therapy[20,21]. Probiotics are useful in maintaining good state of the genitourinary tract[22], to check the serum cholesterol levels[23], to control hypertension[24], to cure diarrheal diseases[24,25] to control side effects of antibiotic[26] to stop putrefactive-type fermentation[27], to support the production and secretion of antibacterial peptides[26], to decrease the incidence of allergy in vulnerable people[24]. Probiotics also support bioavailability and synthesis of nutrients and augment the immune system[28] thus expand the intestinal tract health[29]. Saccharomyces boulardii, bifidobacteria spp., Lactobacillus reuteri, and Lactobacillus GG are generally employed for the treatment of diarrhea[30, 31]. Probiotics are very effective in inhibiting diarrheal diseases caused by rotaviruses in infants and traveler's diarrhea[29,32]. Probiotics inhibit diarrhea-causing microbes by producing bacteriocins or by competing with pathogenic bacteria or viruses and stopping them from binding to the epithelial cells[33, 34].

Probiotic bacteria can subdue gastric colonization and functions of Helicobacter pylori, by adding Lactobacillus salivarius which has the ability to produce high amounts of lactic acid and thus overpower the growth of H. pylori in vitro and in mice[35, 36, 37]. Much interest has been shown regarding the possible role of the probiotics to cure inflammatory bowel diseases like ulcerative colitis[38, 39].

The gut microbiota plays a very important role as environmental factor they control the development of both immune and metabolic functions at the time of pre and post neonatal life thus effect child and mother health[40]. A regular oral dose of 108 viable probiotic lactobacilli can re-establish and preserve the urogenital health of women[41]. Probiotic interventions in the control of type 2 diabetes by changing gut hormones. Because of the discovery of gut hormones such as glucose-dependent insulinotropic polypeptide (GIP) and glucagon-like peptide-1 (GLP-1) incretins and their implications in glucose homeostasis, the gut connection to type 2 diabetes has now been recognized much more than peripheral insulin resistance and the failure of the beta cell. Some of the strains of Lactobacillus spp. could exert a beneficial effect by reducing the body fat percentage in individuals suffering from diet-induced obesity, particularly by reducing the cell size of the white adipose tissues[42]. Colon cancer is a

one of the common cancer throughout the world and probiotics helps in controlling colon cancer by (1) attaching and removing potential carcinogens ; (2) synthesizing antimutagenic or antitumorigenic compounds in the colon; (3) supporting the host's immune response; (4) modifying the intestinal microflora qualitatively and quantitatively; (5) altering the metabolic functions of the intestinal microflora; (6) beneficial effects on the physiology of the host; and (7) changing the physicochemical environment in the colon[43].

The intestinal microbiota affect the human brain growth and its activities[44]. The exchange of regulatory signals through bidirectional and integrative communication between the central nervous system and the digestive tract represents the gut–brain axis[25] This complex system acts through direct and indirect mechanisms that comprises immunological, hormonal, and neural pathways[45]. In fact, many studies have reported that a stressful experience particularly in childhood can disturb the microbiota profile, limiting its multiplicity and thus affect the mircrobial species, and promote the translocation of the species known to provoke inflammation, such as Clostridia, and decrease the population of anti-inflammatory bacteria, such as Lactobacillus[46]. The intestinal microbiota has an powerful effect on many neuromodulators and neurotransmitters such as GABA, serotonin, monoamines, and brain-derived neurotrophic factors, which carry signals to the brain via the enterochromaffin cells, the enteric nerves, and the systemic circulation crossing the blood–brain barriers, in which permeability appears to be controlled by the microbiota in experimental models[47] Overall, these scientific investigations demonstrate the potential effects of probiotics in curing neurological diseases and describe the immunological, neural, and metabolic pathways involved[48]. Currently, the successful utilization of probiotics in treating and preventing neurological disorders is a new trend.

Prebiotics-

Prebiotics are substances that can stimulate the growth of beneficial microorganisms, mainly in the human gut and thus modify the colonic microbiota. The following health benefits are due to prebiotics e.g. relief from poor digestion of lactose, increased resistance to bacterial infection, better immune response and possible protection against cancer, reduction of the risk of diseases such as intestinal disease, cardiovascular disease, non-insulin dependent diabetes, obesity and also reduced risk of osteoporosis because inulin promotes the uptake of calcium and thereby increases bone. Mass[49].

Prebiotics can be defined as non-digestible food ingredients that beneficially affect the body by selectively stimulating the growth and/or activity of a limited number of bacteria in the colon[50, 51, 52 , 53, 54, 55]. Prebiotics are substances that will modify the colonic microflora, stimulating the proliferation and growth of non-pathogenic bacteria with health promoting potential, particularly Lactobacilli and Bifidobacteria[56]. Some examples of prebiotics include fructooligosaccharides, galactooligosaccharides, arabinose, galactose, inulin, raffinose, mannose, lactulose, stachyose, mannanoligosaccharides, xylooligosaccharides, palatinose, lactosucrose, glycooligosaccharides, isomaltooligosaccharides, soybean oligosaccharides, etc[57].

To be considered as having prebiotic action, the compound must reach the colon without degradation or alteration and must be a food substrate that stimulates the existing saprophytic bacterial flora. Food ingredients with prebiotic characteristics generally exhibit certain unique characteristics, such as limited hydrolysis and absorption in the upper gastrointestinal tract, selective stimulation of the multiplication of beneficial bacteria in the colon, potential to suppress pathogens and limit virulence by processes such as immunostimulation and the stimulation of the beneficial microflora, which promote resistance to colonization by pathogens[58].

Prebiotics can be found in some vegetables, such as leeks, onions, chicory, tomatoes, asparagus, artichokes, bananas, and alfalfa. It can also be added to industrial products such as foods for children, dairy and confectionery products, beverages, light mayonnaise and low-fat cheese, and they can be used as dietary supplements[52, 59]. Prebiotics are being used in the food industry as functional ingredients in beverages (fruit juices, coffee, cocoa, tea, soft drinks and alcoholic beverages), milk products (fermented milk, milk powder and ice cream), probiotic yogurts and symbiotic products[60,61] Other applications include desserts (e.g., jellies, puddings, fruit-flavored ice cream), confectionery items (e.g., sweets), biscuits, breakfast cereals, chocolates, breads and pastas, meat products (e.g., fish paste) and tofu. Prebiotics can also be used in cosmetics, pharmaceuticals and products for people with diabetes[61].

The various studies in clinical nutrition conducted over the past 20 years have established the indirect role of prebiotic ingredients in promoting healthy and balanced intestinal microbiota. In addition, the administration of prebiotics reduces blood lipids and blood pressure, increases the synthesis and absorption of nutrients and has anti-carcinogenic action. In addition to its functional properties, prebiotics show interesting properties that have implications for the food processing industry and the content of its end-products. The proper administration of prebiotics consists of following the recommended daily intake, which should be specific to the pathology indicated and at levels that do not cause side effects.

Fructooligosaccharides (FOS)

FOS have functional properties, such as the reduction of cholesterol levels and blood glucose levels, lowering of blood pressure and better absorption of calcium and magnesium[62, 63] FOS are not digested by the human gastrointestinal tract, and when they reach the colon and excite the growth of specific bacteria in the intestine[60]. The bifidobacteria secrete β-fructosidase, which hydrolyses FOS[64]. Daily dose 15 g per day as dietary supplementation[60] by lowering the pH in gut they inhibits pathogens[64, 65].

Inulin

Experimental studies have shown that the application of inulin and oligofructose acts as bifidogenic factors and stimulate the immune system. They help in drop in the levels of pathogenic bacteria in the gut. They stimulate calcium absorption and thus decrease the risk of osteoporosis. Inulin also decrease the synthesis of triglycerides and fatty acids in the liver and decreased levels of these compounds in the blood and reduce chances of atherosclerosis[50].

Polydextrose (PDX)

Polydextrose is partially fermented and this fermentation leads to the growth of favorable microflora, reduction of putrefactive microflora, increased production of short chain fatty acids and elimination of carcinogenic metabolite production[66]. The large intestine has the capacity to absorb calcium and this mechanism accountable for increased calcium absorption in the intestine [67].

Galactooligosaccharides (GOS)

GOS promotes the proliferation of bifidobacteria in gut and decrease the deteriorating bacteria. This results in liver detoxification; prevention of pathogenic diarrhea; aid in cases of constipation; increased lactose tolerance; increased bone mineralization and reduces chances of fracture by the stimulation of calcium absorption[68].

Xylooligosaccharides (XOS)

Xylooligosaccharides have effect on the intestinal flora [69, 70]. Studies done on rats with significant growth of Bifidobacterium ssp. in the gastrointestinal tract [100/71] and the increase of total short chain fatty acids[72, 73]. In humans, the ingestion of XOS also assistance to increase the intestinal flora[74].

Lactulose

Lactulose increases number of beneficial bacteria in the gut at the expense of putrefactive bacteria or other bacteria[75] 0.5% of lactulose in formulations for infants, promoted growth of Bifidobacteria[76]. The administration of milk fermented with

bifidobacteria and lactulose helps the patient suffering with Liver cirrhosis by re-stabilization of beneficial microbiota of the gut, along with the reduction of ammonia and free phenols in the blood[77]. Lactulose is routinely used in treatment of hepatic encephalopathy as it decreases the concentration of ammonia in the blood and preventing the development of this pathology[78, 79].

Meat and Meat products

Enriching meats with fiber, probiotics and omega-3 fatty acids make it a functional food which may prevent diseases and thus promote health. Meat contains many important nutrients, including bioactive compounds such as taurine, L-carnitine, creatine, conjugated linoleic acid (CLA) and endogenous antioxidants. Studies show CLA may reduce cancer incidence, although this has not yet been shown with human studies. Meat also contains unique endogenous antioxidants including carosine, anserine and others, along with iron and zinc, nutrients often lacking in the average diet. Meat also contains a significant source of vitamin B-12. Modification of fatty acid and cholesterol levels in meat may be influenced by selection of breeds and genetic lines and diet. Changes in animal feeding practices and additional ingredients added during meat processing can modify its nutrient contents. Adding probiotics to fermented meat products (i.e. sausage) may lead to health benefits, although this is still in infancy. Several disadvantages exist when using fermented meats as a probiotic carrier. For one, fermented meats are not generally considered 'health food' by consumers. It requires careful selection of probiotic strains since, for example, they would need to have a resistance to bile salts." Fiber-enriched meat products may also offer health advantages, although they can elicit a grainy texture and have a restrictive digestive tolerance. Further studies are needed in this area. Omega-3 enriched meats (currently marketed in Canada) may also soon compete with salmon and other traditional omega-3 rich fish. Marketing meat and meat products as functional foods requires focusing on benefits of the nutrients, particularly meat's high protein content. An anticarcinogenic fatty acid knows as conjugated linoeic acid (CLA) was first isolated from grilled beef in 1987[80]. Nine different isomers of CLA have been reported as occurring naturally in food. CLA is unique in that it is found in highest concentration in fat from ruminant animals (e.g., beef, dairy, and lamb). Beef fat contains 3.1 to 8.5 mg CLA/g fat with the 9-cis and 11-trans isomers contributing 57-85% of the total CLA[81] CLA has been shown to be effective in suppressing forestomach tumors in mice, aberrant colonic crypt foci in rats, and mammary carcinogenesis in rats [82].

In the mammary tumor model, CLA is an effective anticarcinogen in the range of 0.1-1% in the diet, which is higher than the estimated consumption of approximately 1 g CLA/person/day in the United States. The CLA content in dairy cow milk is increased through dietary modification. [83] More recently, CLA has been investigated for its ability to change body composition, suggesting a role as a weight reduction agent by reducing fat deposition and increasing lipolysis in adipocytes.[84]

Safety Issues

Although "increasing the availability of healthful foods, including functional foods, in the diet is vital to ensure a healthier population"[85]. The optimal levels of the majority of the biologically active components under investigation have yet to be determined[86] Although there is evidence that certain functional foods or food ingredients can play a role in disease prevention and health promotion, safety considerations should be supreme. Safety concerns have recently been raised due to high & haphazard consumption of functional food and health nutrients.

In addition, a number of animal studies show that some of the same phytochemicals (e.g., allyl isothiocyanate) highlighted in this review for their cancer-preventing properties have been shown to be carcinogenic at high concentrations[87]. Thus,

Paracelsus' 15th century doctrine that "All substances are poisons .the right dose differentiates a poison from a remedy" is even more pertinent today given the liking for dietary supplements. We should evaluate the benefits and risks of functional food to human health. Facts of toxicity of functional food components are vital to decrease the risk: benefit ratio. For example, Soy phytoestrogens may represent a "double-edged sword" because of reports that genistein may actually promote certain types of tumors in animals.[88]Still there no developed regulations or guidance to companies on the type of safety-related information that should be included on their labels for functional foods and dietary supplements. The absence of such safety information poses a significant safety risk to some consumers."

Ideally following recommendations should be made regarding the safety of functional foods:

i) Develop and promulgate regulations or other guidance for industry on the evidence needed to document the safety of new dietary ingredients in dietary supplements
ii) Develop and promulgate regulations or other guidance for industry on the safety-related information required on labels for dietary supplements and functional foods
iii) Develop an enhanced system to record and analyze reports of health problems associated with functional foods and dietary supplements

CONCLUSION

It is a fact that functional foods with physiologically-active ingredient effect human health. But proper health habits is equally vital. Emphasis should be laid on dietary outline like; food should be mainly plant-based, high in fiber, low in animal fat. Daily diet should contain 5-9 servings of fruits and vegetables. In addition to balanced diet, overall lifestyle also affects human health. Stress, decreased physical activity and smoking deteriorate human health.

For well-being, functional food is being consumed by health-conscious consumers. The field of functional foods still in initial stages. Claims about health benefits of functional foods must be based on sound scientific criteria. Additional research is necessary to authenticate the possible health benefits of those foods for which the diet-health relationships are not sufficiently scientifically validated. Benefits of the foods should be properly communicated to the consumer. In India, functional foods adore the largest share of the nutraceuticals market followed by dietary supplements. This tendency will initiative the market for fortified foods and pro-biotic.

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