REVIEW ARTICLE

CONSUMPTION OF FUNCTIONAL FOOD AND OUR HEALTH CONCERNS

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"Let food be thy medicine and medicine be thy food" was embraced 2500 years ago by Hippocrates, the father of medicine. Food might provide therapeutic benefits is no a newer concept. However this "Food as medicine Philosophy fell into relative obscurity in the 19th century with the advent of modern drug therapy. In the 1900's the role of diet in disease prevention health promotion come to the fore front once again (Table-1)

During the first 50 year of the 20th Century scientific focus was on the identification of vitamins and their role in the prevention of various dietary deficiency diseases. This emphasis on nutrient deficiencies or 'under nutrition' shifted dramatically. In 1970's diseases linked to excess and over nutrition became the major public health concern. Scientist suggested consuming a diet that is low in saturated fat, high in vegetables, fruits, whole grains and legumes to reduce the risk of chronic diseases such as heart disease; cancer, osteoporosis, diabetes and stroke.

Scientists also began to identify physiologically active components in food from both plants and animals (known as phytochemical and zoo chemicals respectively) that potentially could reduce risk for variety of chronic diseases.

In 1990 this type of food was termed as functional food. In contrast to most dietary supplements functional foods are components of the usual diet that may have special disease prevention attributes and are the topic of current traditional scientific investigation on.

What are functional foods?

The term 'functional foods' comprises some bacterial strains and products of plants and animal origin containing physiologically active compounds beneficial for human health and reducing the risk of chronic disease.

According to definition functional food is a part of an everyday diet and is demonstrated to offer health benefits and to reduce the risk of chronic disease beyond the widely accepted nutritional effects.[1] All foods are functional to some extent because all foods provide taste, aroma and nutritive value. The term functional food was first introduced in Japan in mid 1980's. This type of food is known on Japanese market as 'Food for specified health use' (FOSHU). The functional food comprises of:

- Conventional foods containing naturally occurring bioactive substances (e.g., dietary fibre).
- Food enriched with bioactive substances (e.g., probiotics, antioxidants).
- Synthesized food ingredients introduced to traditional foods (e.g., prebiotics).

Among the functional components, probiotics and prebiotics, soluble fibre, omega-3-poly unsaturated fatty acids, conjugated linoleic acid, plant antioxidants, vitamins and minerals, some proteins, peptides and amino-acids, as well as phospholipids are frequently mentioned.

Functional foods are not pills or capsules but are consumed as part-of a normal everyday diet. Epidemiological studies randamized clinical trails carried out in different countries have demonstrated numerous health effects related to functional food consumption, such as reduction of cancer risk, improvement of heart health, stimulation of immune system, decrease of menopause symptoms, improvement of gastrointestinal health, maintenance of urinary tract health, anti-inflammatory effects, reduction of blood pressure, maintenance of vision, antibacterial and anti-viral activities, reductions of osteoporosis and anti-obese effect. (Table-2)

Functional foods of animal origin:

Fish Oils

Probably most intensively investigated class of physiologically active components derived from animal products are the (n-3) fatty acids, predominantly found in fatty fish such as salmon, tuna, mackerel, sardines and herring.[2] The two primary (n-3) fatty acids are eicosapentaienoic acid (EPA; 20:5) and docosahexaenoid acid (DHA; 22:6). 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.[3]

Hundreds of clinical studies have been conducted investigating the physiological effects of (n-3) fatty acids in some chronic conditions as cancer, rheumatoid arthritis, psoriasis, Chron's disease, cognitive dysfunction and cardiovascular disease[4] with the best documented health benefit being their role in heart health. The use of (n-3) fatty acid supplements is safe provided daily intake of

EPA and DHA from supplements do not exceeds 2g per day.[5]

The biological effects of fish oils include inhibition of hepatic synthesis and secretion of triacylglycerol and very low density lipoprotein with reduced postprandial lipemia, increased circulating high density lipoprotins, inhibition of platelet aggregation, and prevention of cardiac arrhythmias.[6]

Probiotics

Probiotics are defined as selected, viable microbial dietary supplements that, when introduced in sufficient quantities beneficially affect human organism through their effects in the intestinal tract.[7,8]

WHO has adopted the definition of probiotics as 'Live microorganisms' which when administered in adequate amounts confer a health benefit on the host. There are large numbers of probiotics currently used and available in dairy fermented food, especially in yogurts. The most beneficial organisms include those of lactobacillus Bifidobacterium, Streptococcus, Lactococcus and Saccharomyces because of their reputed health benefits.[9,10]

The physiological effects related to probiotic bacteria include the reduction of gut *p*H, production of some digestive enzymes and vitamins, production of antibacterial substances, e.g., organic acids, bacteriocins, hydrogen peroxide, diacetyl acetaldehyde, lactoperoxidase system, lactones and other unidentified substances, reconstruction of normal intestinal microflora after disorders caused by diarrhea's, antibiotic therapy and radiation therapy, reduction of cholesterol level in the blood, stimulation of immune functions, suppression of bacterial infections, removal of carcinogens, improvement of calcium absorption as well as the reduction of faecal enzyme activity.[8,9,11]

A scientific status summary on probiotics supports for the therapeutic and preventive use of these functional ingredients for various health concerns including cancer, intestinal tract function, immune function, allergy, stomach health, urogenital health, cholesterol lowering hypertension.[12]

Prebiotics

More recently, research efforts have focused an prebiotics, i.e., non digestible or low digestible food ingredients that benefit the host organism by selectively stimulating the growth or activity of one or a limited number of probiotic bacteria in the colon.[13]

This role is played by fermentable carbohydrates, which are not digested or poorly digested in the small intestine and stimulate, preferentially, the growth of bifido bacteria and some Gram-positive bacteria, belonging to the probiotic bacteria administered to human. Complex carbohydrates pass through the small intestine to the lower gut where they become available for some colonic bacteria. Lactulose, Galacto-oligo-sacchrides, fructo-oligo-sacchrides, inulin and its hydrolysates, malto-oligosacchrides, and resistant starch are prebiotics commonly used in human nutrition. The main end products of carbohydrate metabolism are short-chained fatty acids, namely acetate, butyrate and propionate which have positive effects on colonic cell growth and stability, generate many of the same bacteria as provided in Probiotics and may promote improved bowel habits but also increased flatus.[14]

In practice most common oligosacchrides are inulin and its hydrolysates and oligofructans. They can be found in chicory, onion, garlic, asparagus, leek, bananas, tomatoes, artichoke and many other plants. They enter the colon and serve as substrates for the endogenous colonic bacteria's.

Still newer concept is 'symbiotic' which are mixtures of probiotics and prebiotics that beneficially affect the host by improving the survival and implantation of live microbial dietary supplements in the gastrointestinal tract by selectively stimulating the growth and/or by activating the metabolism of one or a limited number of health promoting bacteria, and thus improving host welfare.[15]

Conjugated linoleic acid (CLA)

CLA is the nonplant ingredient that has been the focus of increased research efforts in recent years. This was first identified as a potent antimutagenic agent in fried ground beef by Pariza and Co-workers,[16] is a mixture of structurally similar form of linoleic acid (Cis-9, trans-II octadecadienoic acid). CLA is present in almost all foods, but occurs in particularly large quantities in dairy products and foods derived from ruminant animals.[17] For example, uncooked beef contains 2.9–4.3 Mg CLA/g fat, where as lamb, chicken, pork and salmon contain 5.6, 0.9, 0.6 and 0.3 mg CLA/g fat, respectively and dairy products contain 3.1-6.1 mg CLA/g fat.[18] The inhibition of mammary carcinogenesis in animals is the most extensively documented physiologic effect of CLA[19] and CLA can also decrease body fat and increases muscle mass both in rodent mode[20] and Humans[21] although not all human studies have been positive in this regard. There is also preliminary evidence that CLA may increase bone density in animal models.[22]

Functional foods of Plant origin:

Polyphenols and flavinoids

The term polyohenol includes simple phenols and flavonoids, which are found in fruits, vegetables and nuts and their products and posses important antioxidant properties. Flavonoids include

proanthrocyanidins, quercetin, and epicatechin, found mainly in chocolate, tea and wine. Red wine contains resveratrol, a non polyphenol anti-oxidant product of grape skins. It was shown that wine phenols inhibited the oxidation of low-density lipoprotein (LDL)[23] an accepted reason for the preventive effect of polyphenols on the development of atheroselerosis. A 5-year prospective Dutch study of 800 elderly men found that the ingestion of flavonoids, mainly in tea, anions and apples, was associated with significant reduction in mortality from coronary heart disease.[24] In addition to antioxidant effects on LDL, other potentially cardio protective effects of polyphenols include inhibition of platelet aggregation and vascular relaxation through the production of nitric-oxide.[25]

In the late 1970's researchers noted that residents in certain areas of France, who were avid drinkers of red wine, had less heart disease than other Western Populations even though they consumed more fat in their diet. This observation triggered numerous investigations into this so called 'French Paradox,[26)] and subsequent research confirmed the presence of high concentration of antioxidants polyphenolics in red grape skins. It must be noted however that moderate consumption of any alcoholic beverage e.g. beer, wine or distilled spirits, has been shown in a number of studies to reduce the risk of heart disease in selected population.[27]

The effect of green or black tea consumption on cancer risk [(28)] has been the focus of many studies. Studies in animals consistently show that consumption of green tea reduce the risk of various types of cancers. Only a few studies have so far assessed the effect of black tea. Green tea is particularly abundant in specific polyphenolic components known as catechins. The major catechins in green tea are epicatechin, epicatechin-3-gallats, epigallocatechin and epigallocatechin-3-gallate (EGCG).[29] One cup (240 ml) of brewed green tea contains up to 200 mg EGCG, the major phenolic constituent of green tea.

Soy isoflavones

Soy isoflavones are phytoesterogens that are derived from the protein fraction of the soybean and its food products (e.g., soy milk, soy flour, tofu, miso) include genistein and daidzein, and possess estrogenic properties because of the similarities of their chemical structures to estrogenic compounds. Clinical trials identified the potential efficacy of soy isoflavones in the prevention of heart disease, osteoporosis, breast and prostate cancer. A metanalysis of 37 clinical studies suggested that soyprotein up to 45 gm per day can lower serum cholesterol levels by 10 %.[30] Because phytoestrogens compete with oestrogen for finding to oestrogen receptors, their use could have beneficial effects in preventing osteoporosis and sex hormone mediated malignancy, such as breast and prostate cancer. Data are mixed on whether soy isoflavones promote or protect against breast cancer.[31–33] Although prostate cancer rates are lower in Eastern cultures where soy products play a major role in diet, and although genistein inhibition the growth of prostate cancer cells, clinical studies have failed to demonstrate positive effects of dietary soy products on reducing the risk of prostate Cancer.[34]

Carotinoids

There are severed plant derived carotenoids in the human diet, of which β-carotene, α-carotene, leutin, zeaxanthin and lycopene appears to have most significance for health. Being lipid soluble, carotenoids are absorbed with fats and circulates bound to different lipoproteins. B-carotene is a limited precursor of vitamin A, and excessive amounts of β carotene lead to reversible carotenemia but not to vitamin A toxicity. The principal biological effects of caroteneoids relate to their antioxidant properties, which form the basis of potential protection against lipid per oxidation, atherogenesis, DNA oxidation and cancer.[35] Clinical studies suggest but have not yet proven that either β-carotene or lycopene is cardio protective.[36,37] Aortic atherosclerosis incidence was significantly inversely correlated with the intake of dietary lycopene in the Rotterdam study of 108 patients and control subject.[38] A review of more than 30 studies concluded that there is an inverse relationship between lycopene in tomato products and the risk of cancers of the prostate, lung and stomach[39] and one study demonstrated a 21% reduction in prostatic Cancer with consumption of diets high in tomato derived lycopene.[40] A study of more than 25,000 middle aged male Finnish smokers found that the incidence of lung cancer was increased in those receiving β-carotene supplements.[41] In large cohort followed overtime, cataract formation was reduced significantly by dietary intake of fruits and vegetables rich in lutein and zeaxantihin.[42,43] Leutein is the main pigment in the macula of the eye (an area of the retina responsible for the sharpest vision). Recent research is focusing on the role of leutin in eye health due to its ability to neutralize free radicals that can damage the eye and by preventing photooxidation. Thus, individuals who have a diet high in leutin may be less likely to develop age related macular degeneration[44,45] or cataract the two most common causes of vision loss in adults. Good sources of lutein include green leafy vegetables such as spinach (7.4 mg/100 g) and cooked cabbage (14.44 mg/ 100 g).

Garlic (Allium Sativum)

It has been used for thousand of years for a wide variety of medicinal purposes; it's effects are likely

due to the presence of numerous physiologically active organosulphur components (e.g., allicin, allylidsulfides).[46] Garlic has been shown to have a modest blood pressure lowering effects in clinical studies,[47] while the epidemiological data suggests an inverse relationship between garlic consumption and certain types of cancer,[48] particularly of the stomach. The latter may be due to part to garlic's ability to inhibit the activity of Helicobacter pylori (the bacterium that causes ulcers). The best documented clinical effect of garlic is its ability to reduce blood cholesterol level. A Meta analysis of 13 placebo-controlled double blind trials [(49)] indicated that garlic consumption (10 mg steam distilled oil or 600–900 mg standardized garlic powder) significantly reduced total cholesterol compared with placebo by 4–6%.

Antioxidants

Plant antioxidants constitute one of the most active food compounds.[50] The main source of these substances is plant material. Garlic, broccoli, green tea, soybean, tomato, carrot, Brussels sprouts, kale, cabbage, onions, cauliflower, red beets, cranberries, cocoa, black berry, blue berry, red grapes, prunes, and citrus fruits are mentioned as the richest source of antioxidants. The content of phenolic antioxidants calculated per one kilogram of plant dry matter amounts to form about 0.1 to 1.0 g in the majority of fruits and vegetables up to 226 gm in green leaves.[51] Interception of free radical generation is to be described under two heads. In a biological system.

Non-enzymatic

- Alpha-tocoferol (vitamin-E)
- Ascorbate (vitamin-C)
- Glutathione
- Beta carotene intercepts free radicals converting them to harmless end products before they can cause cellular damage.
- Plasma protein.
- Bilirubin
- Chemical food additives.

Enzymatic

- Superoxide dismutase- converts superoxide to hydrogen peroxide (H_2O_2)
- Catalyses-Breakdown H_2O_2 by using O_2 as electron accepter
- Glutathione peroxideses – Remove free radicles as electron acceptors

Free radicals are highly toxic to all types of biological molecules including DNA, lipids, protein and carbohydrates. They are involved in the process of lipid peroxidation and atherosclerosis, membrane damage, mutagenesis, carcinogenesis, carbohydrate damage. So, free radicals are a major cause of many degenerative diseases, such as atherosclerosis, cancer, cardiovascular diseases, inflammatory bowel disease, skin aging, old age dementia and arthritis. Epidemiological data and randomized clinical trials provide ample indications that antioxidants play a fundamental role in the prevention of cancer and cardiovascular disease.[52] They act as scavengers of reactive oxygen species and metal chelators that protect human cells and reduce oxidative damage.

Free radicals can damage DNA and cause mutagenicity and cytotoxicity. Thus they play a key role in carcinogenesis. Reactive oxygen species can induce mutation, inhibit DNA repair and inactivation of certain tumour suppressor genes leading to Cancer.[53] It has been demonstrated on the baris of epidemiological studies, that taking large quantities of antioxidants may significantly reduce the risk of cancer disease. Factors inhibiting the promotion and progress of cancer include; β-carotene, curcumin, gingerol, galluson, epigallocatechin and resveratrol.[54]

Nuts

Although nuts are relatively high in fat, most of this fat is in the mono- or polyunsaturated form. Beneficial nuts include almonds, Brazil nuts, peanuts, walnuts, pecans and pistachios. Three large prospective studies demonstrated that the consumption of 1–4 servings of nuts per week was associated with about a 40% reduction in risk of coronary heart disease, even after adjusting for conventional risk factors such as hypertension, smoking, diabetes and hyperlipidemia.[55–57] The purported beneficial effects of nuts include improvement of serum lipid profiles and amounts of the nitric oxide precursor arginine, dietary fibre, and anti-oxidant vitamin-E.[58] Walnuts are particularly noteworthy for having high content of n-3 linoleinic acid.

Fibres, Grains and Cereals

Dietary intake of cereals, legumes, grains, fruits and vegetables should be stimulated due to their high fiber content increases digestion, avoiding intestinal carcinogen accumulation.[59] Fibre fermentation products also induce death of intestinal oncogenic cells,[60] decreasing the risk of gastro intestinal tumours. Fibre intake has been also associated with lowered risk of stomach adenocarcinoma, an effect mediated by increased faecal bulk transit time as well as inhibition of toxic biliary acid synthesis.[61] A diet poor in fat from calories and rich in fibre and whole grains also decrease the risk of endometrial cancers.[62] The American dietetic association (ADA) has recommended a dietary intake of 20 to 35 grams of fibre to improve digestion and prevent constipation, induce satiety, helping in obesity control, prevent and treat diverticulitis, decrease cholesterol absorption in the gut, for glycaemic control in diabetic patients; and to prevent colorectal cancer and possibly breast tumours.[63]

Table-1: System affected by nutritionally related disorders

Body system	Examples of disorders	Nutritional Factors
Nervous System	Cognitive impairment at all stages of life.	Deficiencies of iodine, Iron, folate, vit B_{12}, essential fatty acids (EFA)(-), Dyslipoproteinaemias dependent on apolipoprotein E status (-)
	Cerebrovascular disease Movement disorders (e.g., Parkinsonism)	Macrovascular disease risk factors Oxidants, antioxidants.
Reproductive System	Spermatogenesis, Menstrual cycle, Menopause	Food antioxidant capacity (+), Phytoestrogens (+), Phytoestrogens (+)
Respiratory System	Bronchoconstrition (asthma), Alveolar function (macrophages)	n-3 Fatty acids (+), Food antioxidants (+), Vit D (+)
Musculosketletal System	Inflammatory arthritis (e.g. rheumatoid arthritis), Bone health (osteoporosis)	n-3 Fatty acids, food antioxidants (+), Vit D (+), Ca, P (+), Na effects on Ca excretion (-), Homocysteine (through folate, vit B_6, vit B_{12}) (-), Vit A deficiency, toxicity (-), Fruit, vegetable phytochemicals (+), Vit C (+)
Gastrointestinal System	Microflora, gut function (gastric: Helicobacter pylori; colonic: chronic inflammatory bowel disease, neoplasia)	Prebiotics (+), Probiotics (+), Antibiotic factors (+/-), n-3 Fatty acids (+)
	Motility disorders	Caffeine (-), Polyphenolics (culinary herbs) (+), Ginger (+), Alcohol (-)
	Hepato-biliary, pancreatic	Growth factors (+/-)
Cardiovascular System	Blood pressure	n-3 Fatty acid sources (fish, plants) (+), Na (-), K, Mg, Ca (+)
	Lipids	Fatty fruits (olive, avocado, cocoa red plum) (+), Nuts (+), n-3 Fatty acids (+), Cholesterol (-), Phytosterols (+), Saturated and trans-fatty acids (-)
	Platelet function	n-3 Fatty acids (+), Salicylates (fruits) (+), Polyphenolics (plants) (+), Arginine (nuts) (+)
	Endothelial function, Glycaemic status and its Consequenes, Cardiac rhythm	Low glycaemic index food (+), Polyphenolics (+), Alcohol (-), n-3 Fatty acids (+)
	Abdominal fatness	Wholegrains, fruits, vegetables, (phytochemicals), dietary fibre (+)
Skin	Wrinkling (ageing), skin cancer (SCC)	Fatty fruits (+), Tocotrienol (vit E) (+), Phytonutrients (fruit, tea) (+)
Immunohaemato -logical System	Haemopoiesis Lymphoma and leukaemia	Micronutrients (+), EFA (+), Energy and protein deficiency(-), Paternal, Maternal nutrition (+/-)
Endocrine System	Thyroid	Iodine (+), Antithyroid factors (-)
	Insulin, pancreas	Energy balance (+/-), Food patterns (+/-), Intactness of foods (+)
Special senses	Olfactory	Myriad receptors for various food factors (+); link to memory
	Taste	Preferences, Polymorphisms, Threshold with are and food, Components (e.g. Na, caffeine)
	Auditory	Sounds of eating, e.g. crunch, grind) (+)
	Vision: Retinal function (night blindness) macular function (maculopathy), lens health (cataract)	Vitamin A, carotenoirds (+),Zinc (+), alcohol (-), Lutein, zeaxanthin, Antioxidant foods, Minimising UV damage
Mental health	Mood	Nutritional adequacy (+), Social role of food (+)

(+) favourable effects, (-) unfavourable effects *Adapted from wahlqvist*[65]

Table-2: Examples of Functional Foods

Class/ Component	Source	Potential Benefit
Carotenoids		
Alpha-carotene	Carrots	Neutralizes free radicals which may cause damage to cells
Beta-carotene	Various fruits, vegetable	Neutralizes free radicals
Lutein	Green vegetables	Contributes to maintenance of healthy vision
Lycopene	Tomatoes & tomato products (Ketchup, sauces, etc.)	May reduce the risk of prostate cancer and CVD. Inhibit LDL Oxidation.
Zeaxanthin	Eggs. Citrus, corn	Contributes to the maintenance of healthy vision
Collagen Hydrolysate		
Collagen Hydrolysate	Gelatine	May help improve some symptoms associated with osteoarthritis
Dietary Fibre		
Insoluble fibre	Wheat bran	May reduce risk of breast and/or colon cancer
Beta glucan	Oats	Reduces risk of cardiovascular disease (CVD)
Soluble fibre	Psyllium	Reduces risk of CVD
Whole Grains	Cereal grains	Reduces risk of CVD
Fatty Acids		
Omega-3 fatty Acids-DHA/EPA	Tuna; fish and marine oils nuts and seals (Oils)	May reduce the risk of CVD and improve mental, visual functions
Conjugated linoleic acid (CLA)	Cheese; meat products	May improve body composition, may decrease risk of certain cancers
Flavonoids		
Anthocyandins	Fruits	Anti-oxidant anti-microbial and anti-inflammatory activities; inhibit LDL Oxidation.
Catechins	Tea, Green& Black	
Flavanones	Citrus, Berries.	

Flavones	Fruits/Vegetables	
Glucosinolates, Indoles, Isothiocyanates		
Sulforaphane	Cruciferous vegetables (broccoli, kale), horseradish	Induces detoxification enzymes, may reduce the risk of cancer
Phenols		
Caffeic acid Ferulic acid	Fruits, vegetables, citrus Grape peals, Red wine.	Antioxidant-like activities, may reduce risk of degenerative diseases; heart disease, eye disease
Plant Sterols		
Stanol ester	Corn, soy, wheat, wood oils	Lowers blood cholesterol levels by inhibiting cholesterol absorption
Prebiotics/ Probiotics		
Fructo-oligisaccharides (FOS)	Jerusalem artichokes, shallots, onion powder	May improve gastrointestinal health
Lactobacillus	Yogurt, other dairy	Support GI health, boost immunity.
Saponins		
Saponins	Soybeans, soy foods, soy protein-containing foods	May lower LDL, cholesterol; anti-cancer activity
Soy Protein		
Soy Protein	Soybeans and soy-based foods	25 grams per day may reduce risk of heart disease
Phytoestrogens		
Isoflavones-Daidzein, Genistein	Soybeans and soy-based foods	May reduce menopause symptoms, such as hot flashes, Decreases Cancer risk and cardio vascular risks by scavengering free radicals.
Lignans	Flax, rye, vegetables	May protect against some cancers and heart disease
Sulfides/Thiols		
Diallyl sulfide	Onions, garlic, leeks, scallions	Lowers LDL cholesterol, maintains healthy immune system Antimicrobial and antioxidant activities.
Allyl methyl trisulfide, Dithiolthiones	Cruciferous vegetables	Lowers LDL cholesterol, maintains healthy immune system
Tannins		
Proanthocyanidins	Cranberries, cranberry products, cocoa, chocolate	Reduce Urinary tract infection. May reduce risk of CVD
Onion		
Myricetin & Quercetin	Onion	Antioxidant properties, protecting LDL and myocardium.
Trace-elements		
Selenium	Plants	Antioxidant; cardiovascular protector, induces cancer cell health.
Vitamin E		
Tocopherols	Oils (from rice, soy, olive), fats, rice	Inhibit lipid peroxidation (LDL), anticancer apoptic activities.
Mineral		
Calcium	Milk & derivatives	Decreases proliferation of colon cancer cells, lowering colon cancer risk inhibitor of tumour promoter enzyme ornithin decarboxylase's decrease gut proliferation and irritation.
Adapted from Ferrari[66]		

Future of functional foods

Extensive research is currently directed toward increasing our understanding of functional foods. Functional foods should be used with our conventional food ingredients this may help to prevent chronic disease or optimize health, therefore reducing health care costs and improving the quality of life.

An emerging discipline that will have a profound effect on future functional foods research and development effects is neutrigenomics which investigate the interaction between diet and development of disease based on an individual's genetic profile.[64] In February 2001 the complete sequence of the human genome was announced by Ventor and colleagues. This break through could make it feasible to tailor a diet for an individual's specific genetic profile.

Another technology that will greatly influence the future of functional foods is biotechnology. Examples of biotechnology-derived crops are golden rice and iron enriched rice, which can improve the health of millions world wide.[65] These grain are genetically engineered to provide enhanced level of iron and β-carotene which could, help in prevention of Iron deficiency anaemia and vitamin A deficiency-related Blindness.

CONCLUSION

Functional foods are not a magic bullet or a panacea for poor health habits. There are 'not good and bad foods' only good and bad dietary patterns. Diet is only one aspect of a comprehensive life style approach to good health, which should include regular exercise, tobacco avoidance, stress reduction, maintenance of healthy body weight and other positive health practices. Only when all of these issues are addressed then functional foods can provide health and reduce disease risk.

Further more, because most patients are curious and some what knowledgeable about their diets, physicians must establish a basic knowledge of

conventional functional foods, which is viewed increasingly as an adjunct to sound medical advice.

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