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REVIEW ON HERBAL NUTRACEUTICALS AS A HEALTH BENEFITS

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ABSTRACT

Nutraceuticals are food part or part of food that provides medical health benefits including the prevention or treatment of disease. Nutraceuticals has advantage over the medicines because they avoid side effects, have naturally dietary supplement, etc. nutraceuticals; on the basis of their natural source, chemical grouping, categories into three terms- nutrients, herbals, dietary supplements, dietary fibers. Dietary bioactive compounds from different functional foods, herbs and nutraceuticals (ginseng, ginkgo, nuts, grains, tomato, soy phytoestrogens, curcumin, melatonin, polyphenols, antioxidant vitamins, carnitine, carnosine, ubiquinone, etc.) can ameliorate or even prevent diseases. Protection from chronic diseases of aging involves antioxidant activities, mitochondrial stabilizing functions, metal chelating activities, inhibition of apoptosis of vital cells, and induction of cancer cell apoptosis. Functional foods and nutraceuticals constitute a great promise to improve health and prevent aging-related chronic diseases.

KEYWORDS: Dietary supplements, nutraceuticals, regulation, antioxidants, health benefits.

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1. INTRODUCTION:

The term nutraceuticals were coined from "Nutrition" & "Pharmaceuticals" by *Stephan DE Felice MD,* founder & chairman of the foundation for innovation in medicine (FIM) Cranford, New Jersey, in 1989 [1]. According to DE Felice "nutraceuticals" are food parts or the part of the food that provides medical or health benefits including the prevention and/or treatment of a disease [2]. Greek physicians HIPPOCRATES (known as father of medicines) said "let food be your medicines". The philosophy behind is "focus on prevention". Other words used in the context are dietary supplements, functional food, multifunctional food, etc. functional food are ordinary foods that have components, ingredients that incorporated into give them specific medicinal or health benefit more over nutritional effect [3].

According to dietary supplement, health & education act (DSHEA) dietary supplements are products intended to supplement the diet that bears or contains one or more of the following dietary ingredients: a vitamin, a mineral, an herb or other botanical, an amino acid, a dietary substance for use by man to supplement the diet by increasing the total daily intake or a concentrate, metabolite, constituents, extract or combination of these ingredients [4]. It may be taken in the form of pill capsules, tablet or liquid form. It's not represented for use as a conventional food or as the sole item of a metal or diet. It is labeled as "dietary supplement" [5]. Under the DSHEA (1994), the manufacturer of a dietary supplement is responsible for ensuring that the dietary supplement is safe before it is marketed [6].

The functional food concept can be defined as "Food products to be taken as part of the usual diet in order to have beneficial effects that go beyond basic nutritional function." Baby foods, sport drinks, enriched cereals, breads and other food share considered as functional foods. Some reports that, the Vitamin B-enriched, some was found to protect pellagra; vitamin D-enriched milk

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was effective in eliminating rickets and iodine-Fortififed salt decreased incidences of goitre. Functional foods are different from medical foods and are distributed and regulated separately. Functional foods could be consumed freely as part of our everyday life, whereas medical foods and drugs are consumed when recommended by medical professionals. Aim of this review was to focus on the role of functional foods on human health and to understand its use against different diseases and about its production in the industry [7].

Table 1: Classification of herbal nutraceuticals with examples [8]

Class	Example
Inorganic mineral supplement	Minerals
Vitamin supplements	Vitamins
Digestive enzymes	Enzymes
Probiotics	Digestive enzymes
Dietary fibers	Fibers
Cereals & grains	Fibers
Health drinks	Fruit juice
Antioxidants	Vitamin c
Phytochemicals	Carotenoids
Herbs as functional food	Soy proteins

Table 2: Common herbals as nutraceuticals [9]

Common name	Biological name	constituents	Health benefits
Garlic	Dried bulbs of *Allium sativum*	Allin & allicin	Anti-inflammatory
Maiden hair tree	Leaves of *Ginkgo biloba*	Ginkgolide & bilobalide	Memory enhancer
Echincea	Dried herb of *Echinacea purpurea*	Alylamide & Echinacoside	Immunomodulator
Ginseng	Dried root of glycyrrhiza & liquidrizin	Gienosides & panaxosides	Adaptogenic properties
Liquorice	Dried roots of *glycyrrhiza glabra*	glycyrrhizin	expectorant
Onion	Dried bulb of *cepa linn*	Allicin &allilin	anticancer
Aloe	Dried juice of *aloe barbadenis*	Aloins & aloesin	Migraine, menstrual pain
Senna	Dried leaves of *cassia andustifolia*	sennosides	purgative
Brahmi	Herbs of *centella asiatica*	Asiaticosides	Anti-anxiety, nervinetonic.

1.1 Health benefits of Nutraceuticals

Nutritional therapy is a healing system using dietary therapeutics or nutraceuticals as a complementary therapy. This therapy is based on the belief that foods can not only be sources of nutrients and energy but could also provide medicinal benefits. According to nutraceutical and nutritional therapy theory, it achieves this goal by using efficacy of such nutraceuticals in detoxifying the body, avoiding vitamin and mineral deficiencies, and restoring healthy digestion and dietary habit. Phytonutrients basically is plant nutrients with particular biological activities in supporting human health [10].

1.1.1 Advantages:

1. Avoid the risk of side effect.
2. They may increase the health beneficial effect.
3. It provides naturally dietary supplement, so do not have harmful effects.
4. They may increase the health value, our diet and improve medical condition of human.
5. Herbal nutraceuticals easily be available and economically affordable. [11]

1.2 Classification of Herbal Nutraceuticals

Nutraceuticals or functional foods can be classified on the basis of their natural sources, pharmacological conditions, or as per chemical constitution of the products.

1. On the basis of natural source, it can be classified as the products obtained from plants, animals, minerals, or microbial sources.
2. Nutraceuticals as per the chemical groupings.

Table 3: List of marketed nutraceutical products [12]

Product	Category	Contents	Manufacturer
Calcirol D-3	Calcium supplement	Calcium & vitamins	Cadilla healthcare lim, Ahmedabad, india
GRD	Nutritional supplement	Proteins, vitamins, minerals & carbohydrates	Zydus cadila Ltd. Ahmeabad, india
Proteinex	Protein supplement	Predigested proteins, vitamins, minerals & carbohydrates	Pfizer Ltd., Mumbai, India
Coral calcium	Calcium supplement	Calcium and trace minerals	Nature's answer, Hauppauge, NY, USA
Chyawanprash	Immune booster	Amla, ashwagandha, pippali	Daburindia Ltd.
Omega woman	Immune booster	Antioxidants, vitamins & phytochemicals (e.g. Lycopene & resveratrol)	Wassen, surrey, U.K.
Celestial healthone	Immune booster	Dry fruit extract	Celestial biolabs, limited
Amiriprash	Good immunomodulator	Chyawanprash Avaleha	Uappharmapvt. Limited.

1.2.1 Category of Nutraceutical

- Substances with established nutritional functions, such as vitamins, minerals, amino acids, and fatty acids–Nutrients.
- Herbs or botanical products as concentrates or extracts–Herbals.
- Reagents derived from other sources (e.g., pyruvate, chondroitin sulphate, steroid hormone precursors) serving specific functions, such as sports nutrition, weight-loss supplements, fortified conventional foods, and meal replacements–Dietary supplements.

Dietary supplements are not intended to treat or cure disease, whereas nutraceuticals more emphasize the expected results of these products, such as prevention or

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treatment of diseases. Some of the most common ways of classifying nutraceuticals can be based on food sources, mechanism of action, chemical nature.

The food sources used as nutraceuticals are all natural and can be categorized as-

1. Dietary Fibre.
2. Probiotics.
3. Prebiotics.
4. Polyunsaturated fatty acids.
5. Antioxidant vitamins.
6. Polyphenols.
7. Spices.

Nutraceutical can be broadly classified into the following 2 groups:

i) Potential nutraceuticals.
ii) Established nutraceuticals.

A potential nutraceutical could become an established one only after efficient clinical data of its health and medical benefits are obtained [13].

1.3 Functional food & plant sources:

Epidemiological evidence (*in vivo & in vitro*) & clinical trials data indicates that plant-based diet can reduce the risk of various chronic diseases. In 1992, a review of 200 epidemiological studies demonstrated that risk of cancer fruits [14]. This work demonstrated that, bioactive compounds of plant-based diets can reduce risk of cancer. Cereals & its ingredients are very good source of dietary fibres, proteins, energy, minerals, vitamins. Wheat, oat, barely, flax seed, brown rice & soy products are important cereal based functional food & nutraceuticals [15]. The fermented cereals can be used for the growth of probiotic microorganism also. This review demonstrates health benefits of some plant based functional food [16].

1.3.1 Oats- Oats, commonly known as *Avena sativa* are considered as a minor cereal crop which comes under *popaceae* family [17]. Higher level of protein, lipids, vitamins, minerals, antioxidants & phenolic compounds accounts for the nutritional significance of oats. Oats products are good source of beta glucan, a soluble fibre which has cholesterol lowering capacity, reduce low density lipoprotein. Contain antioxidants compounds, improves gastrointestinal function & glucose metabolism [18]. Human clinical trials conducted on hyper-cholesterolemic subjects demonstrated 5% reduction in serum cholesterol due to intake of 60g oatmeal or 40g oat bran containing 3g of beta glucan [19].

1.3.2 Soy [20-27]

Asian countries are consuming soy foods centuries [20, 21]. Soy has been in the spotlight during the 1990s, soybean (*Glycine max)* consists of mainly isoflavones which are group of naturally occurring heterocyclic phenols which perform several health promoting functions. Soy contains high quality protein & it plays preventive & therapeutic roles against diseases like cardiovascular disease (CVD), cancer, osteoporosis & the alleviation of menopausal symptoms [22]. The cholesterol-lowering effect of soy is the well documental physiological effect [23]. There is strong evidence that soy-based diets consumption leads to decrease total cholesterol, LDL cholesterol, serum lipid concentration & triglyceride level [24]. According to meta-analysis of 38 separate studies involving 743 subjects, consumption of soy proteins significantly reduced LDL cholesterol (12.9%), total cholesterol (9.3%), triglycerides (10.5%). Isoflavones is the key component for the cholesterol-lowering effect of soy. Soy proteins help to decrease LDL synthesis in liver & it can reduce insulin\ glucagon ratio. Isoflavones are heterocyclic phenols structurally similar to the estrogenic steroids [25]. Among the isoflavones, genistein & daidzein are the most notable & soyabean are the significant reported that isoflavones can prevent intestine, prostate, stomach & breast cancers. Another study described that soybeans contains several classes of anti- carcinogens, protease inhibitors, phytosterols, phenolic acid, saponins, isoflavones & phytic [26]. The soy increases bone density & also helps to reduce menopausal symptoms [27].

1.3.3 Rice

Rice is the most significant cereal crops and a staple food for most of the world's population. Rice is a very good reservoir of hypo allergenic protein and lysine. Protein quality of rice is superior to that of wheat and corn [28]. Amino acid composition of rice protein was better than soy protein and casein. It can be a suitable ingredient for infant food formulations. Rice based fermented foods are highly acceptable because of its calorie value [29]. Chung stated that white rice with combination of 8% pigmented giant embryonic rice (*Keunnunjami*) is functional food which has strong hypolipidemic and anti-obesity properties. Choi described the anti-diabetic property of germinated brown rice extract [30].

1.3.4 Wheat

The most widely cultivated cereal crop in the world is wheat which is mainly used baking [31]. Wheat was cultivated first about 10000 years ago [32]. Common wheat (*Tritium aestivum)*, also known as bread wheat, is suitable for biscuits [33]. Free & esterified phenolic acid of wheat have the greatest potential health benefits [34]. Whole wheat & wheat bran bread cereals are significant source of dietary anti-oxidants. Wheat is source of zinc, Iron & selenium [35]. Recently it was demonstrated that whole wheat flour & bread have more antioxidants capacity than refined flour. Wheat bran are rich in phytochemical like phenolic acid &betaine which are beneficial for [36].

1.3.5 Maize

Among the versatile emerging crops, maize is the most important because of its adaptability with varied agro-climatic conditions. Globally, it is considered as queen of cereals for its highest genetic yield potential. After rice and wheat, maize is the third most important cereal for human foodstuff by contributing 9% to Indian basket and5% to World's dietary energy supply [37]. Decortications by abrasion are feasible to obtain smooth texture of cooked products from maize because of its hardness and size and fine grinding is essential [38]. In Pharmaceutical industry, to release tablet formulation immediately pre-gelatinized maize starch was used and it was also considered for sustained release formulations [39].

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1.3.6 Barley

Barley (*Hordeum vulgare*) grain is used as feed, malt, and food [40]. Barley is used as flour, as semolina, and as whole grain. Barley is rich in dietary fibre, both insolubeand soluble fibres. Fibre constituents of barley have protctive and therapeutic effects against various metabolic disorder like cardiovascular diseases, certain cancers and type 2 diabetes[41] beta glucan, which is a key component of soluble fibre implicated in hypercholesterolemia, hypoglycaemia, and decreases the incidence of chemically induced colon cancer inpreclinical model, lowers postprandial plasma glucose and a meliorate sinsulin resistance [42]. Multiple varieties of dishes such as soups, couscous and bread are made by barley products [43].

1.3.7 Millets *(Eleusine coracana)*

Millets belongs to the family Poaceae. Millets are small seeded, annual cereal grasses which can survive in less fertile soil [44]. Millets include sorghum (Jowar), proso millet (Chena), pearl millet (Bajra), foxtail millet (Kakum), finger millet (Ragi), little millet (Kutki), kodo millet (Kodon), barnyard millet (Sanwa), and brown top millet [45,46].

Eleusine coracana is widely cultivated in the arid areas of Africa and Asia. Finger millet is one of the oldest crops in India [47]. In India, it is cultivated over an area of 2.65 million hectares [48]. Millet is considered as one of the important staple foods in some parts of Africa and India (FAO). In India, finger millet was processed by grinding, malting, and fermentation for products like beverages, idli, dosa, and roti [49]. Germinated finger millet can be a good substrate for statins (anti-hypocholestrolemic metabolites) production [50]. Various *in vitro* and i*n vivo* studies demonstrated its blood glucose lowering, cholesterol lowering and wound healing properties [51]. It can be used for the preparation of dietetic foods for anaemia patients and geriatric food formulation [52]. Several works demonstrated the antioxidant properties of millet [53]. Finger millet also possesses anti microbial activities [54]. Protein glycation, one of the complications of diabetes, was inhibited by methanolic extract of finger millet [55]. As reported that finger millet phenolics can inhibit abledose, reductase and snake venom phospholipases (PLA2) too. Among the cereals and millets, finger millet is the richest source of calcium (344 mg %) and potassium (408 mg%).

1.3.8 Sorghum (Sorghum bicolour)

Sorghum is a cereal which belongs to the family Poaceae. It is considered as major source of carbohydrates and proteins. Sorghum is used as human food worldwide [56]. Pigmented sorghum is a good source of dietary phenolicsmainly flavones, flavanones and deoxy anthocyanidins. Several researches have demonstrated anticancer activities of phenolic compounds of sorghum, especially 3 deoxyanthocyanidins and it is effective on various cancers such as skin melanoma, liver, colon, breast, and oesophagus. Sorghum is also effective on diabetes, inflammation, hypertension [57].

1.3.9 Fig (Ficus carica)

Figs belong to the Moraceae family. Semi-arid climate is suitable for fig. Figs are usually dried and stored for later consumption. Medicinal value of figs already documented in various research papers and it has been demonstrated that figs has positive impact to treat respiratory, anti-inflammatory disorders, anti-cancer, antiviral, cardiovascular, aphrodisiac, hair nutritive [58], anti-diabetic, hypolipidemic, antipyretic, antibacterial, antifungal, scavenging activity and immune response[59]. It was demonstrated that ripe dried fig has potential effect on gastrointestinal, inflammatory disorders, and anti-infertility. The wildlife Conservation Society of New York reported that, wild figs are considered as “keystone” fruit due to its high calcium content. Hepatoprotective activity of figs has been demonstrated previously. Other than fruits, latex of figs also has various medicinal importances. Leaves of fig tree are very useful to treat diabetes and contact dermatitis [60].

1.3.10 Fenugreek (Methi)

Fenugreek (*Trigonella foenum-graceum*) is a semi-arid crop belongs to Fabaceae family and is cultivated worldwide. Fenugreek seeds and green leaves are used in food as well as in medicinal application. Fenugreek paste, locally termed as ‘Cemen’ is a popular food in Turkey [61], which is prepared from ground fenugreek seeds. Crushed fenugreek seed is used to make ball to make clarified butter. Fenugreek has strong spicy and seasoning type sweet flavour. Aromatic and flavourful fenugreek is a popular spice and is widely used for well-known medicinal properties. India is a major producer of fenugreek and also a major consumer of it for its medicinal application. It is used as a functional food, traditional food and nutraceuticals. Demonstrated hypo-cholesterolemic activities of fenugreek seeds and reported that fenugreek seeds lowered serum cholesterol, low-density lipoprotein (LDL) and triglyceride in hypercholesterolemic patients. According to Fenugreek consumption in diet reduced triglyceride accumulation in the liver. Fenugreek also used as an antibacterial, anticancer, antiulcer, antioxidant, and antidiabetic agent. It helps to improve digestion. Fenugreek contains different alkaloids, Flavonoids and saponins. As per reported that fenugreek seeds showed hypoglycaemic and anti-hyperglycaemic activity in diabetic mice. The aqueous extract of fenugreek showed significant positive effect on ulcer. It has soothing effect on gastric and gastric ulcer. Fenugreek possess various bioactive compounds, amongst them trigonelline, galactomannan, diosgenin, 4-hydroxyisoleucin, and soluble dietary fibre fraction are important. Several study revealed anti-diabetic property of diosgenin in animal model. Recently, demonstrated that, trigonelline which is bioactive compound of fenugreek is responsiblefor anti-diabetic property of fenugreek and it decreases blood cholesterol too [62]. Diosgenin is one of the important bioactive compounds of fenugreek and it is used as contraceptive pills. Dietary fibreof fenugreek seed is used for cooking and it is very active to reduce postprandial hyperglycemia in preclinical model and decrease serum lipids. Fenugreek provides natural food fibre and other nutrients required for human body. Saponins are found to be in maximum concentration in the fenugreek and Choline content is very high in fenugreek. Fenugreek seed is richer in multivitamin such as Vitamins-A (1040 IU per 100 g), B1(0.41 mg per 100 g), B2 (0.36 mg per 100 g), C (12.0 mg per 100 g),

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nicotinic acid (1.1 mg per 100 g) and niacin (6.0 mg per 100 g).

1.3.11 Mushroom

Cordyceps militaris is widely distributed in China, Tibetan Plateau, Bhutan, Nepal and north east India at high altitude. In traditional Chinese medicine it is used as a tonic herb. *C. militaris* has traditionally been used as a functional food and several bioactive compounds like adenosine, cordycepin, polysaccharides, mannitol, and ergosterol have been isolated from it. It can be used to treat various inflammatory disorders and boosting the immune system. Several researches demonstrated its promising activity in various inflammatory disease models like oval bumin-induced asthma, dextran sodium sulphate (DSS)-induced colitis, and croton oil-induced earoedema. Humoral immune hyper-function was inhibited by cultivated Cordyceps and its improved liver function of post-hepatic cirrhosis patients by up regulates the level of the serum complement. Recently, *C. militaris cultivated* on germinated soybean (GSC) extract and it was very effective against allergy and Type I hypersensitive animal model.

1.3.12 Flax seed: Flax (*Linum usitassimum*) is a blue flowering annual herb comes to Linaceae family. It produces golden yellow to reddish brown coloured flax seed. It has been used for medicinal purposes for over 5000 years. More than 50 countries cultivate flaxseed. According to Oomah, World's largest producer and exporter of flax seeds is Canada. Scientific research has focused on fibre-associated compounds known as lignans. Flax seeds are very effective in several diseases like diabetes, arthritis, neurological disorders, osteoporosis, cardiovascular disease, cancer and various chronic non-communicable. Consumption of flaxseed has also been shown to lower LDL cholesterol and platelet aggregation. Several researches supported the chemo protective activities of the omega-3s and lignin phytoestrogens of flaxseed in human and animals [63]. Oestrogen dependent cancers can be prevented by mammalian lignans. In rodents, flax seed has been shown to decrease tumours of the colon and mammary gland as well as of the lung. Different studies demonstrated that, consumption of flaxseed Reduce breast and prostate cancer. It has also been reported that the ingestion of 10 g of flaxseed daily elicited several hormonal changes associated with reduced breast cancer risk. Recent study revealed the anti-hepatotoxicity property of flax seed oil. *In vivo*, *in vitro* and *in silico* study reported that, dietary flax seed might be a good approach to treat muscle dystrophies.

1.3.13 Tomatoes (*Solanum lycopersicum*)

Tomato is an important vegetable because of lycopene which is the primary carotenoid found in this fruit. Different products are obtained from tomato, such as ketchup, sauces, and soups. The tomatoes are rich in various bioactive compounds such aslycopene, beta-carotene, phenolic compounds, flavonoids, glycoalkaloids, tomatine pro-vitamin A and vitamins C and E. A clinical tudy by Giovannu demonstrated that, tomato can reduce developing advanced prostate cancer. Recent study revealed dietary lycopene consumption protect from prostate cancer by ERG protein expression. Other than prostate cancer, it also has positive effect on breast, digestive tract, cervix, bladder, and skin cancer [64]. Along with peroxyl radicals scavenging capacity lycopene can also scavenge nitrogen dioxide and hydrogen peroxide. Lycopene is the most effectiveas singlet oxygen quencher inbiological systems. Several works demonstrated that lycopene bioavailability of processed tomato is more than unprocessed tomato. Recent study showed the hypolipidemic activities of processed tomato juice in animal model. Tomato drink can reduce about 42% DNA damage in lymphocyte caused by oxidative stress.

1.3.14 Pumpkin (Cucurbita pepo**)**

Cucurbita pepo (pumpkin) comes under the family Cucurbitaceae. Cultivation of pumpkin originated in central Africa on 5500 BCoils, essential fatty acid such as omega 6 and omega 9, phytosterols, andante oxidants such as tocopherols, carotenoids, vitamin A and vitamin E. Various ethno pharmacological studies demonstrated that *Cucurbita pepois* used as antiviral, analgesic urinary disorders, antimicrobial, anti ulcer, antidiabetic, anti cancer, and antioxidant in various diseases. Low dose pumpkin showed hypoglycaemic activity by decreasing triglycerides, LDL and CRP (C-reactive protein) and high dose pumpkin decreased cholesterol. Pumpkin is used as anti-diabetic traditionally medicine worldwide. Several studies reported that pumpkin exhibits anti-diabetic activities in mice model. Another research demonstrated anti-diabetic effect of tocopherol fraction of pumpkin seed oil in Wistar rats [65]. Pumpkin helps to improve pancreas beta cell functionality by increasing the number of insulin positive cells. It is also very effective against alcohol induced hepatic damage. Recent research stated that, the pumpkin seeds are very useful to manage the benign prostatic hyperplasia.

1.3.15 Garlic

Garlic (*Allium sativum*) was originated in Central Asia and is used universally as a flavouring agent as well as traditional medicine and a functional food to enhance physical and mental health. The health benefits of garlic are numerous, including anti-diabetic, cholesterol-lowering properties, chronic inflammation, Cancer chemo preventive anti-aging, antibiotic, and anti-hypertensive, increase blood circulation, anti-gastric cancer, antioxidant. Garlic has various medicinal values due to its oil-and water-soluble, sulphur-containing elements. The Whole garlic bulb contains alliin, a derivative of the amino acid cysteine. Alliin is converted to allicin by alinase. Allicin is responsible for the pungent odour of fresh garlic. Alliin was the first Natural compound which has both carbon and sulfur-centered stereochemistry. Allicin have been investigated for their chemo-preventive activity [66]. Water content is 65% of fresh weight of garlic and the bulk of the dry weight is composed of mainly fructans, a fructose-containing carbohydrate, followed by other compounds like fibre, sulphur compounds, free amino acids and protein. Several works demonstrated that, garlic extract capable to reduce diet-induced hyper-cholesterolemia. Garlic has also been used for the prevention of CVD [67]. The cardio protective effects are more likely due to its cholesterol-lowering effect. A meta-analysis demonstrated that, an average of 900 mg garlic/day can reduce 9% serum cholesterol. Some authors suggested

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that garlic can reduce total cholesterol levels by 12%. Although another study reported that, 12 weeks of garlic treatment was ineffective to reduce cholesterol in hypercholesterolemia subject. Anti-tumor genesis activity of garlic has been demonstrated in several preclinical models. Several epidemiological studies demonstrated that, stomach cancer risk can be reduced by increasing allium intake. In a clinical study with more than 40,000 postmenopausal women showed that, garlic consumption can reduce nearly 50% risk of colon cancer. Antimicrobial activity of garlic has been documented from long time and Mr. Louis Pasteur also demonstrated the same. Several recent studies also reported the promising effect of aqueous garlic extracts against various bacteria as antibacterial agent. Recent study demonstrated that, allicin and other organo sulphur compounds from garlic showed promising antibacterial effect on methicillin-resistant *Staphylococcus aureus* (MRSA) which are now considered as a major hospital acquired pathogen all over the world. It has been shown hepatoprotective activities of garlic in several studies also. Due to hepatoprotective effect of garlic, it can be a very good supplementation with firstline anti-TB drugs. Antimicrobial activity of garlic against *Mycobacterium tuberculosis* was firstly documented in 1946. Another study reported that, being promising antimicrobial agent, aqueous extract of garlic can be useful for dental caries and periodontitis.

1.3.16 Cranberry (Vaccinium macrocarpon**)**

Cranberry belongs to the Ericaceae family and 90% of total production of it contributed by North America and Canada. Intake of cranberry juice significantly increases plasma anti oxidant level. Cranberry juice has been recognized as efficacious in the treatment of urinary tract infections since 1914. Several investigations have exhibited the ability of proantho cyanidins of cranberry juice to inhibit the attachment of *Escherichia coli* Touroepithelial cells. Cranberry is beneficial to various diseases like several *in vitro* studies supported the anti-cancer property of cranberries [68].

1.3.17 Cocoa (Theobroma cacao**)**

Theobroma *cacao* is commonly known as cacao tree or cocoa tree. The cocoa tree originated from ancient Central America. Cocoa and cocoa-rich chocolates are very popular and widely consumed food component. Cocoa is beneficial on blood pressure, vascular, platelet function and insulin resistance. Cocoa beans and their parts are important ingredients for making chocolate. Cocoa is among the richest sources of polyphenols and the total polyphenol content of the cocoa bean is about 6-8% by dry weight. Flavonoids, polyphenols, and procyanidins are the most important bioactive compounds with disease preventive characteristics. Cocoa and cocoa products are recognized for health benefits related to hypertension, diabetes, anaemia, cardiovascular diseases, atherosclerosis, obesity, tuberculosis, fever, gout, kidney stones, mental fatigue, poor sexual appetite, neurodegenerative diseases and cancer [69]. Recent meta-analysis study stated the blood pressure lowering property of cocoa rich food and it has been found that, in addition to the hypotensive effects, cocoa flavanols reduce adipose tissue by stimulating thermo genesis and lipolysis. Recent research demonstrated that, cacao osmotin and its derived peptides might be a good drug candidate against pathogenic fungi [70].

1.3.18 Peanut

Peanut is an important crop worldwide and by-products of peanut contain vitamins, proteins, antioxidants, fibres, polyphenols, and minerals. These ingredients are used in many processed foods. Some reports described that, peanuts are also source of flavonoids, phytosterols and phenolic acids which are able to block the absorption of cholesterol from diet. Peanut also contains 20 amino acids and known for its disease preventive properties.

1.3.19 Strawberry

Strawberries, a rich source of phytochemicals and vitamins are considered as functional food for their preventive and therapeutic health benefits. Strawberry is also known for its antioxidant capacity. Many studies found its anti-inflammatory, Anti hyperlipidaemic, antihypertensive, or antiproliferative effects principally via down regulation of NF-kB activity. Strawberries are a significant source of flavonoids. Flavonoids have been shown to have direct antibacterial activity. Different epidemiological studies support the protective effects of strawberries against cancer, inflammation, cardiovascular mortality and hypertension. Some studies demonstratethat, strawberries reduce oxidant stress. Different epidemiological and clinical studies observed cardioprotective effects of strawberries. Using in vitro models reported the role of strawberry phytochemicals in managing hyperglycaemia and hypertension. Another report demonstrated berry polyphenols as a potential phytotherapy in obesity and hyperglycaemia. Strawberry has been shown to exert anti carcinogenic effects. As per showed the effects of freeze-dried strawberries on the inhibition of tumours in rodents. Tannins (a specific strawberry polyphenols) showed significant anticancer effects in human breast, cervix, and colon carcinoma cells. Ellagic acid found in strawberries demonstrated anti carcinogenic effects in several human cancer cell models in some studies. Several studies described the role of strawberries in curing age related neurodegenerative disorders.

1.4 Functional Foods from Animal Sources:

Some animal products with potential beneficial effects on human health are considered as functional foods. Some examples are as follows:

1.4.1 Fish

Fish contain animal protein. Fish oils contain the omega-3 (n-3) polyunsaturated fatty acids, vitamins and minerals. The omega-3fatty acid is an essential class of polyunsaturated fatty acids (PUFAs). Omega-3 fatty acids can reduce the rate of cardiovascular diseases or CVD and it can also lower triglyceride level. Studies by reported the effects of omega-3 fatty acids to reduce the incidence of CVD. Some observational studies report a decrease in cardiovascular disease with higher fish oil intake. Omega-3 fatty acids also decrease the risk of thrombosis. Consumption of 35g of fish per day has been shown to reduce the risk of total mortality by cardiovascular disease. Fish oil also plays role in

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decreasing weight and waist circumference. The evidence of fish oil supplements lowering triglycerides has been found in dialysis patients. Saccone and Berghella reported that, fish Oil supplements appeared to be associated with greater weight at birth of the child. Another report demonstrated that, supplementation of fish oil improves the quality of life in patients with chronic heart failure. Some studies reported that, patients with a higher consumption of fish are less likely to have type 2 diabetis as compared to patients with lower fish consumption. Recent randomized, controlled clinical trial by Phase showed the effects of long-chainomega-3fish oils on cognitive and cardiovascular function.

1.5 Dairy products

Dairy products are considered as functional foods as they are rich of calcium. Fermented dairy food products could prevent diseases such as hypertension. Calcium helps preventing osteoporosis and possibly colon cancer. Other than calcium, many other components in fermented dairy products are known as probiotics. Probiotics are microorganisms with health benefits to the host animal by improving its intestinal microorganisms. Probiotics are termed as functional foods which can alter and modify pre-existing intestinal flora. Both beneficial (e.g. Bifidobacterium and *Lactobacil lus*) and detrimental (e.g. Enterobacteriaceae and *Clostri dium* spp.) bacteria inhabit the human gastrointestinal tract. Among these bacteria, lactic acid bacteria are used in food fermentation. Probiotics are known for their anti-carcinogenic, hypo-cholesterol emic and antagonistic actions against gut pathogens. Probiotics are used in colon cancer risk reduction. This is because lactic acid cultures are able to alter the activity of faecal enzymes such as beta-glucuronidase, azoreductase, nitro reductase which plays a role in the development of colon cancer the prebiotics are defined as non-digestible food ingredients that beneficially affect the host by selectively stimulating the growth or activity of one or a few number of bacteria in the colon and thus improves host health. These include starches, dietary fibres, sugar alcohols, and oligosaccharides. Among these prebiotics oligosaccharides found naturally in many fruits and vegetables and have received great attention for their health benefits. Prebiotics as food additives are valuable for functional foods and also helps in preventing diet-related diseases. The prebiotic concept has been further extended to understand the effect of the symbiotic which is a mixture of pro-and prebiotics. Many such symbiotic products are currently on the market in different countries. Recently our group demonstrated the use of combination of probiotic microbial.

1.5.1 Animal foods

Some animal foods such as vitamin-like substances, coenzyme Q10, beta-lipoic acid and others are considered as physiologically active compounds. According to some report's carnitine is an essentialnutrient in infancy. Coenzyme Q10 is a vitamin-like substance and plays an important role in the generation of cellular energy in the human body. It also helps in healthy cardiovascular effects. beta-Lipoic acid has been known for its antioxidant activity. Table 5 showing some examples of nutraceutical substances grouped by food source and Table 6 showing some of the food ingredients approved by Food Safety and Standards Authority of India (FSSAI) in India.

1.6 Impact of Urbanization on Health and Functional Food Market

The direct and indirect beneficial effects of functional food depend on environmental factors such as place and time of cultivation. The benefits and risks of functional foods to individuals and populations as a whole must be determined carefully Industrialization, globalization and urbanization, these three factors influence, Indian life-styles and food habit. In India, incidence of lifestyle related health problems such as diabetes, cardiovascular diseases, hypertension and obesity increasing rapidly. Day by day people are becoming disease prone due to the stressful work and less physical activity. Work related stress leads to many diseases such as hypertension and cardiovascular diseases. Choice of foods and diet structure such as fast food and added sugar in the diet gradually are changing the human health quality. In this current scenario functional food plays an important promising role in the healthy human life. Indian consumers markets are increasing for a healthy food as well as demand of functional foods are increasing in Indian food industry.

1.7 Indian Functional Food and Nutraceutical Market Size and Growth

Among the developing countries, India is the most potential market for nutraceuticals and dietary supplement products. Nutraceuticals market is growing rapidly in comparison to other sectors of Indian food market. According to Ernst and Young study, Indian functional food market tin 2008 was about INR 30 billion, apart from the dietary supplements and it has grown at a CAGR (compound annual growth rate) of 18% as compared to a world average of 7%. Indian functional food market deals with products like fruits, vegetables, fortified juices, energy drinks, fresh dairy products, confectionary, breakfast cereals, and fibre rich foods which imparting the desired health benefits and physiological changes. Main ingredients of these products are probiotics, prebiotics, omega fatty acids fortified foods, tocopherols, phytoestrogens, xylitol, soy, gluten and whey proteins. In 2010, about116 new functional food products were launched in India. Out of these, 80 products were targeted at enhancing the cardio vascular functioning and the rest 36 at promoting the immunity [71].

CONCLUSION:

Nutraceuticals have proven health benefits and their consumption (within their acceptable Recommended Dietary Intakes) will keep diseases prevention and allow humans to maintain an overall good health. Although nutraceuticals have significant promise in the promotion of human health and disease prevention, health professional, nutritionists, and regulatory toxicologist should strategically work together to plan appropriate regulation to provide the ultimate health and therapeutic benefit to mankind. That is why implementation of regulatory body is necessary to standardize the nutraceutical industry. It is also necessary to review this topic because the nutraceutical industry is growing at a rate far exceeding expansion in the food and pharmaceutical industries. Herbal nutraceutical is a

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powerful instrument in maintaining health and to act against nutritionally induced acute and chronic diseases, thereby promoting optimal health, longevity, and quality of life. Functional foods are an important part of healthy lifestyle that also includes a balanced diet and physical activity. Phytochemicals, micronutrients in food and animal resources, microbes and their metabolic by-products directly or indirectly help mobilize the body's physiological network encompassing the neuro-immuno-endocrine cycles and help maintain optimum health. Future more research on nutraceuticals will expand the existing knowledge of functional food as well as developing specific strategy in the biodiversity management.

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Disclosure of conflict of interest

The author declares no conflict of interest.

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