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NEUTRACEUTICALS: ROLE OF NATURAL MOLECULES IN PHARMACOTHERAPY

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ABSTRACT

In recent years there is a growing interest in neutraceuticals which provide health benefits and acts as an alternative treatment to the modern medicine. The ability of neutraceuticals to influence chronic diseases like diabetes, different types of cancers, etc. should be recognized as an enormous opportunity in their treatment by using natural molecules. These neutraceuticals are the medicinal food that not only enhances the human health but modulates immunity and intern prevents and also helps in curing certain specific diseases. Neutraceuticals may range from natural diets, herbal and polyherbal products to genetically engineered foods and also the processed products such as cereals, soups and beverages. These neutraceuticals play a vital role in future therapeutic development. By employing the neutraceuticals in the armamentarium of pharmacotherapy it is possible to reduce or even eliminate the need for conventional medications, which intern helps in reducing the chances of the associated adverse effect and thus promoting the quality of life. Pharmaceutical and nutritional companies are aware of the monetary success taking advantage of the more health-seeking consumers and the changing trends in the therapeutic interventions resulting in value-added products aimed at better health for tomorrow. The neutraceuticals revolution will lead us into a new direction of medicine and health. Attempts were made to review the neutraceuticals as an alternative treatment for different types of disease. Primarily which is aimed at cost effective treatment with less or no side effects.

KEY WORDS: Nutrition, neutraceuticals, natural molecules, herbs, pharmacological agents

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INTRODUCTION

Neutraceuticals are the derived product that ranges from isolated nutrients, dietary supplements and herbal products, specific diets and processed foods such as cereals, soups, and beverages[1] etc. They provide extra benefit to the human body and the deficiency in them leads to disorders. The associated risk of toxicity or adverse effect of drugs led us to consider safer neutraceuticals and functional food based approaches for the management of health. This intern resulted in a worldwide revolution in neutraceuticals. This revolution will direct us into a new age of medicine and health[2]. The food industry will become a research-oriented industry on par with the pharmaceutical industry. The neutraceuticals are usually based on nutrition and pharmaceutical intervention. They are classified as dietary supplements and functional foods[3]. The dietary supplements are derived from food products and are concentrated in the form of liquid or capsules. These supplements are usually incorporation in the patient diet for attaining the quality life. The functional foods are processed so that the consumers can consume enriched food close to the natural food. Some additional complementary nutrients are added for restoration of nutrient content to the food. Intern these functional foods regulate the biological process and helps in preventing the disease promotion. These neutraceuticals acts as a bridge between the food and medicine[4]. The global market size is estimated to rise annually between 30 and 60 billion US$, with Japan, US, and Europe occupying the biggest share when compared to our country. By 2020 the neutraceuticals demand is forecast to touch $200 billion (Fig 1). The neutraceuticals market in India is estimated to grow to US$2,731 million in 2016 at a CAGR of 13% Bio-spectrum Asia Edition, 16 March 2012. The standardization of neutraceuticals products and execute them up to the clinical trials is the need of the hour. When we are able to achieve this we can strategize the investments and can take the neutraceuticals to greater heights. These medical food products are intended for the management of certain diseases such as diabetes, cancer, cardiovascular diseases, arthritis, immune disorders, hyperhomocysteinemia, certain inflammatory and pain associated disorders.

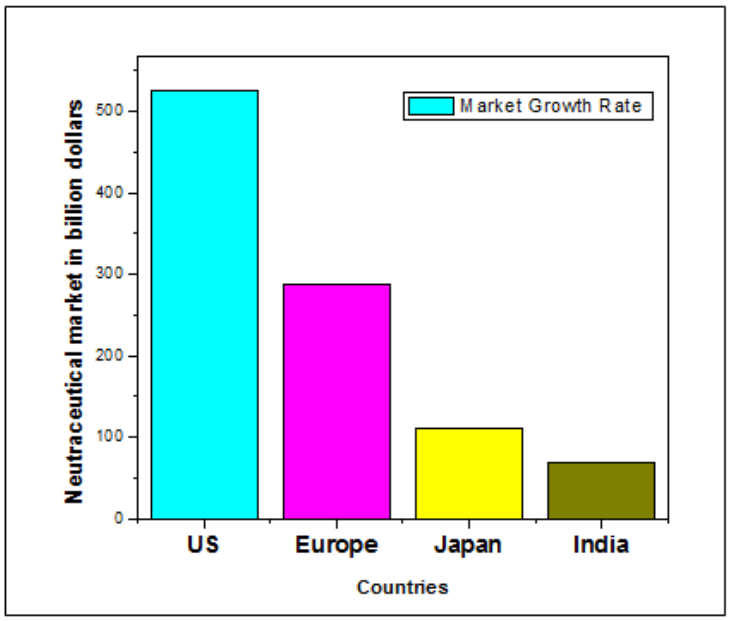

Figure 1
***Scenario of Neutraceuticals Market*[43]**

Although neutraceuticals have considerable promise in promoting human health and also in preventing the diseases conditions. The key professional involved are health professional, nutritionists and regulatory toxicologist should strategically work together and also develop a concrete plan for appropriate regulation for attaining ultimate health and therapeutic benefit to mankind. In long run the clinical studies are required to scientifically validate the neutraceuticals in overcoming various medical conditions. The interaction between neutraceuticals with food and drugs is another thrust area, which should also be taken into consideration while designing the natural molecules. The processing methods and also the biological availability and effectiveness of neutraceuticals in the pharmacotherapy need to be well determined. This review emphasizes on the natural molecules and their targeted action to a particular disease intervention on the pharmacological basis. The pharmaceutical and biotech companies should take a lead in developing natural drugs, neutraceuticals for safer and effective treatment with no adverse effect.

NEUTRACEUTICAL FOR CERTAIN ASSOCIATED DISEASES

Nutraceuticals are currently in focus and receiving recognition as beneficial agents curing the coronary heart disease, obesity, diabetes, cancer, osteoporosis and other chronic and degenerative diseases such as Parkinson's and Alzheimer's diseases etc (Fig 2). The studies indicated that the pharmacological actions of natural compounds involve a wide range of biological processes, including antioxidant defensive activation mechanism, signal transduction pathways, cell survival-associated gene expression, cell proliferation and differentiation and preservation. The properties of these natural molecules play a crucial role in the protection against the pathogenesis of several age-related or chronic diseases (Table-1 & 2). It is very essential that these nutrients found in many foods, fruits and vegetables are required to be well documented for future generation.

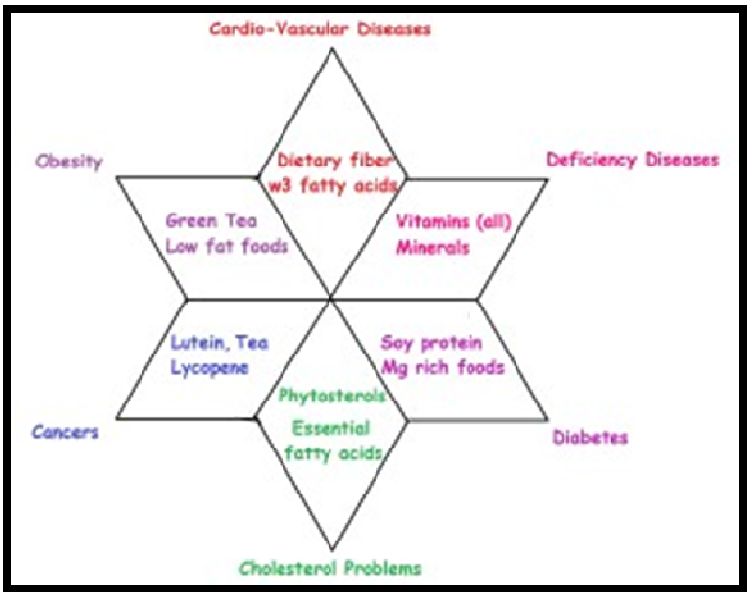

Figure 2
Neutraceuticals and the Disease which can be preventable

NEUTRACEUTICALS IN TREATMENT OF DIABETES

Nutrition plays an important role in the treatment and management of diabetes. The use of dietary supplements in the treatment of the diabetes like vitamins, such as vitamin C and B, minerals such as chromium, as well as herbs like *Gymnema sylvestre*, is well documented as safe and effective way of reducing or lowering blood sugars levels[6]. Botanicals, vitamins, anti-oxidants, minerals, amino acids and fatty acids are important sources of novel therapies for treatment of T2D and insulin resistance. According to DSHEA sources numerous neutraceuticals have shown promising potentiality in the treatment and management of diabetes in the form of complementary and alternative medicine. Herbal extracts such as aloevera, Acacia Arabica, Allium Cepa and Allium Sativum reported to have anti diabetic activity[7,8]. This aloevera is more responsive when the patients are not able to respond to glibenclamide treatment and helps in reducing sugar levels to 48% and triglycerides level to 52% when treated with aloevera extract[9,10]. Before the discovery of insulin, Jamun was useful in the treatment of diabetes and is an integral part in various alternative systems of medicine. Jamun i.e., Eugenia jambolana is a plant with known ethno medicinal uses. Eugenia jambolana reported to have hypoglycaemic, or blood-sugar lowering action[11]. Ginseng is another herb found to have remarkable blood sugar lowering capacity in normal and hyperglycaemic mice. In a study of two 8-week trials following patients with T2D when treated with american ginseng significantly decreased fasting blood glucose and post-prandial blood glucose levels[12]. *Gymnema Sylvestre* extract also helps in controlling the glycaemic levels few non-randomized controlled clinical trials confirmed improved glycaemic control in patient after receiving extract of *Gymnema*[13]. The leaves of the Lagerstroemia Speciosa (Banaba plant) contains corosolic acid, the leaves tend to have anti-diabetic properties[14]. Over 2000 year's tulsi was used in the treatment of type diabetes and has indicated a decrease in blood glucose levels[15]. Several polyherbal formulations have been tested from years for their anti-diabetic potentiality. In a study it has been found that hypoglycaemic effect of polyherbal formulation, consisting of *Tribulus terrestris, Piper nigrum* and *Ricinus communis*, was established in alloxan-induced diabetic rats[16]. Maximum reduction in the blood glucose level noted with polyherbal formulation 400 mg/kg, which was comparable to standard drug used, that is glibenclamide[17]. In a separate study we have observed that the usage of *Eugenia jambolana* and C*innamomum zeylanicum* showed tremendous effects in lowering the blood glucose levels and it was on par with the prescribed standard drug glibenclamide[18]. In spite of effective research in diabetes, the search for the effective molecules in the treatment of diabetes is increasing day by day and scientists are looking for molecules which are produced from natural sources possessing more efficacy with no or minimal side effects. Use of combination of synthetic herbal and neutraceuticals is the best and the synergistic way of treating diabetes is the latest option[19].

NEUTRACEUTICALS IN THE TREATMENT OF CANCER

Complementary and Alternative medicine is rapidly increasing in developed and developing countries. These countries use traditional medicines practices for curing chronic as well as acute diseases. As you are aware that Indian system of medicine, named as Ayurveda which plays important role in treatment of chronic disease i.e., cancer. Currently the usage of products in the form of herbal medicine, food supplement are gaining momentum in today's life. As they are devoid of less toxicity towards the human life with more efficacy. Some of them have been well studied in various experimental models of cancer, both *in vivo* and *in vitro* models. The studies have shown significant inhibition in the process of cell proliferation. Few of them are already in the phase of clinical trial. Cancer patients are specially exploring the use of neutraceuticals, because of the high risk of mortality and long-term morbidity associated with surgical procedures of cancer management and high side effects associated with chemotherapy. A

healthy lifestyle and good diet can aid in preventing cancer. The persons consuming large amount of lutein-rich foods such as chicken eggs, spinach, tomatoes, oranges and leafy greens experienced the lowest incidence of colon cancer can be seen[20]. At the molecular level, free radicals and aldehydes which are produced during chronic inflammation can induce deleterious gene mutation and posttranslational modifications of key cancer-associated proteins. Ginseng a herb possessing an anti-inflammatory activity that targets many of the key players involved in the inflammation-to cancer[21]. The presence of flavonoids in citrus fruit helps in fighting against cancer by acting as antioxidants. The Soyfoods are unique sources of isoflavones, the polyphenolic phytochemicals exemplified by epigallocatechin gallate from tea help in preventing or inhibit the growth of cancer cells[22]. It was reported that lycopene containing fruits and vegetables contains cancer-protective effect by decrease in oxidative and other damage to DNA in humans. Lycopene is major carotenoids which are regularly used in western diets and it is found almost exclusively in tomatoes, pink grapefruit, guava, papaya and water melon[23]. Ellagic acid found in strawberries, cranberries, walnuts, pecans, pomegranates are the best proven source in preventing cancer[24,25]. Curcumin derived from the *Curcuma longa* possesses anticarcinogenic activity due to the presence of yellow colour pigment[26]. The anticancer potentiality of curcumin stems possesses ability to suppress the proliferation of a variety of tumor cells. Others such as Beet roots, cucumber fruits, spinach leaves, and turmeric rhizomes, were reported to possess anti tumor activity[27]. Use of vitamins such as A, B, C, D3, E and K and glutathione as single agents or in combination) does not interfere in the therapeutic interventions and modalities of cancer. Many studies have demonstrated the improvement in quality of life and the value of complementary medicine as an adjuvant to chemotherapy or radiotherapy[28]. Majority of the studies indicates a preventive role of neutraceuticals in cancer, however more scientific and evidence based studies are needed for authenticating the usage of neutraceuticals in the treatment of cancer.

NEUTRACEUTICALS IN THE TREATMENT OF CVD

Globally the chronic diseases like cardiovascular diseases are rapidly increasing. In 2020, these diseases will contribute approximately 65% of the 60.5 million total reported deaths in the world. These diseases are associated with hypertension (high blood pressure), coronary heart disease (heart attack), cerebrovascular disease (stroke), heart failure, peripheral vascular disease, etc. On the other side it would be the leading cause of death in developing countries. Majority of the cardiovascular diseases are preventable and controllable. It was reported that low intake of fruits and vegetables is associated with a high mortality in cardiovascular disease[29]. Research studies have identified the protective role of diet rich in fruits and vegetables against CVD. Neutraceuticals in the form of antioxidants, dietary fibers, omega-3 polyunsaturated fatty acids (n-3 PUFAs), vitamins, and minerals are more recommended together with physical exercise for prevention, control and treatment of CVD[30]. It was found that the molecules like polyphenol present in grapes and in wine alter cellular metabolism and signaling, which is consistent with reducing arterial disease. The active moiety present in fruit, leaves and skin of many plants and whole grains contains octacosanol act as gastroprotectives and also lipid lowering agents[31,32]. Fatty acids present in fish are well established a dietary component helps in preventing cardiovascular disorders. The food products like milk and egg are rich in proteins and polyunsaturated fats or essential fatty acids[33]. These are essential for production and rebuilding of cells and also help in reducing the blood pressure and lowering cholesterol and triglycerides levels. The supplement also helps in preventing disease condition like arrhythmia. Nutritional value of egg is increased because of addition of gamma linolenic acid (GLA) which has many benefits, including prevention and management of CVD like hypertension[34].

NEUTRACEUTICALS IN THE MANAGEMENT OF OBESITY

Obesity is defined as an unhealthy amount of body fat, and is a well-established risk factor for many associated disorders like angina pectoris, congestive heart failure, hypertension, hyperlipidemia, respiratory disorders, renal vein thrombosis, osteoarthritis, cancer, reduced fertility etc[35]. Infact obesity is a condition, with serious social and psychological dimensions, affecting virtually of all age groups and socioeconomic status of the individuals. The existence of obesity nearly increasing drastically due to life style, quality of life and also the habitat. It is estimated that it may increase by over 50% in the coming years. There is nothing like treatment it can be controlled only by preventing the progressing of the disease by following certain diet plans and changing the lifestyle of the individuals. It has been recommended that weight reduction programs focus on achieving a modest weight loss of 7–10% of the initial weight. The restriction in the calories intake and increased physical activity has shown to be only moderately successful in managing the condition of obesity. Thus many health care practitioners and obese individuals are seeking the help of pharmaceuticals and neutraceuticals for the effective treatment of obesity. Tolerable and effective neutraceuticals administrations can increase energy expenditure and/or decrease caloric intake which is desirable for body weight reduction. The use of herbal stimulants, such as ephedrine, caffeine, ma huang-guarana, chitosan and green tea has proved to be effective in facilitating body weight loss[36]. Buckwheat seed proteins have beneficial role in obesity and constipation acting similar to natural fibers present in food[37]. The extracts of 5-hydroxytryptophan and green tea may promote the weight loss, while the former decreases appetite, the later increases the energy expenditure[38]. A combinational therapy of glucomannan, chitosan, fenugreek, *G sylvestre*, and vitamin C in the dietary supplement significantly helps in reducing the body weight and promoting the fat loss in obese individuals.There is a very high prevalence of obesity globally and hence nutrition and exercise play a key role in its prevention and treatment. Nutraceuticals interventions are currently being investigated on a large-scale basis as potential treatments for obesity and weight management. Nutraceuticals like conjugated linoleic acid (CLA), capsaicin, *Momordica Charantia* (MC) and Psyllium fiber possess potential anti-obese properties[39]

NEUTRACEUTICALS IN DEFICIENCY DISEASES

Vitamins and minerals are important nutrients that are essential for overall health, growth and development of an individual. Vitamins and minerals also ensure that various chemical reactions are able to take place in the body. If a person does not consume enough of the required specific types of vitamins and minerals for an extended period of time then he can develop any one of several diseases. One among them is Iron-deficiency anemia which is most common medical conditions caused by a deficiency in the nutrition[40]. Iron-deficiency anemia is characterized by a lack of healthy red blood cells due to inadequate amounts of iron in the body. If you lack red blood cells, your tissues do not receive enough oxygen this intern may lead to fatigue, shortness of breath and dizziness. Iron-deficiency anemia can also be caused by low intake dietary products or loss of blood. Mild to moderate cases of iron-deficiency anemia can be corrected with increased intake of dietary iron or oral neutraceuticals. In case of severity the patient may require blood transfusion. The minerals such as calcium and phosphorus and fat-soluble vitamin D are all essential for the formation of strong bones. The constant usage of our body leads to breaks down old bone and regenerates new bone in its place. Calcium and phosphorus combines to form hydroxyapatite, which provides the structure and strength to bones and teeth. Vitamin D regulates calcium and phosphorus by stimulating the absorption of the minerals in intestinal tract and maintaining a normal range of the minerals in the bloodstream. In any of these vitamins and minerals are less or below threshold limit they lead to a condition called osteoporosis. To prevent the development of osteoporosis

condition, it is important to intake adequate amounts of vitamin D, calcium and phosphorus. Insufficient amounts of water-soluble B-vitamin niacin in the diet can lead to a disease called pellagra, which is characterized by inflammation of the skin, rashes, loss of memory, confusion and diarrhea. Macrocytic anemia is another type of anemia that can be caused by inadequate amounts of vitamin B12 or folate. Both of these water-soluble B-vitamins are necessary for the proper synthesis of RBCs. Without adequate amounts, the body can make red blood cells, but they are too large and unable to function properly. As a result, the body becomes deprived of oxygen. Micronutrients for which preliminary evidence of benefit exists include vitamin C and vitamin D. In addition, numerous neutraceuticals that may influence osteoarthritis pathophysiology, including glucosamine, chondroitin, Sadenosylmethionine, ginger and avocado/soybean un-saponifiables, have been tested in clinical trials and. are used in the deficiency disorders. High content of polyphenolic flavonoids in neutraceuticals and functional foods had been ascribed to possess antioxidant/radical scavenging activity. These products are safe and well tolerated, but interpretation of the collective results is hampered by heterogeneity of the studies and inconsistent results and is to be scientifically authenticated.

NEUTRACEUTICALS IN CHOLESTEROL TREATMENT

Cholesterol has long been implicated as a significant risk factor associated in cardiovascular disease. Phytosterols compete with dietary cholesterol by blocking the uptake as well as facilitating its excretion from the body. Phytosterols in diet have the potentiality in reducing the morbidity and mortality from cardiovascular disease[41]. *Fagopyrum esculentum Moench* (sweet buckwheat), originated in Asian countries is found to be potential in treatment of cholesterol. Buckwheat seeds possess proteins, flavonoids, flavones, phytosterols, thiamin-binding proteins etc. these proteins are beneficial in constipation treatment and obesity and more importantly helps in lowering cholesterol levels[42]. Use of flax seed and salmon containing fatty acids omega-3 PUFAs,are potential controllers of the inflammatory mediation processes. It also helps in maintenance of brain function and reduces the deposition of cholesterol. The Legumes (chickpeas and soybeans), grains, palm oil contain non-carotenoids, which remove cholesterol and also found to be anti carcinogenic. Non-flavonoid polyphenolics which are present in dark grapes, raisins, berries, peanuts, turmeric roots are known to be strong anti-inflammatory, anti-oxidants, and also acts as effective anti-clotting agents and helps in reducing cholesterol.Canola oil and stanols a functional food helps in lowering triglycerides level and also intern reduces the cholesterol. Rice bran contains both Lutein and Zeaxanthin, which improves eyesight and helps in lowering serum cholesterol levels. Rice bran helps in lowering LDL levels and increases the HDL levels favoring the cardiovascular health[43].

TABLE 1
The important vitamins and their functionality[5]

FAT-SOLUBLE VITAMINS		
Vitamin A (Retinol, beta-carotene and various other carotenoids)	Helps maintain good vision, resistance to infections, and supports growth and repair of body tissues. Maintains the integrity of WBC and RBC, assists in immune reactions, helps maintain the stability of cell membranes.	Milk, eggs, meat, fish liver oils. Beta-carotene and other carotenoids are found in: Green leafy vegetables - kale, spinach, broccoli, collard greens, parsley, turnip greens, escarole. Yellow vegetables - carrots, sweet potatoes, winter squash, pumpkin. Yellow and orange fruits - mango, cantaloupe, papaya, and apricots.
Vitamin D (Cholecal ciferol, ergocalciferol)	Member of a large and cooperative bone-making and bone maintenance team. Regulates absorption of calcium and phosphorus for bone health.	Formed in skin when exposed to sunlight. Also found in dairy products, egg yolk, fish liver oils, tuna, mackerel, herring, sardines, oysters, yeast.
Vitamin E (Tocopherol, Tocotrienols)	Fat-soluble antioxidant. Helps maintain cell membrane, red blood cell integrity, protects vitamin A and fatty acids from oxidation.	Found primarily in plant oils, green, leafy vegetables, wheat germ, whole grains, egg yolk, nuts, seeds, and liver.
Vitamin K	Helps make factors that promote blood clotting.	Bacterial synthesis in the digestive tract. Diet generally supplies remaining need. Green, leafy vegetables, cabbage-type vegetables and milk.
WATER-SOLUBLE VITAMINS		
Vitamin B1 Thiamine	Helps metabolize carbohydrates, maintain appetite and normal digestion. Part of a coenzyme used in energy metabolism. Supports normal appetite and nervous system function.	Found in many foods: whole grain cereals, legumes, beans, nuts, brewer's yeast, wheat germ, pork, ham, and liver.
Vitamin B2 Riboflavin	Part of coenzymes used in energy metabolism, supports normal vision and skin health.	Milk, yogurt, other dairy, meat, leafy greens, whole grains.
Vitamin B3 Niacin, nicotinic acid, niacinamide	Part of a coenzyme used in energy metabolism, supports health of skin, nervous system and digestive system.	Tuna, dairy, meat, whole grains, nuts and all protein containing foods.
Vitamin B5 Pantothenic Acid	Part of Coenzyme A, which is used in energy metabolism	Widespread in foods.
Vitamin B6 Pyridoxine, pyridoxal, other	Part of a coenzyme that helps the body synthesize nonessential amino acids. Significant role in protein metabolism.	Green leafy vegetables, meats, fish, poultry, shellfish, legumes, fruits, whole grains.
Vitamin B12 Cobalamin	Part of coenzymes used in new cell synthesis; helps to maintain nerve cells.	Animal products (meat, fish, poultry, shellfish, eggs, cheese, milk).
Biotin	Part of a coenzyme used in energy metabolism, fat synthesis, amino acid metabolism and glycogen synthesis.	Widespread in foods.
Folic acid Folate, folacin	Part of coenzymes used in new cell synthesis. Essential for blood cell formation, protein metabolism, and prevention of neural tube defects.	Green leafy vegetables, liver, fortified grain products, legumes and seeds.
Vitamin C (ascorbic acid)	Essential element in collagen formation (strengthens blood vessels, forms scar tissue, is a matrix for bone growth); an antioxidant; strengthens resistance to infections; and improves absorption of iron.	Abundant in most fresh fruits (esp. citrus) and vegetables.

TABLE 2
The selected minerals and their functionality[5]

NUTRIENT	FUNCTIONS IN THE BODY/BENEFITS	DIETARY SOURCES
	SELECTED MINERALS	
Boron	Bone health, prevention of osteoporosis.	Non-citrus fruits, leafy vegetables.
Calcium	The principal mineral of bones and teeth, also involved in normal muscle contraction (including heart muscle).	Milk and milk products, small fish with bones, tofu, broccoli, chard and legumes.
Chloride	An electrolyte that maintains normal fluid balance and proper acid-base balance, part of hydrochloric acid found in the stomach.	Salt, soy sauce, moderate quantities in whole, unprocessed foods and large amounts in processed foods.
Chromium	Associated with insulin and required for the release of energy from glucose.	Brewer's yeast, unrefined whole grain cereals, fats, vegetable oils.
Copper	Supports healthy bones, muscles, and blood vessels. Assists in iron absorption.	Liver, legumes, nuts, seeds, raisins, whole grains, shellfish, shrimp.
Fluoride	Involved in the formation of bones and teeth.	Drinking water (if fluoridated) tea, seafood.
Iodine	Essential component of thyroid hormones that regulate tissue growth and cell activity.	Iodized salt, seafood, plants.
Iron	Part of the protein hemoglobin which carries O2 in the body. Part of the protein myoglobin in muscle which makes O2 available for muscle contraction. Necessary for the utilization of energy as part of the cells' metabolic machinery.	Red meats, liver, poultry, fish, shellfish, beans, peas, dried fruit, eggs. Certain foods contain phytates, which may inhibit iron absorption.
Magnesium	Involved in bone mineralization, the building of protein, enzyme action, normal muscular contraction, and transmission of nerve impulses	Nuts, legumes, whole grains, beans, green leafy vegetables, seafood, chocolate.
Manganese	Involved in the formation of bone, as well as in enzymes involved in amino acid, cholesterol, and	Nuts, whole grain cereals, beans, rice, dried fruits, green leafy vegetables.
Molybdenum	Important in a variety of enzyme systems.	Legumes, grains, organ meats.
Phosphorus	A principal mineral of the bones and teeth; part of every cell; maintains acid- base balance.	Abundant in all animal foods.

CONCLUSION

Neutraceuticals are available in the form of isolated nutrients, dietary supplements and specific diets to genetically engineered foods, herbal or polyherbal products and processed foods rich in nutrient values. Neutraceuticals provide all the essential substances that should be present in a healthy diet for the human. Neutraceuticals provides energy and nutrient supplements to the body, which are required for maintaining optimal health in a natural way. The neutraceuticals industry is rapidly exceeding and expanding in food and pharma industry. The demand of neutraceuticals in future generation depends majorly on consumer perception towards the understanding of relationship between the diet and disease. Neutraceuticals are widely used in the food and pharmaceutical industries. The interaction and interrelationship between the food and drug is often neglected and it should be taken in to consideration while designing new chemical entities. Neutraceuticals can provide considerable health benefits especially in the prevention or treatment of acute and chronic diseases. But its development totally depends on addressing the issues pertaining to purity, quality and safety. Long-term adverse effects and toxicity are to be well documented in supplementation studies and also in clinical trials. There should be strict regulatory guidelines for neutraceuticals considerations in understanding long term clinical trials of

neutraceuticals which are intern scientifically authenticated and validated. Most of the manufacturing industries and market for neutraceuticals is increasing rapidly where the side effects are not reported or often unproven. In order to have scientific knowledge about the use of neutraceuticals, the common person needs to be educated about the recommended daily doses of these natural molecules. With the rapidly increasing interest in the nutraceutical revolution, we need to establish a vibrant nutraceutical research community which is absolutely necessary to convert the majority of potential neutraceuticals to established ones thereby truly delivering their enormous benefits to all of us. Finally, one should recognize that single or combination of dietary neutraceuticals along with new chemical moieties are contributing towards the therapeutic action and needs to be addressed in future for safe medications involving natural molecules.

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