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Nutraceuticals: In the treatment & prevention of diseases –an overview

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Abstract

The aim of this current review article was to examine the impact of Nutraceuticals as an alternative treatment for different types of disease. In this scenario natural products (nutraceuticals) play vital role which is plant based. The term of Nutraceuticals was coined by Dr. Stephen Defelice in 1989.

Keywords: Nutraceuticals, Functional foods, Used in the treatment of different diseases.

1. Introduction

The term Nutraceuticals was derived from ‘Nutrition’ and ‘Pharmaceuticals’ by Stephen Defelice, who is the founder and chairman of foundation for innovative medicine. The actual use of Nutraceuticals is to attain desirable therapeutic outcomes with reduced side effects. About 2000 years ago, Hippocrates emphasized ‘let food be your medicine and medicine be your food’s Nutraceuticals are used as food or part of food which will provide medical or health benefits including prevention or treatment of disease. Herbal Nutraceuticals are powerful instruments in maintaining health and act against nutritionally induced acute and chronic diseases by promoting optimal health, longevity and quality of life.

2. History of Nutraceuticals

The concept of Nutraceuticals went back three thousand years ago. Hippocrates (460-377 B.C) stated ‘let food be thy medicine and medicine be m thy food’. In the early 1900s, in united states food manufacturers start adding small quantity of iodine to salt to prevent Goiter. In Japan, England and other countries, Nutraceuticals are already becoming part of dietary landscape, nowadays Nutraceuticals are most rapidly growing segments of the industry & the global nutraceutical market is estimated as USD 117 billion.

3. Nutraceutical Categories

i) Dietary Supplements including botanicals

- Vitamins, co-enzymes, minerals, carnitine
- Ginko bilba, Ginseng, Saint John's Wort, Saw Palmetto

ii) Functional Foods

- Oats, bran, Psyllium and lignin's for heart disease and colon cancer
- Prebiotics - Oligofructose for control of intestinal flora
- Omega-3 milk in prevention of heart disease
- Canola oil with lowered triglycerides for cholesterol reduction
- Stanols (Benecol) in reduction of cholesterol adsorption

iii) Medicinal Foods

- Transgenic cows and lactoferrin for immune enhancement
- Transgenic plants for oral vaccination against infectious diseases
- Health bars with added medications.

iv) Area Covered by Nutraceutical Products

- All therapeutic areas such as anti-arthritis, pain killers, cold and cough, sleeping disorders, digestion and prevention of certain cancers, osteoporosis, blood pressure, cholesterol, depression and diabetes, etc have been covered by nutraceuticals ^[5].

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v) Health benefits of Nutraceuticals

- They Avoid side effect.
- They increase the health beneficial effect.
- They have naturally dietary supplement, so do not have unpleasant side effect.
- They May increase the health value and improve medical condition of human.
- They May easily be easily available and economically affordable.

Nutritional therapy is a healing system using dietary therapeutics. This therapy is based on the belief that foods can not only be sources of nutrients and energy but could also provide medicinal benefits.

4. Functional foods

The US Institute of Medicine’s Food and Nutrition Board defined functional foods as “any food or food ingredient that may provide a health benefit beyond the traditional nutrients it contains”. Functional foods contain physiologically active components obtained either from plants or animal sources. Vegetable and fruit fibers (with pectin), garlic and oily seeds (walnut, almonds, etc.), and fish oils have lipid-lowering effects in humans, through inhibition of fat absorption and suppression of hepatic cholesterol synthesis [8].

i) Fish

People who take fish and fish oil supplements have a lower rate of CVD. Fish contains various nutrients with potentially favourable effects on health; attention has been focused on omega-3 (n-3) fatty acids. n-3 fatty acids also include the plant-derived alpha-linolenic acid.

ii) Fruits and vegetables

Inadequate consumption of fruit and vegetables has been linked with higher incidence of CVD. Fruits and vegetables have been found to decrease susceptibility of LDL particles to oxidation. Several bioactive components are present in fruits and vegetables such as carotenoids, vitamin C, fiber, magnesium, and potassium act synergistically or antagonistically to promote a beneficial effect. Soluble fibres including pectin’s from apples and citrus fruits, β -glucan from oats and barley, and fibres from flaxseed and Psyllium are known to lower LDL-C.

iii) Nuts and Legumes

Nuts are complex foods containing cholesterol lowering mono- and polyunsaturated fatty acids, arginine, soluble fiber, and several antioxidant polyphenols. Legumes are also complex foods rich in soluble fibers and polyphenols, as well as folic acid.

iv) Ginger

Ginger is a very popular spice and can be produced near about 100,000 tons a year. It is used in traditional Japanese Kampo, Ayurvedic, and Chinese medicine as an anti-inflammatory agent for musculoskeletal diseases.

v) Milk and Hyper immune milk

A cross-sectional epidemiological study suggested that the frequency of symptomatic knee OA was lower in milk consumers. This milk is produced by cows that are immunised with intestinal bacteria antigens. It is enriched in high-molecular weight immunoglobulins (IgG) and is claimed to

contain anti-inflammatory low-molecular weight components [11].

vi) Dietary Fibers

Dietary fibers are used in health food products for normalization of intestinal transit time. They have dual effect on intestinal transit. First effect is on the bulk faeces, which are often increased, in significant proportion (127% after ingestion of 20 g of wheat bran), this action is concerned with insoluble fibers. The other effect of dietary fibers is on the duration of transit, which gets normalized around in 48 hrs. Long transit time gets shortened and short transit gets longer.

5. Use of Nutraceuticals in the Treatment of Different Diseases

i) Rice bran and Cardiovascular Diseases, Eye Sight

Rice bran lowers the serum cholesterol levels in the blood, lowers the level of (LDL) and increases the level (HDL) in cardiovascular health. Higher the ratio more will be the risk of coronary heart diseases. Rice bran contains both Lutein and Zeaxanthin, which improves eyesight and reduces the chance of cataracts. The essential fatty acids, omega-3, omega-6, omega-9 and folic acid in rice bran are also promoting eye health.

ii) Corn (heart attack, lung cancer)

Corn’s contribution to heart health lies not just in its fiber, but in the significant amounts of folate that corn supplies. Corn maintains the homocysteine, an intermediate product is an important metabolic process called the methylation cycle. Homocysteine is directly responsible for damage of blood vessel heart attack, stroke, or peripheral vascular disease. It has been estimated that consumption of 100% of the daily value (DV) of folate would, by itself, reduce the number of heart attacks suffered by 10%. (Bazzano *et al.*, 2002). Corn also contains cryptoxanthin, a natural carotenoid pigment. It has been found that cryptoxanthin can reduce the risk of lung cancer of 27% on daily consumption (Yuan, 2003).

iii) Dietary Polyphenols Used in the Treatment of Diabetes

In recent years, there is growing evidence that plant-foods Polyphenols, due to their biological properties, may be unique nutraceuticals and supplementary treatments for various aspects of type 2 diabetes mellitus. Polyphenolic compounds can also prevent the development of long-term diabetes complications including cardiovascular disease, neuropathy, nephropathy and retinopathy.

iv) Sorghum (against pathogen)

sorghum is the main dietary source for 3-deoxyanthocyanidins, which are present in large quantities in the bran of some cultivars (Awika, 2004). The defense mechanism of sorghum against pathogen is due to an active process, resulting in the accumulation of high levels of 3-deoxyanthocyanidin phytoalexins in infected tissues (Lo *et al.*, 1996) [14].

v) Buck wheat (obesity-constipation)

Buckwheat seed proteins have beneficial role in obesity and constipation acting similar to natural fibers present in food. 5-hydroxytryptophan and green tea extract may promote weight loss.

vi) B-Carotene (cancer)

Beta-carotene is the main source of vitamin A and has anti-

oxidant properties which help in preventing cancer and other diseases. Among the other carotenes, beta carotene is the most active antioxidants. Alpha and beta carotenes, along with gamma carotene and the carotenes lycopene and lutein68 which do not convert to vitamin A, seem to offer protection against lung, colorectal, breast, uterine and prostate cancers. B-Carotene is the more common form and can be found in yellow, orange, and green leafy fruits and vegetables. These can be carrots, spinach, lettuce, tomatoes, sweet potatoes, broccoli, cantaloupe, oranges, and winter squash.

vii) In the treatment of arthritis

Arthritis is a common disease in which the end-point results in joint replacement surgery. The use of nutraceuticals is an alternative treatment for pathological manifestations of arthritic disease. The efficacy of fish oils (e.g. cod liver oil) in the diet has been demonstrated in several clinical trials, animal feeding experiments and *in vitro* models that mimic cartilage destruction in arthritic disease. Other than this, there is some evidence of other nutraceuticals, such as green tea, herbal extracts, chondroitin sulphate and glucosamine.

viii) Nutraceuticals used against Alzheimer's disease (AD)

Alzheimer's disease (AD), also called senile dementia of the Alzheimer type (SDAT), primary degenerative dementia of the Alzheimer's type (PDDAT), or simply Alzheimer's, is the most common form of dementia. The various Nutraceuticals, which are used to cure Alzheimer's disease are

- a) **Anti-oxidants:** antioxidants like vitamin E and vitamin C.
- b) **Ginkgo biloba:** Ginkgo biloba is perhaps the most studied herbs with reference to memory, cognition, overall brain performance, and certainly AD.
- c) **Huperzine alpha:** Huperzine alpha or huperzine A is a very appealing plant compound that is extracted from club

d) moss, or *Huperzia serrata*. It is a sesquiterpene alkaloid, which is a potent and reversible inhibitor of acetyl cholinesterase ^[10].

ix) In the treatment of diet-related diseases: In Western societies, the incidence of diet-related diseases is progressively increasing due to greater availability of hypercaloric food and a sedentary lifestyle. Obesity, diabetes, atherosclerosis, and neurodegeneration are major diet-related pathologies that share a common pathogenic denominator of low-grade inflammation. Functional foods and nutraceuticals may represent a novel therapeutic approach to prevent or attenuate diet-related disease in view of their ability to exert anti-inflammatory responses. In particular, activation of intestinal T regulatory cells and homeostatic regulation of the gut microbiota have the potential to reduce low-grade inflammation in diet-related diseases ^[10].

x) Vision improving agents

Lutein is one of most important carotenoids, found in many fruits and vegetables like mangoes, corn, sweet potatoes, carrots, squash, tomatoes, etc. Lutein dipalmitate is found in the plant *Helenium autumnale*. Lutein is also known as helenien is used for the treatment of visual disorders. Zeaxanthin is used in traditional Chinese medicine mainly for the treatment of visual disorders. Food sources of zeaxanthin include corn, egg yolk and green vegetables and fruits, such as broccoli, green beans, green peas, brussel sprouts, cabbage, kale, collard greens, spinach, lettuce, kiwi and honeydew. Lutein and zeaxanthin are also found in nettles, algae and the petals of many yellow flowers. In green vegetables, fruits and egg yolk, lutein and zeaxanthin exist in non-esterified forms.¹⁵

6. Nutraceuticals and their uses

Chemical constituents	source	uses
Carotenoids		
Lycopene	Guava, papaya, water melon, Tomatoes, pink coloured grape fruit.	They reduces cholesterol levels, anti oxidants, protects against cancer.
β-Carotene	Vegetables, fruits, oats, Carrots.	Antioxidants, protection of cornea against uv light.
Lutein	Spinach, corn, avocado, egg yolk	Protect eyes against age related muscular degenerations, cataracts, anticancer activity(colon)
Tocotrienol	Palm oil, different grains.	Improves cardio vascular health, fight against cancer (breast cancer).
Saponins	Beans like soya beans, chickpeas.	Very effective against colon cancer, reduces cholesterol level.
Polyphenolic Compounds		
Flavonones	All Citrus fruits	Different types of Anti oxidant & anticancer activity.
Flavones	Different types of fruits, soya beans, vegetables.	Different types of Anti oxidant & anticancer activity.
Flavonols	Broccoli, tea, Onions, fruits like Apple etc.	Antioxidant activity
Curcumin	Turmeric root	Strongly anti-inflammatory and strongly anti-oxidant, effective anti anti-clotting agent.
Glucosinolates	Cauliflower, Cruciferous vegetables	Anticancer activity, protect against bladder cancer
Phytoestrogens		
Isoflavones	Legumes, beans like soy beans	It Lowers LDL cholesterol, antioxidants, protects against prostate, breast, bowel, and

			other cancers.
	Lignans	Vegetables, rye & Flaxseed	Protect against development of cancer like colon and breast cancer.
Dietary fibre			
	Soluble fibre	Beans like Legumes, cereals like oats, barley, some fibrous fruits	They help in maintenance of a healthy digestive tract & have anticancer activity.
	Insoluble fibre	whole grain foods wheat and corn bran, Nuts, etc.	They help in maintenance of a healthy digestive tract, and have Anticancer (colon) activity.
	Sulphides/Thiols	Present in Cruciferous vegetables	Help in maintenance of healthy immune function.
Fatty Acids			
	Omega 3 Fatty Acids	Present in Salmon & Flax seed	They are the Potent controllers of the inflammatory processes, help in Maintenance of brain function & Reduce cholesterol disposition.
	Monosaturated fatty acids	Present in Tree nuts	They Reduce the risk of coronary heart disease.
	Prebiotics/Probiotics Lactobacilli, bifidobacteria	Present in Yogurt, other dairy and nondairy applications.	They help to improve gastrointestinal health and systematic immunity.
	Minerals like zinc, Calcium, Selenium, copper, Potassium	Food	They are the Important constituents of balanced diet
	Polyols Sugar alcohols (xylitol, sorbitol)	Present in Fruits	They may reduce the risk of dental caries (cavities)

7. Current market scenario

In the Global market Nutraceuticals and functional foods has become a multi-billion Dollar industry and within Canada, it is estimated that the Canadian nutraceutical industry has a potential to grow up to 50 billion US dollars. After US, JAPAN nutraceutical industry is the second largest market in the world, which has a steady average growth rate of 9.6% per anum ^[17].

8. Conclusion

Nutraceuticals has proven their health benefits and disease prevention capability, which should be taken according to their acceptable recommended intake. In the present scenario of self-medication nutraceuticals play major role in therapeutic development. But their success depends on maintaining on their quality, purity, safety and efficacy.

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