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Nutraceutical the current scenario: A review

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Abstract
Nutraceutical is regarded as the bio active substance and the constituents are either of known therapeutic activity or are chemically defined substance generally accepted to contribute substantially to the therapeutic activity of the drug. Using food products to promote health and cure disease is renowned. Currently, most of the drug molecules available in the formulations were anciently used in their crude form. Dr Stephen De Felice first coins the term nutraceutics in 1989 to provide medical or health benefits including the prevention and treatment of dis-eases. This review classified the large number of nutraceuticals available from various sources and its significance. Further, the regulatory status of nutraceuticals and latest trends in nutragenomics are discussed.

Keywords: nutraceutical, dietary supplements, disease

Introduction
The term nutraceutical was originally defined by Dr. Stephen L. DeFelice, founder and chairperson of the Foundation of Innovation Medicine (FIM), Crawford, New Jersey. Since the term was coined by Dr. Defelice, its meaning has been modified by Health Canada which defines nutraceutical as: a product isolated or purified from foods, and generally sold in medicinal forms not usually associated with food and demonstrated to have a physiological benefit or provide protection against chronic disease. Dr Stephen DeFelice coined the term "Nutraceutical" from "Nutrition" and "Pharmaceutical" in 1989 [6].

Concept of nutraceuticals
In the pharmaceutical development process, it is a requirement to have clinical test results from animal tests and studies, for verification of the effects. On the other hand, in the case of nutrition, there was no verification method for foods in preventing diseases in the past. In recent years however, as food composition has been scientifically proven to cause lifestyle-related diseases, and has become a social issue as figure 1 [22]

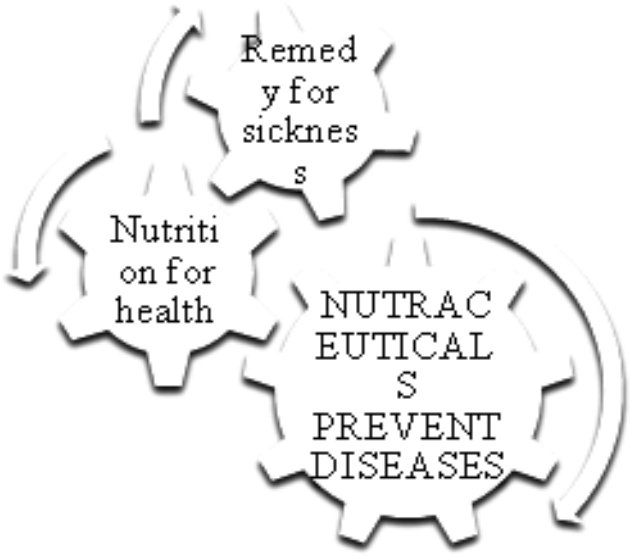


Fig 1: concept of nutraceutical

Nutraceutical Categories[2]
1. **Dietary Supplements including botanicals**
- Vitamins, co-enzymes, minerals, carnitine
- Ginko bilba, Ginseng, Saint John's Wort, Saw Palmetto

2. **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

3. **Medicinal Foods**
- Transgenic cows and lactoferrin for immune

enhancement
- Transgenic plants for oral vaccination against infectious diseases
- Health bars with added medications [2].

Type of nutraceuticals

Dietary Supplements

A dietary supplement is a product taken by mouth that contains a "dietary ingredient" intended to supplement the diet. The "dietary ingredients" in these products may include: vitamins, minerals, herbs or other botanicals, amino acids, and substances such as enzymes, organ tissues, and metabolites. Dietary supplements can also be extracts or concentrates, and may be found in many forms such as tablets, capsules, softgels, gelcaps, liquids, or powders which includes [7, 9].

Types of dietary supplement

Fig 2

1. Probiotics

Probiotics are beneficial components of the microbial that have been used for centuries because of the health benefits they confer to the host. Only recently, however, has the contribution of probiotics to modulation of immunological, respiratory, and gastrointestinal functions started to be fully appreciated and scientifically evaluated.

Mechanism of action of probiotics
- Modification of the stucure and function of intestinal epithelium.
- Competition or nutrient.
- Modification of microbial population.
- Aggregation with pathogenic bacteria.
- Competitive adhesion to epithelial receptars.
- Production of specific substances (organic acids, bacteriocins, dipicolinic acid) [21]

2. Prebiotics

Prebiotics are dietary substances (mostly consisting of non-starch polysaccharides and oligosaccharides poorly digested by human enzymes) that nurture a selected group of microorganisms living in the gut. They favour the growth of beneficial bacteria over that of harmful ones.

Unlike probiotics, most prebiotics are used as food ingredients—in biscuits, cereals, chocolate, spreads, and dairy products, for example. Commonly known prebiotics are:
- Oligofructose
- Inulin
- Galacto-oligosaccharides
- Lactulose
- Breast milk oligosaccharides

3. Anti-oxidant

Damage to cells caused by free radicals is believed to play a central role in the aging process and in disease progression. Antioxidants are our first line of defence against free radical damage, and are critical for maintaining optimum health and wellbeing. The need for antioxidants becomes even more critical with increased exposure to free radicals. Pollution, cigarette smoke, drugs, illness, stress, and even exercise can increase free radical exposure. Because so many factors can contribute to oxidative stress, individual assessment of susceptibility becomes important.

To protect the cells and organ systems of the body against reactive oxygen species, humans have evolved a highly sophisticated and complex antioxidant protection system. It involves a variety of components, both endogenous and exogenous in origin, that function interactively and synergistically to neutralize free radicals.

These components include:
- Nutrient-derived antioxidants like ascorbic acid (vitamin C), tocopherols and tocotrienols (vitamin E), carotenoids, and other low molecular weight compounds such as glutathione and lipoic acid.
- Antioxidant enzymes, e.g., superoxide dismutase, glutathione peroxidase, and glutathione reductase, which catalyze free radical quenching reactions.
- Metal binding proteins, such as ferritin, lactoferrin, albumin, and ceruloplasmin that sequester free iron and copper ions that are capable of catalyzing oxidative reactions.
- Numerous other antioxidant phytonutrients present in a wide variety of plant foods [5].

Classification of antioxidant
- Non- enzymatic
- Vitamins

1. Ascorbic acid
2. Vitamin – E (α- tocopherol)
3. B – Carotenes

- Plant products and extracts
- Plant products

1. Lycopine
2. Resveratol
3. Soy
4. Ginseng
5. Flavonoids
6. Turmeric

- Plant extract

1. Green tea extract
2. Bilberry extract

- Synthetic component

1. Melatonin
2. Allopurinol
3. Microhydrin
4. Aspirin derivatives

- Marine products and Transition metal

1. Sodium sulphate
2. Alginate
3. Selenium
4. Zinc
5. Copper

- Enzymatic

1. Superoxide dismutase
2. Glutathione peroxidise
3. Catalase
4. Peroxidase [5]

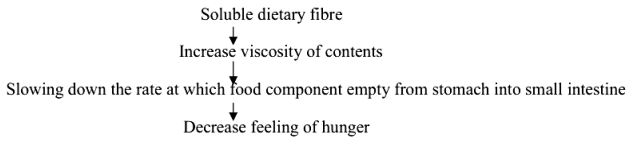
5. Dietary fibres

Dietary fibre is the remnants of the edible part of plants and analogous carbohydrates that are resistant to digestion and absorption in the human small intestine with complete or partial fermentation in the human large intestine. It includes polysaccharides, oligosaccharides, lignin and associated plant substances. Dietary fibre exhibits one or more of either laxative (fecal bulking and softening; increased frequency; and/or regularity), blood cholesterol attenuation, and/or blood glucose attenuation [19].

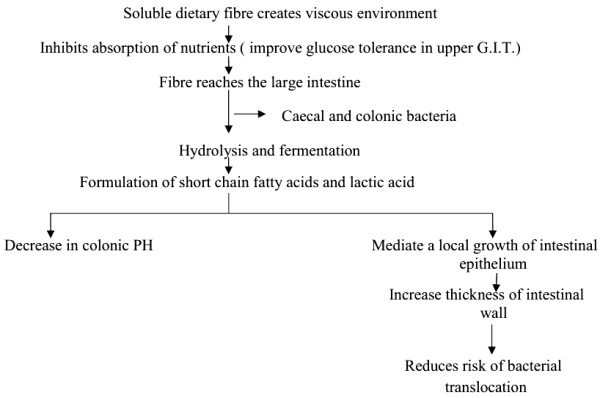
Mechanism of action

The best generally known effect of dietary fibre is its influence on stool. It decreases the time for food passage through entire gastro intestinal tract and increase focal bulk. The mechanism of action of dietary fibre is divided in two parts.

In stomach



In small intestine



6. Omega -3 fatty acids

Long-chain polyunsaturated fatty acids with the first double bond at the third position from the methyl terminal (so called n-3 FAs or omega-3 FAs) can be found in plants and fish. The essential omega-3 FA is alpha-linolenic acid (ALA) that occurs in plants (walnuts, soybean, flaxseed and their oils). This FA is a precursor also for arachidonic acid, which is further metabolised giving rise to eikosanoids with multiple biological functions in the organism. ALA is a substrate for elongation and thus eicosapentaenoic (EPA) and docosaheaxaenoic (DHA) omega-3 FAs are being produced. The latter two can be found in larger quantities in fish meat or fish oil, respectively (salmon, mackerel, trout) (Nettleton 1991). As only less than 5 % of ALA is converted to EPA and DHA in human organism, the dietary sources of these are also considered essential [22].

Mechanism of action

Omega-3 fatty acids can alter the membrane fluidity by displacing cholesterol from the membrane.

- An optimal fluidity influenced by essential fatty acids, is required for neurotransmitter binding and the signalling within the cell.
- Essential fatty acids can act as sources for second messenger within and between neurons.

FSSAI: The new ray of hope

Food Safety and Security (FSS) Act was passed by the parliament in 2006. In 2008, Food Safety and Standard Authority of India (FSSAI) came into existence. The FSSAI has prepared the draft rules and regulations for implementation of FSS Act 2006 which is going through process of prepublication consultation. It is expected that by the end of this month (September 2010) the draft regulation would be sent for notification.

Scope and oppourtunity of Indian nutraceutical market

The Indian nutraceutical market valued at $ 1,480 million in 2011 could grow to $ 2,731 million in 2016, a report said today. According to the report by business research and consulting firm Frost & Sullivan, functional foods will be the quickest growing category followed by dietary supplements until 2015. However, dietary supplements specifically herbal and dietetic supplements, will form the greatest opportunity areas for nutraceutical manufacturers, it added. Nutraceutical a portmanteau of the words 'nutrition' and 'pharmaceutical', is a food or food product that reportedly provides health and medical benefits, including the prevention and treatment of diseases. The report said that at present the dietary supplements were the largest category accounting for 64 per cent of the nutraceuticals market. This market is driven primarily by the pharmaceutical sector in the form of vitamin and mineral supplements, it added. As per the study the global nutraceutical market was estimated to be $ 149.5 billion in 2011 with US, Europe and Japan being the largest regional markets, accounting for nearly 93 per cent of the global nutraceutical demand. As these markets are nearing maturity, with exceedingly high per capita spends on nutraceutical products nutraceutical manufacturers are looking at developing countries such as India and China as key growth regions, it added. Apart from the current low per capita spend on these products in India, other factors that could support the growth of nutraceuticals in India are increasing obesity in the population and rising instances of diabetes and cardiovascular diseases, the report said. The government is also chipping in by funding vitamin fortification initiatives due to increasing food security concerns in India and need for additional nutrition [1].

Global demand in nutraceutical

World demand for nutraceutical ingredients advanced 5.8 percent annually to $15.5 billion in 2010, serving a $197 billion global nutritional product industry. China and India will emerge as the fastest expanding nutraceutical markets as strong economic growth allows them to upgrade and diversify food, beverage and drug production capabilities.

Herbal, non-herbal extracts has increasing acceptance by consumers and medical professionals pushed world demand for herbal and non-herbal extracts up to 6.5 percent annually to $1.85 billion in 2010. Nutrients, minerals and vitamins

demand reached $9.5 billion in 2010, up to 6.3 percent annually from 2005. Global demand for nutraceutical vitamin ingredients increased up to 4.6 percent annually to $4.2 billion in 2010. Natural vitamin E formulations and beta carotene (vitamin A) will also fare well in the global marketplace based on efficacy advantages over synthetic ingredients for adult and pediatric nutritionals [20].

Nutraceutical growth

In the global marketplace nutraceuticals and functional foods have become a multi-billion dollar industry and estimates. Internationally, significant limitations to growth in thisarea are resulting from a necessity to properly label and assess the health effects of nutraceutical and functional foods. Selection for consistent production of high and low productivity of active plant components within specific ecological regions will allow development of alternative nutraceuticals and functional foods with distinctive and more reliable health and food properties.

The United States of America (USA) currently possesses the largest and most rapidly expanding functional food and nutraceutical market in the world. India is the home of a Large number of medicinal herbs, spices and tree species that have a substantially large domestic market. The functional foods and nutraceuticals are available as traditional Indian Ayurvedic Medicines in India and marketed in different brand names. However, no strict pharmaceutical regulations are available for the Ayurvedic and nutraceutical health products in India; they are available to the public as over the counter without any medical prescription. India has a large share of the international functional food and nutraceutical market, and exports products to various countries. However, India's major export destination is the USA and Japan, the global food market growth about the nutraceuticals is shown in figure 3 [20].

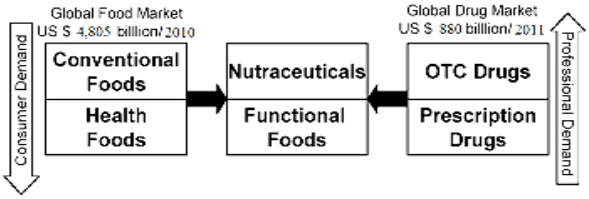


Fig 3

Table 1: Nutraceuticals used on disease

Cardiovescular disease	**Nutraceuticals play an important role in cardiovascular prevention in patients with dyslipidemia. Many scientific studies support the use of these substances alone or associated with other drugs in clinical practice. Specifically, monacolines, berberine, policosanol and gamma-oryzanol could significantly reduce cholesterolemia [3].**
Diabetes mellitus	Ethyl esters of n-3 fatty acids may be beneficial in diabetic patients Docosahexaenoic acid modulates insulin resistance and is also vital for neurovisual development. Lipoic acid, an antioxidant, for treatment of diabetic neuropathy. Dietary fibers from psyllium have been used for glucose control in diabetic patients and to reduce lipid levels in hyperlipidemia [4]
Obesity	A blend of glucomannan, chitosan, fenugreek, G sylvestre, and vitamin C in the dietary supplement significantly reduced body weight[18] Conjugated linoleic acid (CLA), capsaicin, Momordica Charantia(MC) possesses potential anti obese properties [10]
Cancer	To prevent prostate/breast cancer a broad range of phyto-pharmaceuticals with a claimed hormonal activity, called "phyto-estrogens" is recommended. Soyfoods source of isoflavones, curcumin from curry and soya isoflavones possess cancer chemopreventive properties [11] Lycopene concentrates in the skin, testes, adrenal and prostate where it protects against cancer [12]
Anti-inflammatory activities	Cat's claw has 17 alkaloids, along with glycosides, tannins, flavonoids, sterol fractions, and other compounds and work as potent anti-inflammatory agent [13] Allergy Quercet (found in Onions, red wine and green tea) reduce the inflammation that results from hay fever, bursitis, gout, arthritis, and Asthma [14]
Alzheimer's disease	β-carotene, curcumin, lutein, lycopene, turmerin etc may exert positive effects on specific diseases by neutralizing the negative effects oxidative stress mitochondrial dysfunction, and various forms of neural degeneration[15]
Parkinson's disease	Vitamin E in food may be protective against Parkinson's disease [16] Creatine modifies Parkinson's disease features as measured by a decline in the clinical signs [17]

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.

Conflict of Interest

The authors declare that they have no conflicting of interests.

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