

Review Article**NUTRACEUTICALS-PORTMANTEAU OF SCIENCE AND NATURE****Tank Dharti S*, Sanket Gandhi, Manoj Shah**

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*Corresponding author's E-mail: dhartitank@gmail.com**Received on:** 21-10-2010; **Finalized on:** 15-12-2010.**ABSTRACT**

Nutraceuticals is a broad umbrella term used to describe any product derived from food sources that provides extra health benefits in addition to the basic nutritional value found in foods. The term *Nutraceutical* is a hybrid of *nutrition* and *pharmaceutical technology*, coined in 1989 by Stephen DeFelice. In present article an attempt has been made to discuss all aspects of Nutraceuticals- Definition, how they differ from functional food and dietary supplement, classification, marketed products, the pros and cons and future aspects.

Keywords: Nutraceuticals, Dietary supplement, Functional food, Medicine, Marketed products.

INTRODUCTION

In present scenario, rapid industrialization and technological advancement has led to improved quality of life in terms of income, spending and lifestyle along with the economic growth. The first victim of this lifestyle change has been food habits. It has also imposed a major challenge in the form of 'lifestyle diseases'. Consumption of junk food has increased enormously, which has led to a number of diseases related to nutritional deficiencies. Nutraceuticals can play an important role in controlling them. The idea behind the mode of action of nutraceuticals is to provide functional benefits by increasing the supply of natural building blocks in the body. Replacement of these building blocks can work in two ways: to diminish disease signs or to improve performance. Nutraceuticals is a broad umbrella term used to describe any product derived from food sources that provides extra health benefits in addition to the basic nutritional value found in foods.

Nutraceuticals- Looking back

The concept of nutraceuticals has evolved considerably over the years. The Ancient civilizations have provided evidence suggesting that foods can be effectively used as medicine to treat and prevent disease. Documents hint that the medicinal benefits of food have been explored for thousands of years. Around three thousand years ago, Hippocrates (460–377 BC), the well-recognized father of modern medicine, stated "Let food be thy medicine and medicine be thy food" to predict the relationship between appropriate foods for health and their therapeutic benefits¹. The truth in this saying is widely recognized today.

The concept of nutraceutical started flourishing in Europe, Germany and France long back. In USA in early 1900s this concept got popularity. In Japan, The modern nutraceutical market began to develop in Japan during the 1980s. The term Nutraceutical was coined from

nutrition and *pharmaceutical technology* in 1989 by Stephen DeFelice, founder and chairman of foundation for innovation in medicine (FIM), an American organization which encourages medical health, Cranford, New Jersey (Figure1.)²⁻⁴

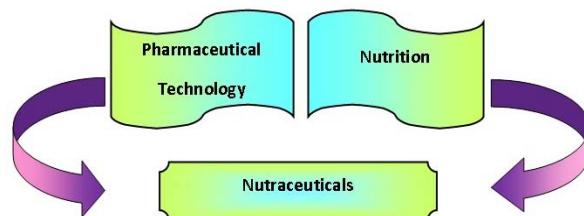


Figure 1: Term Nutraceutical is a hybrid of nutrition and pharmaceutical technology [5].

According to him "*a nutraceutical is any substance that is a food or a part of food that provides medical or health benefits, including the prevention and/or treatment of disease*".

Such products may range from isolated nutrients, dietary supplements and specific diets to genetically engineered designer foods and herbal products^{2,5}. These nutraceuticals normally contain the required amount of vitamins, lipids, proteins, carbohydrates, minerals, or other necessary nutrients, depending on their emphases^{6,7}.

Definitions:

Stephen defelice: *A Nutraceutical is any substance that is a food or a part of food that provides medical or health benefits, including the prevention and/or treatment of disease*.^{2,4}

As per Merriam-Webster Dictionary: *A food stuff (as a fortified food or a dietary supplement) that provides health benefit*.



The Nutraceuticals Institute defines them as: *naturally derived bioactive compounds that are found in foods, dietary supplements and herbal products, and have health promoting, disease preventing, or medicinal properties*^{6,7}.

Are Nutraceuticals food or drug?

Nutraceuticals are foods or food ingredients that provide medical or health benefits. This emerging class of products blurs the line between food and drugs. They do not easily fall into the legal categories of food or drug and often inhabit a grey area between the two (Figure 2)⁸.

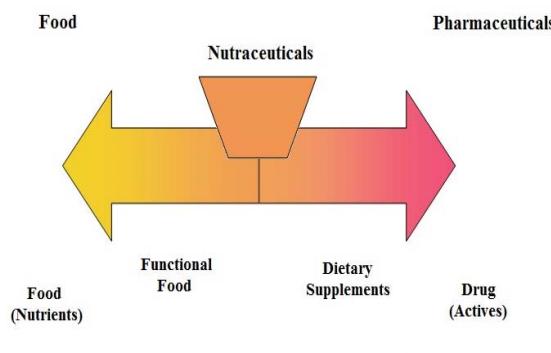


Figure 2: Nutraceuticals are partly considered as food and partly as drugs

Nutraceuticals = Food?

Food is any substance or material eaten to provide nutritional support for the body. Nutraceuticals are considered food as they provide nutrition or health benefits.

Then how they differ?

Food is generally recognized as safe whereas Nutraceuticals may contain substances that are "natural" but may not be generally recognized as safe.

Nutraceuticals =drugs?

Within European Medicines law a nutraceutical can be defined as a medicine for two reasons:

- 1) It can used for the prevention, treatment or cure of a condition or disease or
- 2) It can be administered with a view to restoring, correcting or modifying physiological functions in human beings⁹.

Drugs are subject to an approval process prior to marketing. To be approved, a drug must demonstrate safety and efficacy for its intended use. Nutraceuticals are not drugs simply because they have not gone through an approval process¹⁰.

Nutraceutical = Dietary supplements?

The Dietary Supplement Health and Education Act (DHSEA), defined "dietary supplement" using several criteria.

A dietary supplement:

- is a product (other than tobacco) that is 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, constituent, extract, or combinations of these ingredients.
- is intended for ingestion in pill, capsule, tablet or liquid form.
- is not represented for use as a conventional food or as the sole item of a meal or diet.
- is labeled as a "dietary supplement."

Nutraceuticals differ from dietary supplements in the following aspects:

Nutraceuticals must not only supplement the diet but should also aid in the prevention and/or treatment of disease and/or disorder.

Nutraceuticals are represented for use as a conventional food or as the sole item of meal or diet¹¹.

How Nutraceuticals differ from Functional food?

Nutraceuticals slightly differ from functional foods. When food is being cooked or prepared using "scientific intelligence" with or without knowledge of how or why it is being used, the food is called Functional food. Thus, functional food provides the body with the required amount of vitamins, fats, proteins, carbohydrates, etc. needed for its healthy survival.

When functional food aids in the prevention and/or treatment of disease(s) and/or disorder(s) other than anemia, it is called a Nutraceutical. (Since most of the functional foods act in some way or the other as anti-anemic, the exception to anemia is considered so as to have a clear distinction between the two terms, functional food and nutraceutical.) Examples of nutraceuticals include fortified dairy products (e.g. milk) and citrus fruits (e.g. orange juice)¹¹.

Traditional versus Nontraditional foods

Nutraceuticals on the market today consist of both traditional foods and nontraditional foods.

Traditional nutraceuticals are simply natural, whole foods with new information about their potential health qualities. There has been no change to the actual foods, other than the way the consumer perceives them. Example includes lycopene in tomatoes, omega-3 fatty acids in salmon.

Nontraditional nutraceuticals, are foods resulting from agricultural breeding or added nutrients and/or ingredients, to boost their nutritional values. Examples include β-carotene-enriched rice, and soybeans, orange juice fortified with calcium, cereals with added vitamins or minerals¹².



Classification of Nutraceuticals:

Numerous nutraceuticals currently are available in the market. The following chart represents a sample of available nutraceuticals, their components, sources and their potential human health benefits (Table 1)^{13,14}.

Table 1: Samples of available nutraceuticals, their components, sources and their potential human health

Chemical Constituent	Source	Potential benefit
A. Carotenoids (Isoprenoids)		
β-Carotene	Carrots, various fruits, Oat, vegetables	Antioxidant boosts activity of Natural Killer immune cell, Gives cornea protection against UV light.
Lutein	corn, avocado, egg yolk , spinach	Protects the eyes against the development of Age-related Macular Degeneration, Cataracts, Anticancer(colon)
Lycopene	Tomatoes, watermelon, pink grapefruit, guava, papaya	Powerful antioxidant, protects against formation of cancers (Prostate, Bladder, Cervical, Leukemia, reduces cholesterol levels.
B. Tocotrienol (Isoprenoids)	Grains, Palm oil	Anticancer (breast cancer), Promotes cardiovascular health
C. Saponins	chickpeas and soybeans	Lowers cholesterol, effective against colon cancer
D. Polyphenolic Compounds		
Flavonones	Citrus fruits	Antioxidants, Reduce risk of cancer
Flavonols	Onions, apples, tea, broccoli	Antioxidants
Flavones	Fruits, Vegetables, Soyabean	Antioxidants, Reduce risk of cancer
Anthocyanins	Blueberries, Blackberries, black raspberries	anti-oxidants, counteracts inflammation in the body, lower blood sugar levels in people with diabetes.
Phenolic acids	Berries, legumes.	Phenolic acids reduce oxidation of LDL cholesterol. Reduce formation of cancer.
Resveratrol	Dark grapes, Raisins, berries, peanuts	lowers total serum cholesterol increasing HDL
Curcumin	Turmeric root	strongly anti-inflammatory and strongly anti-oxidant, effective anti anti-clotting agent
E. Glucosinolates	cruciferous vegetables, cauliflower	Anticancer-greatest protection against bladder cancer.
F. Phytoestrogens		
Isoflavones (genistein, daidzein)	soy beans, legumes,	Lowers LDL cholesterol (bad cholesterol) antioxidants, prostate, breast, bowel, and other cancers.
Lignans	Flaxseed, rye, vegetables	Inhibit the development of breast cancer and colon cancer.
G. Dietary fibre		
Soluble fibre (Prebiotics)	Legumes, oats, barley, some fruits	Contribute to maintenance of a healthy digestive tract, Anticancer.
Insoluble fibre	whole grain foods wheat and corn bran, nuts	Contribute to maintenance of a healthy digestive tract, Anticancer(colon)
H. Sulfides/Thiols Dithiolthiones	Cruciferous vegetables	May contribute to maintenance of healthy immune function.
I. Fatty Acids		
Omega 3 Fatty Acids(Poly Unsaturated Fatty Acids)	Salmon, Flax seed,	Potent controllers of the inflammatory processes, Maintenance of brain function, Reduce cholesterol disposition.
Monosaturated fatty acids	Tree nuts	Reduce risk of coronary heart disease
J. Probiotics/Prebiotics Lactobacilli, bifidobacteria	Yogurt, other dairy and nondairy applications	May improve gastrointestinal health and systematic immunity
K. Minerals Calcium, Selenium, Potassium, Zinc, Copper	Food	Important constituents of balanced diet
L. Polyoxyethylene Sugar alcohols (xylitol, sorbitol)	Fruits	May reduce risk of dental caries (cavities)



Table 2: List of Marketed nutraceuticals products

Product	Constituent	Category	Company
BetaFactor® Capsules	Beta-glucan (Dietary fibre)	Immune supplement	Ameriden® International, Inc., USA
TOZAL Eye Health Formula	omega 3 fatty acids, zinc, antioxidants and lutein	improved vision	AmeriSciences, USA
Source Naturals Lycopene® 10mg Softgel	Lycopene (carotenoids)	Antioxidant	Source Naturals
POMx Antioxidant Recovery® Drink	Polyphenols	speed muscle recovery	POM Wonderful Ltd, USA
PediaSure®	Protein, vitamin and other natural supplement	Nutritional supplement	Abbott Nutrition
Proteinex®	Predigested proteins, vitamins, minerals, carbohydrates	Protein supplement	Pfizer Ltd. , India
BeneFlora® Probiotic	Lactobacillus Acidophilus, Bifidobacterium Bifidum.	improve gastrointestinal health and systematic immunity.	Nupro, USA
Ferradol Food® powder	Carbohydrate, Protein, Niacinamide, Calcium, Iron Zinc,Vitamins.	Nutritional supplement for children and adults	Pfizer Limited, India
Weight smart™	Vitamins and trace elements	Nutritional supplement	Bayer corporation, USA
brainSpeed Memory®	blend of vitamins and minerals	Brain health	Natrol, USA
Muscle Optimeal®	Protein. Vitamins, dietary fibre, xylitol and trace elements	Meal replacement drink mix	Jarrow formulas, USA
AvoVida® with Glucosamine	Phytosterols: Beta-Sitosterol, Campesterol, and Stigmasterol from avocado and soy.	Maintaining healthy cholesterol levels and maintaining healthy joints.	Cyvex nutritrion, USA
NeuroHelp Essential™	Vitamin supplement with natural antioxidants	Vitamin supplement product specifically formulated to improve nerve health.	NeuroHelp, USA
EFAGold™ Super Lignan capsule	Vitamin D and Lignan	Easier Menopausal Transition, Cardiovascular Health	Nature's Way,USA
5-Hour energy®	Vitamins, Citicoline, Tyrosine, Taurine, Malic Acid, Glucuronolactone, Caffeine	Energy drink	Living essentials, USA
Snapple-a-day™	Vitamins and Minerals	Meal replacement beverage	Snapple beverage group, USA
Omega women	Antioxidants, Vitamins, Lycopene, Resveratrol	Immune supplement	Wassen, U.K

Regulation

Nutraceuticals have no official meaning and do not constitute a distinct category of foods. Most often they are simply natural, whole foods that consumers have been eating for thousands of years. As a result, the FDA regulates them in the same way they regulate all foods. The safety of ingredients must be assured in advance and

all claims must be substantiated, truthful and nonmisleading¹².

In 2006, the Indian government passed Food Safety and Standard Act to integrate and streamline the many regulations covering nutraceuticals, foods and dietary supplements.



What are the Pros and Cons?

Nutraceuticals may seem attractive because they do not require an appointment with a health care provider and are easily available without a prescription. Many people believe this approach is more natural than using prescription drugs. They feel dietary supplements will help them feel stronger and healthier, give them more energy, and prevent illness. Some people turn to these products when they feel standard treatments for their specific illness have failed.

There are also some drawbacks to using these products, however for one thing, drugs—including prescription drugs and those sold over the counter—are regulated by the US Food and Drug Administration. Drug manufacturers must submit scientific evidence that their products are safe and effective. Then they must manufacture the drugs in a strictly that ensures they are pure and contain the exact amount of the specific ingredients they should.

Nutraceuticals, on the other hand, are regulated as foods, not as drugs. They may contain more, less, or none of the actual effective ingredient, and they may be contaminated with other substances. In addition, Nutraceutical manufacturers are not required to submit scientific studies proving their product's safety and effectiveness. Just because Nutraceuticals seem natural does not mean they are safe, or that they will have the effects they promise. Supplements, just like drugs, can have unwanted side effects as well as desirable effects. Some supplements can interact with prescription drugs, causing harm.

Benefits of using Nutraceuticals:

Human capital is the most essential prerequisite for stable growth and prosperity of any society. The importance of nutraceuticals to the human organism is that they provide all the essential substances that should be present in a healthy diet. Very often the daily hustle and our diet lead to unhealthy way of life. This is getting us "off balance" and if we neglect it, ailments are the next to come.

The right administration of nutraceuticals provides for better quality of life, which means for every one of us:

- o healthier life
- o better mood and self-confidence
- o better working capacity
- o better social environment

Also Nutraceuticals Attribute following benefits:

- May increase the health value of our diet.
- Provides healthier life and help us live longer.
- May help us to avoid particular medical conditions.

- May have a psychological benefit from doing something for oneself.
- May be perceived to be more "natural" than traditional medicine and less likely to produce unpleasant side-effects.
- May present food for populations with special needs (e.g. nutrient-dense foods for the elderly)[5].
- The society wins lower health expenditure, lower social expenditure and more productive individual.

The Drawbacks:

Bioavailability (absorption rate) of a supplement product is one of the main challenges in finding effective nutraceutical products. The bioavailability of nutrients is higher in food eaten in its natural state. Nutraceuticals with poor absorption rates results in nutrients being disposed from the body without providing any nutritional or medicinal benefit.

Impact of placebo effect: Similar to pharmaceuticals, part of the effectiveness of nutraceuticals may be attributed to the placebo effect. Consumers using nutraceuticals may inaccurately credit their use of nutraceuticals for healing illness, when the body is often able to recover on its own.

Product quality issues: Nutraceuticals from the international market may claim to use organic or exotic ingredients, yet the lack of regulation may compromise the safety and effectiveness of products.

Safety & Interactions with other drugs: The danger is that many of these products do not provide consumers with solid information about their safety and effectiveness, possible side effects, interactions with prescription medicines or the impact they may have on existing medical conditions.

Current Market scenario:

Nearly two-thirds of the American population takes at least one type of nutraceutical health product. The use of nutraceuticals, as an attempt to accomplish desirable therapeutic outcomes with reduced side effects, as compared with other therapeutic agents has met with great monetary success. The preference for the discovery and production of nutraceuticals over pharmaceuticals is well seen in pharmaceutical and biotech companies. Presently the nutraceutical industry in the US is about \$86 billion. This figure is slightly higher in Europe and in Japan represents approximately a quarter of their \$6 billion total annual food sales- 47% of the Japanese population consume nutraceuticals¹⁵. Japan, USA, UK is the world leaders in the nutraceuticals market India and China becoming the fastest growing markets. Worldwide there are around 5000 established nutraceutical products (Table 2). Vitamins, Minerals and Nutrients constitute about 85% of the market while antioxidants and anti-agents account for 10% other segments such as herbal



extracts occupy 5% of the market, globally. Sales of nutraceuticals are projected to reach \$187.4 billion by 2010 against an estimated \$155.9 billion in 2007¹⁶. Because new medicines are harder to find and more expensive and risky to develop than ever before, many companies, for example, Du Pont, Abbott Laboratories and Warner Lambert, which have produced conventional pharmaceuticals in the past are now merging to survive, or are turning to nutraceuticals⁴.

Future Aspects:

Increasing awareness levels about fitness and health, spurred by media coverage are prompting the majority of people to lead healthier lifestyles, exercise more, and eat healthy. The expanding nutraceutical market indicates that end users are seeking minimally processed food with extra nutritional benefits and organoleptic value. This development, in turn, is propelling expansion in the nutraceutical markets globally. The emerging nutraceuticals industry seems destined to occupy the landscape in the new millennium. Its tremendous growth has implications for the food, pharmaceutical, healthcare, and agricultural industries. Many scientists believe that enzymes represent another exciting frontier in nutraceuticals⁵. Also attempts to aid Genetic disorders using Nutraceuticals are major areas of concern.

CONCLUSION

In this age of self medication, Nutraceuticals are destined to play a crucial role in future therapeutic developments but their success will be governed by control of purity, safety and efficacy, including innovation. Nutraceuticals efficiently congregates nature and science for human welfare.

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