



NUTRACEUTICALS: A REVIEW

Sarin Rajat*, Sharma Manisha, Singh Robin, Kumar Sunil
Rayat Institute of Pharmacy, Railmajra, Distt. Nawanshahar, Near Ropar, Punjab, India

Article Received on: 17/02/12 Revised on: 20/03/12 Approved for publication: 19/04/12

*Email: rajatsarin20@gmail.com

ABSTRACT

The term "nutraceutical" was coined from "nutrition" and "pharmaceutical" in 1989 by Stephen DeFelice. Drugs shows various side effects and adverse effects due to which consumers are generally moves to take food supplements to improve health. Such products may range from isolated nutrients, dietary supplements and diets to genetically engineered "designer" foods, herbal products and processed foods such as cereals, soups and beverages. Nutraceuticals used in various diseases, Alzheimer's disease, cardiovascular disease, obesity disease, cancer etc. This review focus on definition, history, comparing with various other terminologies, classification and various marketed products.

KEYWORDS: Nutraceutical, Dietary Supplements, Functional food, Marketed nutraceutical etc.

INTRODUCTION

Due to risk of toxicity or adverse effect of drug, consumers are turning massively to food supplements to improve health where pharmaceutical fails. This resulted in a world wide nutraceuticals revolution¹. The term "nutraceutical" was coined from "nutrition" and "pharmaceutical" in 1989 by Stephen DeFelice, MD, founder and chairman of the Foundation for Innovation in Medicine (FIM), Cranford, NJ. According to DeFelice, nutraceutical can be defined as, "a food (or part of a food) that provides medical or health benefits, including the prevention and/or treatment of a disease"². However, the term nutraceutical as commonly used in marketing has no regulatory definition³. Such products may range from isolated nutrients, dietary supplements and diets to genetically engineered "designer" foods, herbal products and processed foods such as cereals, soups and beverages. Presently over 470 nutraceutical and functional food products are available with documented health benefits. Many of these new products that are being promoted to treat various diseases find their origin in the plant kingdom. This is an obvious choice as many plants produce secondary compounds as alkaloids to protect themselves from infections and these constituents may be useful in the management of human infection. Many of the phyto medicines are the typical examples. The old proverb "an apple a day will keep the doctor away" is now replaced by "a nutraceutical a day may keep the doctor away"⁴. 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 term used to describe any product derived from food sources that provides extra health benefits in addition to the basic nutritional value found in foods⁵. These nutraceuticals normally contain the required amount of vitamins, lipids, proteins, carbohydrates, minerals, or other necessary nutrients, depending on their emphases⁶. Nutraceuticals on the market today consist of both **traditional foods** and **non-traditional 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 fattyacids in salmon. **Non Traditional** 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 minerals⁷.

HISTORY

The original idea in these concepts goes back three thousand years ago. Hippocrates (460–377 BC), the well-recognized father of modern medicine, stated "Let food be thy medicine and medicine be m thy food" to predict the relationship between appropriate foods for health and their therapeutic benefits⁸. The truth in this saying is widely recognized today. The concept of nutraceuticals is not entirely new, although it has evolved considerably over the years. In the early 1900s, food manufacturers in the United States began adding iodine to salt in an effort to prevent goiter, representing one of the first attempts at creating a functional component through fortification. Today, researchers have identified hundreds of compounds with functional qualities, and they continue to make new discoveries surrounding the complex benefits of phytochemicals (non-nutritive plant chemicals that have protective or disease preventive properties) in foods. In Japan, England and other countries, nutraceuticals already have become part of the dietary landscape. Consumer interest in the relationship between diet and health has increased the demand for information on nutraceuticals. Rapid advances in science and technology, increasing health care costs, changes in food laws affecting label and product claims, an aging population and rising interest in attaining wellness through diet are among the factors fueling U.S. interest in nutraceuticals. Credible scientific research indicates many potential health benefits from food components. These benefits could expand the health claims now permitted to be identified by the Food and Drug Administration⁹.

NUTRACEUTICALS VS OTHER TERMINOLOGIES:

There is a lot of confusion regarding the terminologies like "nutraceuticals", "functional foods", "dietary supplements" "designer foods", "medical foods", "pharmafoods", "phytochemicals" etc.

“Pharmaceuticals” may be considered as drugs used mainly to treat diseases, while “nutraceuticals” are those that are intended to prevent diseases. Within European Medicines law a nutraceutical can be defined as a medicine for two reasons: It can be used for the prevention, treatment or cure of a condition or disease or be administered with a view to restoring, correcting or modifying physiological functions in human beings¹⁰.

Both pharmaceuticals and nutrients can cure and prevent disease(s) but only pharmaceuticals have governmental sanction. 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 process¹¹. Many pharmaceuticals have their origin in plants and animals and are no less “natural” than nutrients. Classic example of nutrients is synthetic vitamins¹².

“Medical foods” are a specific category of therapeutic agents that are intended for the nutritional management of a specific disease. An example of medical foods is formulations intended to manage patients with inborn errors in amino acid metabolism. Newer medical foods are designed to manage hyperhomocysteinemia, pancreatic exocrine insufficiency, inflammatory conditions, cancer cachexia, and other diseases¹². Food is generally recognized as safe whereas Nutraceuticals may contain substances that are “natural” but may not be generally recognized as safe.

Nutraceuticals sometimes referred as **“functional foods”**, have caused heated debate because they blur the traditional dividing line between food, and medicine. 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 antianemic, 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) and vegetables¹³.

The Dietary Supplement Health and Education Act (DHSEA), defined “dietary supplement” using several Criteria.

A dietary supplement

1. 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 vita-min, 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.
2. is intended for ingestion in pill, capsule, tablet, or liquid form.
3. is not represented for use as a conventional food or as the sole item of a meal or diet.
4. is labeled as a “dietary supplement.”
5. includes products such as an approved new drug, certified antibiotic, or licensed biologic that was marketed as a

dietary supplement or food before approval, certification, or license (unless the Secretary of Health and Human Services waives this provision)¹⁴.

Thus, nutraceuticals differ from dietary supplements in the following aspects:

1. Nutraceuticals must not only supplement the diet but should also aid in the prevention and/or treatment of disease and/or disorder.
2. Nutraceuticals are represented for use as a conventional food or as the sole item of meal or diet.

A ray of “cure preference” in the mind of common patients revolves around nutraceuticals because of their false perception that “all natural medicines are good.” Also, the high cost of prescription pharmaceuticals and reluctance of some insurance companies to cover the costs of drugs helps nutraceuticals solidify their presence in the global market of therapies and therapeutic agents¹⁵.

CLASSIFICATION OF NUTRACEUTICALS:

Nutraceuticals classified on the basis of various chemical constituent present in herbal plants. Table1. shows list of various nutraceutical, their components, source and their potential benefits^{9,15,16}.

REGULATIONS: Nutraceuticals have no official meaning and do not constitute a distinct category of foods. Most often, they are simply natural, whole foods 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 non misleading⁹. In 2005, the National Academies Institute of Medicine and National Research Council created a blue-ribbon committee to create an improved framework for the Federal Food & Drug Administration to evaluate dietary supplements. Though the improved framework fails to distinguish between “nutraceuticals” and “dietary supplements”. With the continued use of a broad definition and lacking greater distinction, a cost-effective and scientifically based framework was needed to evaluate the safety of “dietary supplements” including those consumer products recognized internationally as “nutraceuticals”¹⁷.

MARKETED NUTRACEUTICAL: There are many nutraceutical products that are marketed by different manufacture for the health benefits of human being. Table2. Shows different marketed nutraceutical their category, ingredient and manufacturer.

CONCLUSION

At present, nutraceutical represent the fastest growing segment of today’s food industry. Although it may be many years before the new designer foods will be stocked on supermarket shelves, the ongoing program will lead to a new generation of foods, which will certainly cause the interface between food and drug to become increasingly permeable. 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. The right administration of nutraceuticals provides for better quality of life, healthier life, better mood and self-confidence, better working capacity, better social environment. Thus, in the future we will see the emergency of nutraceutical soups, nutraceutical processed meat, bread and sausage. And many of these foods might be genetically produced. 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 movement 'from treatment to prevention' stimulates demand for nutraceuticals as they offer additional health benefits beyond basic nutrition," says Ewa Hudson, head of health & wellness research at Euromonitor. 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 nutraceuticals. The expanding nutraceutical market indicates that end users are seeking minimally processed food with extra nutritional benefits and organoleptic value. Many scientists believe that enzymes represent another exciting frontier in nutraceuticals. For diseases expected to increase in number, but can be prevented by lifestyle change, such as metabolic syndromes, the patients are required to positively change their lifestyles. One of the solutions is to change their diet. Nutraceuticals should contribute to prevention of such diseases. The research strategy of the world towards nutraceuticals should be in future for living life healthy and improve quality of life.

ACKNOWLEDGEMENT

The authors would like to thank The Director, Rayat Institute of Pharmacy (Punjab) for providing the necessary facilities for the research work.

REFERENCES

1. Rohan S, Ghodake, Bhartesh R, Kalai, Kiran A, Wadkar, Sandeep B, Patil, Nilofar S, Naikwade. Nutraceuticals: The Medicinal Key of Living Life Healthy! J.Pharm Res. & Clin Pract. 2011; 1(2):121-129.
2. Brower V. Nutraceuticals: poised for a healthy slice of the healthcare market? Nat Biotechnology. 1998; 16: 728-731.
3. Zeisel SH. Regulation of "Nutraceuticals." Science. 1999; 285:185-186.
4. Dr K Bhaskaran. Nutraceuticals. Health Administrator Vol : XX Number 1&2 : 76-77.
5. Tank Dharti S, Sanket Gandhi, Manoj Shah. Nutraceuticals-portmanteau of science and nature. 2010; 5(3).
6. Whitman M. Understanding the perceived need for complementary and alternative nutraceuticals: lifestyle issues. Clin J Oncol Nurs. 2001; 5: 190-194.
7. Nutraceuticals.Aboutbioscience.org.2007.http://docs.google.com/viewer?a=v&q=cache:n2Bhd6DATggJ:www.aboutbioscience.org/pdfs/Nutraceuticals.
8. Bagchi D. Nutraceuticals and functional foods regulations in the United States and around the world. Toxicol 2006; 221: 1-3.
9. Nutraceuticals.Aboutbioscience.org. North Carolina Association For Biomedical Research. 2007.1-10.
10. Dietary Supplement Health Education Act (DSHEA) of 1994. Public Law 103-417.http://www.fda.gov.(03 may 2010).
11. Boothe, D.M. Nutraceuticals in Veterinary Medicine. Part II. Safety and Efficacy 1998; 20 (1):15-21.
12. A Rajasekaran, G Sivagnanam and R Xavier. Nutraceuticals as therapeutic agents: A Review. Research J. Pharm. and Tech. 1(4): 2008, 328-340.
13. Kalra EK. Nutraceutical — Definition and Introduction. AAPS Pharm Sci. 2003; 5: 1-2.
14. FDA/CFSAN resources page. Food and Drug Administration Web site. Dietary Supplement Health and Education Act of 1994. Available at: http://vm.cfsan.fda.gov/~dms/dietsupp.html.
15. Ben Best. 08 August 2006. Phytochemicals as Nutraceuticals. http://www.benbest.com/nutraceut/ phytochemicals.html (18 June 2010).
16. Wildman Robert E.C., Kelley Mike. Nutraceuticals and Functional Foods. In: Wildman Robert E.C. Handbook of Nutraceuticals and Functional Foods. Second Edition. Newyork: CRC Press, 2007; 1-9.
17. Committee on the Framework for Evaluating the Safety of the Dietary Supplements (2005). "Committee Change". Dietary Supplements: A Framework for Evaluating Safety. Institute of Medicine. p. 21

TABLE 1. CLASSIFICATION OF NUTRACEUTICALS

Chemical constituent	Source	Potential benefit
1.Carotenoids (Isoprenoids)		
a. Lycopene	Tomatoes, pink grapefruit, guava papaya, watermelon	Antioxidant activity, protects against formation of cancer mainly prostate, bladder, cervical, leukemia.
b. Lutin	Corn, avocado, egg yolk, spinach	Anticancer activity (colon), cataracts, protects the eyes against development of age related muscular degeneration.
c. β-Carotene	Carrots, various fruits and vegetables	Antioxidant activity which neutralizes free radicals, protect cornea against UV light. Antioxidants, anticarcinogenic
d. α-carotene	Carrots	Antioxidants, anticancer
e. α-cryptoxanthin	Oranges&tangerines	Protects eye from macular degeneration and cataracts
g. Zeaxanthin	Corn, avocado	
2.Dietary fibres		
a. Soluble fibre	Legumes, oats, barely, some fruits	Anticancer, helpful in maintaining the digestive tract
b. Insoluble fibre	Whole grain foods Wheat and corn bran, nuts	Anticancer(colon), helpful in maintaining the digestive tract
3.Polyphenolic compounds		
a. Flavonones	Citrus fruits	Antioxidants, Anti cancer
b. Flavones	Fruits, Vegetables, Soyabean	Antioxidants, Anti cancer
c. Flavonols	Onions, apples, tea, broccoli	Antioxidants
d. Anthocyanins	Blueberries, Blackberries, black Raspberries	anti-oxidants, counteracts inflammation in the body, Lower blood sugar levels in people with diabetes.
e. Phenolic acids	Berries, legumes.	Phenolic acids reduce oxidation of LDL cholesterol. Reduce formation of cancer.
f. Resveratrol	Dark grapes, Raisins, berries, peanuts	lowers total serum cholesterol increasing HDL
g. Curcumin	Turmeric root	strongly anti-inflammatory and strongly anti-oxidant, effective anti anti-clotting agent
4.Fatty Acids		
a. Omega 3 Fatty Acids(PolyUnsaturated Acids)	Salmon, Flax seed	Potent controllers of the inflammatory processes, Maintenance of brain function, Reduce cholesterol disposition.

b.Monosaturated fatty acids	Tree nuts	Reduce risk of coronary heart disease
5.Isothiocyanates a. sulporaphane	Cauliflower, broccoli, cabbage, kale, Horseradish	May enhance detoxification of undesirable compounds and bolster cellular antioxidant defences
6.Phenols a. Caffeic acid, b. Ferulic acid	Apples, pears, citrus fruits, some vegetables	May bolster cellular antioxidant defenses; may contribute to maintenance of vision and heart health
7.Plant Stanols/Sterols a. Stanol/sterol esters	Fortified table spreads, stanol ester dietary supplements	May reduce risk of coronary heart disease
8. Tocotrienol (Isoprenoids)	Grains, Palm Oil	Anticancer (breast cancer), Promotes cardiovascular health
9. Saponins	chickpeas and soybeans	Lowers cholesterol level, Anticancer activity (colon)
10. Probiotics/Prebiotics Lactobacilli, bifidobacteria	Yogurt, other dairy and non dairy Applications	May improve gastrointestinal health and systematic Immunity
11.Minerals Calcium,selenium, potassium, zinc, copper	Food	Important constituent of balance diet
12.Polyols Sugar alcohols (xylitol, sorbitol)	Fruits	Reduces risk of dental caries
13.Sulfides/Thiols Dithiothiones	Cruciferous vegetables	May contribute to maintenance of healthy immune function
14.Glucosinolates	Cruciferous vegetables, Cauliflower	Anticancer (bladder cancer)
15.Phytoestrogens		
a.Isoflavanes (genistein,daidzein)	Soy beans, legumes	Lowers LDL cholesterol antioxidant, anticancer(prostate, breast, bowel)
b. Lignanans	Flaxseed, rye, vegetables	Inhibit the development of breast cancer and colon cancer
16. Alkaloids		
a. Quinine	Cinchona	Anti-malarial
b. Tropane alkaloids	Solanaceous members : Deadly night shade, Datura	In treatment of heart ailments
c. Morphine	Opium poppy	Antidepressant, pain killer
d. Ergot alkaloids	Fungus: <i>Claviceps purpurea</i>	Abortifacients
e. Vincristine	Periwinkle	Antineoplastic
f. Vinblastine	Periwinkle	Antineoplastic
g. Coumarin	Fenugreek	Hypoglycaemic
h. Scopoletin	Fenugreek	Hypoglycaemic
i.Fenugreekine	Fenugreek	Hypoglycaemic
j. Trigonelline	Fenugreek	Hypoglycaemic
17.Non-carotenoid terpenoids		
a. Perillyl alcohol	Cherries & mints	Anticancer
b. Saponins	Legumes (Chicks, peas, fenugreek, all pulse crops)	Reduces cholesterol levels in blood
c. Terpenol	Carrots	Anticancer
d. Terpene limonoids	Peels and membranes of citrus fruits	Anticarcinogenic
18. Anthraquinones		
a. Senna	Legumes and pulses	Purgative,
b. Barbaloin	Aloe	Laxative, anti-helminthic
c. Hypericin	St. John's wort	Analgesic
d. Capsaicin	Capsicum (hot peppers)	Anticancer,anti-inflammatory, anti-apoptotic
e. Piperine	Black peppers, jalapeno peppers	Helps in digestion

19. Terpenes		
a.Menthol (Monoterpene)	Plants of mint family	Topical pain reliever & anti-pyretic
b.Borneol (Monoterpene)	Pine oil	Disinfectant
c.Santonin (Sesquiterpene)	Wormwood	Photosensitizer
d.Gossypol (Sesquiterpene)	Cotton	Contraceptive

Table 2. LIST OF MARKETED NUTRACEUTICALS

Marketed Nutraceutical	Category	Ingredients	Manufacturer
Weight smart [™]	Nutritional supplement	Vitamins and trace elements	Bayer corporation, Morristown,NL, USA
Omega woman	Immune supplement	Antioxidants, vitamins and phytochemicals (eg. Lycopene, and resveratrol)	Wassen, Surrey, U.K.
Rox®	Energy drink	Taurine, caffeine and glucuronolactone	RoxAmerica,Spartanburg, SA, USA
Proteinex®	Protein supplement	Predigested proteins, vitamins, minerals and carbohydrates	Pfizer Ltd., Mumbai, India
Pner plus [™]	Neuropathic pain supplement	Vitamin and other natural supplement	NeuroHelp,SanAntonio, Texas, USA
Mushroom optimizer [™]	Immune supplement	Mushrooms,polysaccharides and Folic acid	Jarrow formulas, Los Angeles, CA, USA
Chaser [™]	Hangover supplement	Activated calcium carbonate and vegetable carbon	Living essentials, Walled lake, MI, USA
Calcirol D-3®	Calcium supplement	Calcium and vitamins	Cadilla healthcare limited, Ahmedabad, India.
Appetite Intercept [™]	Appetite suppressant	Caffeine, tyrosine and Phenylalanine	Natrol, Chatsworth, CA, USA
Betafactor® capsules	Immune supplement	Beta –glucan	Ameriden® international Inc.,USA
Tozal Eye Health formula	Improved vision	Omega 3 fatty acids, zinc, antioxidants and lutein	Ameri Sciences, USA
Snapple-a-day [™]	Meal replacement beverages	Vitamins and minerals	Snapple beverages group, USA
Brainspeed Memory®	Brain health	Blend of vitamins and minerals	Natrol, USA
Red bull®	Energy drink	Taurine, caffeine and Glucuronolactone, b-group vitamins	Austrian red bull GmbH
5-Hour energy®	Energy drink	Vitamins, tyrosin,Taurine, malicacid,caffeine, Glucuronolactone,	Living essentials, USA
Wellife®	Amino acid supplement	Granulated-L-glutamine	Daesang America Inc., Hackensach, NJ, USA
Pediasure®	Nutritional supplement	Protein, vitamin and other natural supplement	Abbott nutrition
Threptin® Diskettes	Protein supplements	Proteins and vitamin B	Raptakos, Brett & Co. Ltd., Mumbai, India
Olivinol [™]	Dietary supplement	Natural antioxidant, hydroxytyrosol	Cre Agri, Hayward, CA, USA
Beneflora® probiotic	Maintain gastrointestinal health	Lactobacillus acidophilus, bifidobacterium bifidum	Nupro, USA
Ferradol Food® Powder	Nutrition supplement	Carbohydrates, proteins, Niacinamide, calcium, iron, zinc, vitamins	Pfizer Limited , india
Muscle Optimeal®	Meal replacement drink mix	Protein, vitamins, dietary fibres, xylitol and trace elements	Jarrow formulas, USA
Revital®	Daily health supplement	Ginseng , vitamins and minerals	Ranbaxy
becadexamine®	Nutritional supplement	mutivitamins	Glaxosmith kiln
Glowelle®	Beauty drink	antioxidants, vitamins and botanical and fruit extracts	Nestlé