EMPRO

Current Research in Pharmaceutical Sciences

Available online at www.crpsonline.com

crps online CRPS CURRENT RESEARCH IN PHARMACEUTICAL SCIENCES

ISSN: 2250 – 2688

Received: 29/07/2020
Revised: 15/08/2020
Accepted: 25/08/2020
Published: 08/10/2020

Ram Narayan Prajapati and Sanjeev Kumar
Institute of Pharmacy, Bundelkhand University, Jhansi-284128, Uttar Pradesh, India

Correspondence

Dr. Ram Narayan Prajapati
Institute of Pharmacy, Bundelkhand University, Jhansi-284128, Uttar Pradesh, India

Email: prajapatirn@gmail.com

DOI: 10.24092/CRPS.2020.100301

Website: www.crpsonline.com

Quick Response Code:

The Role, Scope, Health Benefits and Market Growth of Nutraceuticals: An Overview

Ram Narayan Prajapati and Sanjeev Kumar

ABSTRACT

Nutraceuticals are products used as medicines in addition to nutrition. Nutraceuticals can be defined as substances that have physiological benefits or provide protection against chronic disease. Nutraceuticals can be used to improve health, slow down the aging process, prevent chronic diseases, increase life expectancy or support body structure or function. Nutraceuticals are getting a lot of attention these days because of their potential nutritional, safety and therapeutic benefits. Recent studies have shown that these compounds have promising results in various complications. In this review, we have made a great effort in proposing new concepts for nutraceuticals based on disease indications. Highlights herbal remedies that are effective for harsh therapeutic conditions associated with oxidative stress, including allergies, Alzheimer's disease, cardiovascular disease, cancer, diabetes, eye, immunity, inflammation, and Parkinson's disease and obesity. These nutraceuticals are used in various diseases, their application, and current market demand. Examples of fish oil preparations, prebiotics and probiotics reviewed.

Key words: Nutraceutical, Dietary supplements, Antioxidants, Probiotics, Health benefits.

1. INTRODUCTION

1.1 History

The term "nutraceutical" was coined in 1989 by Stephen De Felice, founder and president of the Foundation for Innovation in Medicine in Cranford, New Jersey. De Felice defined a food as: "Foods or portions of foods that confer medical or health benefits, including the prevention and treatment of disease." [1,4] The idea of using food for both nutritional and medicinal purposes is rooted in many ancient cultures. In fact, the concept of nutraceuticals is almost 3000 years old! It began to catch on when Hippocrates, the father of modern medicine, recognized the relationship between food and health. Traditionally, the people of India and China consume various natural foods that are considered medicinal. Countries like Germany, France and England were the first to consider nutrition as more important than both exercise and genetics in people's pursuit of good health. Today, nutraceuticals have evolved from their traditional background to a highly scientific field, where the efficiency and safety of products are supported by evidence, new research and evolving technologies.

1.2 What are Nutraceuticals?

Nutraceuticals are derived from the combination of two words **"Nutrition"** and **"Pharmaceuticals"** and have been termed by Stephen De Felice in 1989 MD, founder, and chairman of the foundation for Innovation in Medicine (FIM), Cranford, New Jersey.[1] He defined it as "*a food or part of a food that provides pharmacological benefits, including the prevention and treatment of disease".*[2] However, the term nutraceutical as commonly used in marketing has no regulatory definition.[3] Many different terms and meanings are used in different countries which can confuse. In simple terms, nutraceuticals are products derived from food sources that have nutritional and medicinal value. Nutraceuticals is also known by the following terms:

- Functional food
- Medical food
- Designer food
- Phytochemicals
- Dietary Supplements

Nutraceuticals is a comprehensive umbrella term that is used to define any product resulting from food sources with extra health benefits in addition to the basic nutritional value found in foods.[4] A nutraceutical may be a naturally nutrient-rich food such as spirulina, garlic, soy, or a specific component of food like omega-3-oil from salmon. They are also known as medicinal foods, nutritional supplements, and dietary supplements. It ranges from isolated nutrients, dietary supplements, genetically engineered 'designer' foods, herbal products, and processed products such as cereals and soups. They have received considerable interest because of their presumed safety and potential nutritional and therapeutic effects.[5] Apart from lifestyle disorders nutraceuticals are used in a diverse array of clinical conditions like inflammation, immunodeficiency, allergy, arthritis, malignancies, indigestion, depression, sleep dysfunction, hypertension, and blood cholesterol control.[6]

These products include supplements, diets, herbal products, genetically modified foods and vitamins. They contain high concentrations of bioactive compounds, derived from natural sources, which have physiological benefits and help prevent and treat disease. Nutraceuticals even include everyday foods like probiotics and prebiotics, fortified cereals, processed foods and beverages. Basically, a nutrient is a substance that has physiological benefits or provides protection against chronic disease. Unfortunately, the definition of nutraceuticals varies from country to country, depending on how they are classified and regulated. At present, there is no clear definition of dietary supplements in the world. Nutraceuticals can improve health, slow down the aging process, prevent chronic disease, increase life expectancy or support body structure and function.[1] They are also used to prevent and treat mental health problems and disorders.

The past decade has witnessed a tremendous resurgence in the interest and use of "Nutraceuticals" (or "functional foods") in which phytochemical constituents can have long-term health-promoting or medicinal qualities (Figure-1).

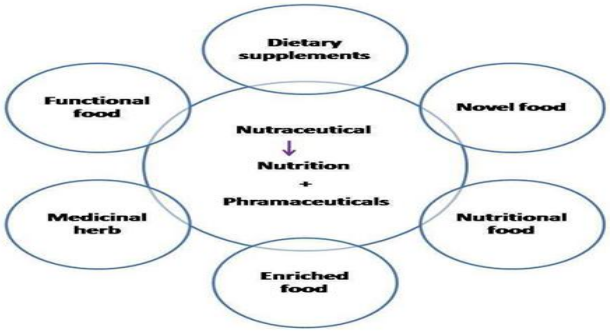


Figure 1. Inter-Relationship of Various Food as Nutraceuticals

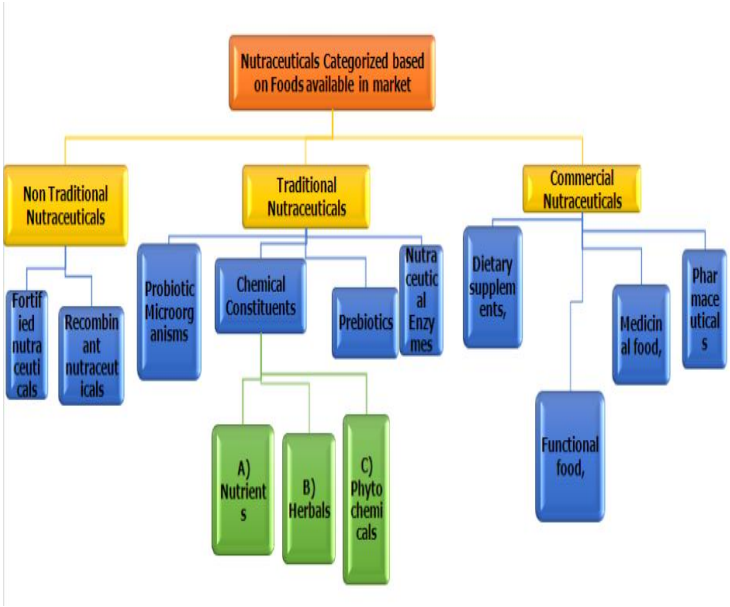
A nutraceutical is the opposite of "junk food and according to World Health Organization, over 80% of the world's population (4.3 billion people) rely upon such traditional plant-based systems of medicine as phytochemicals, nutritional constituents, or as a functional food.[7,8] Functional foods are ordinary foods that have components, ingredients, incorporated in them a specific medicinal or physiological benefit other than a purely nutritional effect. [9,10] Nutraceuticals are essentially prophylactic or preventive in contrast to drugs, which are active chemical substances used for the treatment of an illness. They represent a different approach, one based on nutrition for curing ill health or overall wellness of the whole body, rather than drug-based curing of disease.[11,12,13] Nutraceuticals or functional foods can be classified based on their natural sources, pharmacological parameters. The most usual nutraceuticals are nutrients, herbs, dietary supplements, functional food, and natural chemical derived from different medicinal plants.[14]

The global market for nutraceuticals is expected to touch USD 722.49 Billion by 2027 with a CAGR (COMPOUND ANNUAL GROWTH RATE) of over 8%. The market for nutraceuticals has witnessed significant transformation in recent times with the advent of newer technologies like nanotechnology as well as the development of advanced procedures/instruments which favor both quantitative and qualitative analysis.[15]

2. CLASSIFICATION OF NUTRACEUTICALS

Nutraceuticals or functional foods can be classified based on their sources [16]

1. Natural or traditional
   (Based on natural sources, it can be classified as the products obtained from plants, animals, minerals or microbial sources)
2. Unnatural or Non-traditional
   (Nutraceuticals, as prepared via biotechnology, is called unnatural or non-traditional)
3. Commercial Nutraceuticals



2.1 Natural or Traditional Nutraceuticals

These are mainly three types-

1) Chemical Constituents
   i) Nutrients
   ii) Herbal
   iii) Phytochemicals
2) Nutraceutical enzymes
   i) Chemical constituents
3) Probiotic Micro-organisms
4) PUFAs
5) Antioxidants

2.1.1 Nutrients

Nutraceuticals the nutrients include amino acids, fatty acids, minerals, and vitamins, with recognized nutritional functions. Minerals found in plants, animals, and dairy products are useful in osteoporosis, anemia, and in building strong bones, teeth, muscles, and improved nerve impulse and heart rhythm (Table 1.).[17]

Nutrients	Health benefits
Fat-Soluble Vitamins Vitamin A	Antioxidant, essential, for growth and development, maintains healthy vision, skin, and mucous membranes, may aid in the prevention and treatment of certain cancers and the treatment of certain skin disorders
Vitamin D	Essential for the formation of bones and teeth, helps the body absorb and use calcium
Vitamin E	An antioxidant helps form blood cells, muscles, lung, and nerve tissue, boosts the immune system
Vitamin K	Essential for blood clotting
Water-Soluble Vitamins	Antioxidant, necessary for healthy bones, gums, teeth, and skin, helps in wound healing,
Vitamin C	May prevent the common cold and attenuate its symptoms
Vitamin B1	Helps to convert food into energy, essential in neurologic functions
Vitamin B2	Helps in energy production and other chemical processes in the body, helps maintain healthily eyes, skin, and nerve function
Vitamin B3	Helps to convert food into energy and maintain proper brain function
Vitamin B6	Helps to produce essential proteins and convert protein into the energy
Vitamin B12	Helps to produce the genetic material of cells, helps with the formation of red blood cells, maintenance of the central nervous system and synthesize amino acids and is involved in the metabolism of fats, protein, and carbohydrates
Folic acid	Necessary to produce the genetic materials of cells, essential in the first three months of pregnancy for preventing birth defects, helps in red blood cell formation, protects against heart disease
Pantothenic acid	Aids in the synthesis of cholesterol, steroids, and fatty acids, crucial for intra-neuronal synthesis of acetylcholine
Minerals Calcium	Essential for building bones and teeth and maintaining bone strength, important in nerve, muscle and glandular functions
Iron	Helps in energy production, helps to carry and transfer oxygen to tissues
Magnesium	Essential for healthy nerve and muscle function and bone formation, may help

	preventpremenstrual syndrome (PMS)
Phosphorous	Essential for building strong bones and teeth helps in the formation of genetic material, energy production and storage
Trace elements Chromium	Insulin helps to convert carbohydrates and fats into energy
Cobalt	The essential component of vitamin B12, but ingested cobalt is metabolized in vivo to form the B12coenzymes
Copper	Essential for hemoglobin and collagen production, healthy functioning of the heart, energy production, absorption of iron from the digestive tract
Iodine	Essential for the proper functioning of the thyroid
Selenium	Antioxidants, essential for the healthy functioning of the heart muscle
Zinc	Essential for cell reproduction, normal growth, and development in children, wound healing, production of sperm and testosterone
Vitamin like compounds Biotin	Required for various metabolic functions
L- Carnitine	Oxidation of fatty acids, promotion of certain organic acid excretion, and enhancement of the rate of oxidative phosphorylation
Choline	A lipotropic agent used to treat fatty liver and disturbed fat metabolism
Vitamin F	Involved in the proper development of various membranes and synthesis of prostaglandins, leukotrienes and various hydroxy fatty acids
Inositol	Lipotropic agent necessary for amino acid transport and movement of potassium and sodium
Taurine	Aids in retinal photoreceptor activity, bile acid conjugation, white blood cell antioxidant activity, CNS neuromodulation, platelet aggregation, cardiac contractility, sperm motility, growth, and insulin activity

2.1.2 Herbals

Herbal nutraceuticals help to improve health and avert chronic diseases most of these are analgesic, anti-inflammatory, astringent, antipyretic, antiarthritic.Some of the herbals contain flavonoids like apiol, psoralen that are diuretic, carminative and antipyretic. Peppermint (Mentha Piperita) contains menthol as an active component that helps cure a cold and flu. [18]

2.1.3 Phytochemicals

Phytochemicals are plant nutrients with particular biological activities that promote human health. They are also referred to as phytonutrients. [19]

2.1.4 Nutraceuticals enzymes

Enzymes are an essential part of life these enzymes are derived from plants, animals, and microbial sources.

2.1.5 Probiotic microorganisms

Probiotics are very important to make life smoother by removing the toxic flora of the intestine and maintaining a friendly environment. Currently, various probiotics like *Bacillus bulgaricus* products are available in the market with adequate nutrients to counter various pathogens so that several ailments related to the human body can be treated.[20]These microorganisms are responsive bacteria that promote healthy digestion and absorption of some nutrients. They most importantly act to mob out pathogens, like yeast and other bacteria and viruses that may cause disease and develop a communally advantageous symbiosis with the human gastrointestinal tract. [21] They possess an antimicrobial effect through altering the microflora averting adhesive of the pathogen to the intestinal epithelium, competing for nutrients necessary for pathogen survival, producing an antitoxin effect, and retrogressing some of the consequences of infection on the intestinal epithelium, such as secretory changes and neutrophil migration. For instance, probiotics can cure lactose intolerance by enhancing the production of a specific enzyme (Beta-galactosidase) that can hydro the offending lactose into its components sugar. [22]

2.1.6 Poly-Unsaturated Fatty Acids (PUFAs)

These are fatty acids that contain more than one double bond and include essential fatty acids example- Omega-3 Fatty acids, sunflower oil, corn oil, soyabean oil, fish oil. The group of polyunsaturated fatty acids (PUFAs) is divided into two groups omega-3, omega-6. Polyunsaturated fatty acids differ in the position where the first double C- bond is located. Two PUFAs are called essential fatty acids since they cannot be synthesized in the human body and are vital for physiological integrity. One is linoleic acid belongs to the N-6 family. The other one is an alpha-linolenic acid (LNA) belonging to the N-3 family. These essential parent compounds can be converted in the human body to long-chain fatty acids.[23]

2.1.7 Antioxidant

Antioxidants are our first line of defense against free radical damage and are critical for maintaining optimum health and wellbeing. Oxygen is a highly reactive atom that is capable of becoming part of potentially damaging molecules commonly called "Free Radicals" they are present in fruits, vegetables, fishes.

2.1.7.1. Nutrient-derived antioxidants -like ascorbic acid (Vitamin C), Tocopherol and tocotrienols (Vitamin E), Carotenoids, and other low molecular weight compounds such as glutathione and lipoic acid.

2.1.7.2. Antioxidant enzymes - Antioxidant enzymes such as superoxide dismutase, glutathione peroxidase, glutathione reductase which catalyzed free radicals quenching reactions.

2.1.7.3. Metal-binding proteins- such as ferritin, lactoferrin, albumin, free iron, and copper ions.Numerous other antioxidant phytonutrients are present in a wide variety of plants foods.

2.1.7.4 Dietary antioxidants

- Vitamin C
- Vitamin E
- Beta carotene, other carotenoids, and oxycarotenoids.

2.1.7.5 Metal-binding proteins

- Albumin
- Ceruloplasmin
- Metallothionein
- Ferritin
- Myoglobin
- Transferrin

Figure 3. Various Natural Products as Sources of Vitamins, Minerals, and Antioxidants

2.2 Unnaturalor Non-Traditional Nutraceuticals

These are the artificial foods developed via biotechnology. The bioactive components in food samples are engineered to produce products for human wellness. They were classified into two groups.

1. Fortified nutraceuticals
2. Recombinant nutraceuticals

2.2.1 *Fortified Nutraceuticals*

These are nutraceuticals from agrarian breeding or added nutrients and/or ingredients. examples include cereals with added vitamins or minerals, milk fortified with cholecalciferol used in vitamins D deficiency, flour with added folic acids, prebiotic and probiotic fortified milk with *Bifidobacterium Lactis* HN019 used in diarrhea, respiratory infections, and severe illnesses.[24]

2.2.2 *Recombinant Nutraceuticals*

Recombinant nutraceuticals include the making of prebiotics and the extraction of bioactive components by enzymes/fermentation technologies as well as genetic engineering technology. Also, energy-providing foods, such as bread, alcohol, fermented starch, yogurt, cheese, vinegar, and others are produced using modern biotechnology.[25]

2.3 Commercial Nutraceutical

Commercial nutraceuticals are also classified into these two groups.

1. Dietary supplements
2. Functional food

2.3.1 Dietary supplements

They are concentrated sources of nutrients or other substances with a nutritional or physiological effect, alone or in combination. [26,27] Dietary supplements contain all products that can be purchased by the consumer without a prescription. Many potential benefits have been attributed to antioxidants used in the form of dietary intake or supplementation. Antioxidants, in general, may be useful in the prevention of cancer and cerebrovascular disease. [28,29,30,31] Dietary supplements are not classified as drugs. The main difference is that they do not have approved therapeutic claims unlike in the case of drugs. Moreover, dietary supplements could either contain vitamins, minerals, herbals, or amino acids, all aimed to add to or supplement the diet of an individual. They are not intended to be taken alone as a substitute for any food or medicine (Table 2).

Physiological property	Proposed effect	Health benefits
Soluble dietary fiber	Delays gastric emptying and prolonging intestinal phase	Contribute to safety.
	Prevent or delays nutrients uptake in small intestine	Lower blood cholesterol level.
	Prevent the reabsorption of bile acid	Prevents breast cancer.
	Prevent the digestive enzymes from reaching lipid substrates, inhibits the enzyme activity	Lowers glucose, insulin, and lipid level after a meal.
Interaction/binding	Binding to bile acids	Lower blood cholesterol level.
	Interaction with digestive enzymes	Lowers glucose, insulin, and lipid level after a meal.
Fermentation	Growth of health-promoting bacteria	Protect against inflammation and colorectal cancer.
	Production of short-chain fatty acids	Lowers blood cholesterol levels and protect against cancer.
Insoluble dietary fiber	Increase stool weight	Reduce the incidence of colorectal cancer and intestinal diseases.
	Accelerate transit time	Reduce time for nutrients to absorb, lowers glucose, insulin, and lipid level.

2.3.2 *Functional food*

As defined by the United States of America Institute of Medicine's Food and Nutrition Board, functional food is *"any food or food ingredient that may offer a health benefit beyond the traditional nutrients it contains"*. The functional food concept is – *"Food products to be taken as part of the usual diet to have helpfuleffectsthat go beyond basic nutritional function"*. Functional foods contain physiologically active components obtained either from plants or animal sources (Table.3). [32]

Table 3. Nutraceuticals and their Uses

Chemical constituents	Source	Uses
Carotenoids		
Lycopene	Guava, papaya, water melon, Tomatoes, pink-colored grapefruit.	They reduce cholesterol levels, antioxidants, protectagainst 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 cardiovascular health, fight against(breast cancer)
Saponins	Beans like soya beans, chickpeas	Very effective against colon cancer reduces cholesterollevel
Polyphenolic Compounds		
Flavanones	All citrus fruits	Different types of anti-oxidant and anticancer activity
Flavones	Different types of fruits, beans, soya vegetables.	Different types of anti-oxidant and anti-cancer activity
Flavanols	Broccoli, tea, onions, fruits like apple	Antioxidant activity
Curcumin.	Turmeric root	Strongly anti-inflammatory and strong antioxidant,an

		effective anti-clotting agent
Glucosinolates	Cauliflower, cruci vegetables fero us	Anticancer activity, protect against bladder cancer
Phytoestrogens		
Isoflavones	Legumes, beans like soybeans	It Lowers LDL cholesterol, antioxidants, protects againstprostate, breast, bowel, and other cancers
Lignans	Vegetables, rye, and flaxseed	Protect against the development of cancer like colon and breast cancer
Dietary fiber		
Soluble fiber	Beans like Legumes, cereals likeoats,barley, some fibrous fruits	They help in the maintenance of a healthy digestive tract &have anticancer activity
Insoluble fiber	Wheat and nuts.	They help in the maintenance of a healthy digestive tract andhave Anticancer (colon) activity.
Sulfides/Thiols	Present in Cruciferous vegetables	Help in maintenance of healthy immune function
Fatty Acids		
Omega 3 fatty acids	Present in salmon and flaxseed	They are the Potent controllers of the inflammatory processes, help in Maintenance of brain function & Reduce cholesterol disposition.
Monosaturated acids	Present in tree nuts	Reduce the risk of coronary heart disease
Prebiotics/Probiotics	Lactobacilli, bifidobacteria present in yogurt, other dairies, and nondairyapplications	They help to improveimmunity
Minerals like calcium, selenium, copper, potassium	Food	They are the important constituents of a balanced diet
Polyols sugar alcohols (xylitol, sorbitol)	Present in foods	They may reduce the risk of dental caries(cavities)

Table 4: Types of Nutraceuticals Products Available in the Market [33]

	Nutraceuticals	
Functional food	**Functional beverages**	**Dietary supplements**
Cereals	Energy drinks	Vitamins
Bakery & confectionary	Sports drink	Minerals
Dairy	Fortified juice	Botanicals
Snacks	Dairy beverages	Enzymes
Functional fats, oils	Tea & coffee	Fatty acids
Baby foods		Proteins

3. SCOPE OF NUTRACEUTICALS[34]

Nutraceuticals play a significant role in modifying and maintaining normal physiological function that maintains healthy human beings. The food products used as nutraceuticals can be categorized as dietary fiber, prebiotics, probiotics, polyunsaturated fatty acids, antioxidants, and other different types of herbal natural foods. These nutraceuticals are used in various diseases such as obesity, cardiovascular diseases, cancer, osteoporosis, arthritis, diabetes, cholesterol, etc. On the whole, “nutraceutical” has to lead to a new era of medicine and health, in which the food industry has become a research-oriented sector (Figure- 4).

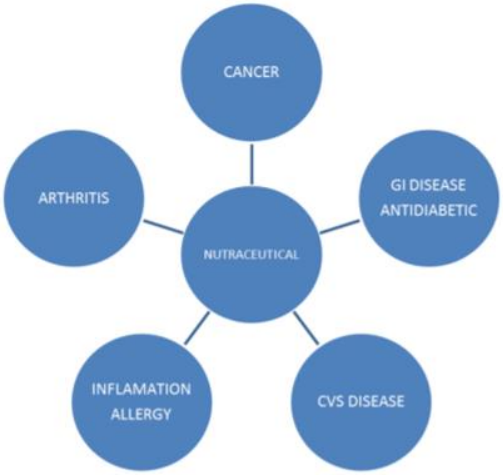


Figure4. Scope of Nutraceuticals

4. ROLE OF NUTRACEUTICALS

4.1 CVS disease

Dietary fibers, antibiotics omega-3-polyunsaturated fatty acids, vitamins, minerals are for the prevention under treatment of CVS disease. [35] Polyphenol (in grape) prevent and control arterial diseases Flavonoids (in onion, vegetables, grapes, red wine, apples, and cherries) block the ACE and strengthen the tiny capillaries that carry oxygen and essential nutrients to all cells. Rice bran lowers the serum cholesterol levels in the blood, lowers the level of (LDL) and increases the level (HDL) in cardiovascular health. The 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. It is reported that a low intake of fruits and vegetables is associated with high mortality in CVS disease.

Various nutraceuticals are used to treat CVS disease are

- Phytosterols
- Polyphenols
- Flavonoids
- Vitamin E
- Curcumin
- Omega-3-fatty acids
- Garlic

4.2 Diabetes

The use of ethyl esters of N-3 Fatty Acids may be beneficial in diabetic patients. Docosahexaenoic acids (DHA) modulate insulin resistance and are also vital for neurovascular development.[36] Docosahexaenoic acid is an omega-3 fatty acid that is found along with eicosapentaenoic acid (EPA) in cold-water fish, including tuna and salmon. DHA plays a key role in the development of eye and nerve tissues.

Various nutraceuticals are used to treat diabetes are

- Antioxidant
- Vitamin C
- Calcium
- Vitamin D
- Carbohydrates
- Fat
- Protein

4.3 Cancer

Flavonoids, which block the enzymes that produce estrogen, reduce estrogen-induced cancers. Prevent prostate/breast cancer a broad range of Phyto-pharmaceuticals with a claimed hormonal activity, called “phytoestrogens” is recommended. Soy foods source of isoflavones, curcumin from curry, and soy isoflavones possess cancer chemo preventive properties. Lycopene concentrates in the skin, testes, adrenal, and prostate where it protects against cancer.

Various nutraceuticals are used to treat cancer are

- Chestnut
- Berries
- Soya
- Green tea
- Garlic
- Ginseng
- Tomato & red pepper

4.4 Irritable bowel syndrome

Inflammatory bowel diseases/ syndrome including Crohn’s disease and ulcerative colitis are a group of idiopathic chronic and relapsing inflammatory disorders of the GIT tract.Whose incidence and prevalence have been increasing in the last decades.[37] Nutraceuticals is a broad term used to describe any product derived from food sources claiming extra health benefits beyond the intrinsic nutritional value found in foods. The beneficial effects of nutraceutical compounds in human health have been emerging in the last decades. Although few clinical trials have been performed in IBD patients, nutraceuticals, such as herbal

products or vitamins, are generally accepted as safer alternatives/supplementation to conventional therapy

Various nutraceuticals are used to treat IBD syndrome are

- Curcumin
- Aloe vera
- Garlic
- Honey
- Probiotics
- Minerals

4.5 Obesity

Obesity is a global public health problem and is defined as the "accumulation of the unhealthy amount of body fat". It is a well-established risk factor for many disorders like angina pectoris, congestive heart failure (CHF), hypertension, hyperlipidemia, respiratory disorders, renal vein thrombosis, osteoarthritis, cancer, and reduced fertility. [38]

4.6 Gastro-intestinal disease

Eating habits and trends in food production and consumption have health, environmental and social impacts. Diet has implications on gut health. Gut complications, such as ulcerative colitis, Crohn's disease, irritable bowel syndrome, and gluten therapy-resistant celiac, result from overgrowth and imbalance of intestinal microbial flora and are related to one's diet. Gut health determines an individual's overall health.[39] The human gut has the following functions:

(a) It breaks food down to nutrients,

(b) It facilitates the absorption of nutrients into the blood through intestinal walls, and

(c) It prevents foreign and toxic molecules from entering the bloodstream.

Various nutraceuticals are used to treat GIT disease are:

- Curcumin
- Aloe vera
- Garlic
- Honey
- Probiotics
- Minerals
- Carbohydrates
- Omega -3- fatty acid

4.7 Osteoarthritis

Osteoarthritis is a debilitating joint disorder, is the most common form of arthritis in the USA. It affects an estimated 21 million people in 2004; the direct and indirect healthcare costs associated with all forms of arthritis were approximately 86 billion dollars.[40]

5. HEALTH BENEFITS OF NUTRACEUTICALS [41]

- it may increase the health value of our diet
- it may help us live-life longer
- it may help to avoid a particular medical condition
- it may present food for populations with special needs.

6. NUTRACEUTICALS IN DRUG DELIVERY

Nutraceuticals are mostly absorbed by the oral route the major concern is the absorption of nutraceutical products by the GI tract and also its fate after first-pass metabolism therefore the absorption kinetics and the pharmacokinetics of these products are still in a mist. This presents a unique challenge to many nutraceuticals products and so research thrust on their delivery approaches is now gaining momentum. [42] A very common example is the marketed nutraceutical containing Milk thistle plant extract recommended for hepatoprotection. [43]The main bioactive component of the extract silymarin suffers from degradation in the GIT which is a major setback to the efficacy of nutraceuticals. A similar problem is also observed in different bioactive like alpha-tocopherol, ascorbic acid, curcumin, green tree extract, lycopene used in various nutraceutical formulations. So, researchers are trying to solve the issue by using modern drug delivery approaches to improve the efficacy of nutraceuticals. [44]The most common and widely explored approach in nutraceutical drug delivery is based on nano-technological intervention.[45] Nanoscale delivery of nutraceuticals has a definite impact on the absorption and distribution kinetics of the nutraceuticals leading to product efficacy enhancements protecting the nutraceuticals against GIT degradation and first-pass effect.[46] Nano emulsions-based drug delivery system are nano micelles are obtain explored to improve oral bioavailability of nutraceuticals as these products are mostly given by oral route. Different delivery approaches like nanoparticles, liposomes, micelles, phospholipid complexes are designed to achieve bioavailability enhancements. [47]

Besides these nano-devices provide site-directed delivery of nutraceuticals which significantly reduce chances of residual toxicity. As per different research reports and market products, various types of delivery devices like reverse micelles, nanoemulsion, nanosuspension, liposome, phytosome, surfactant micelles, etc. are investigated [48] for efficacy enhancements of nutraceuticals.Some new technological advancements in

nutraceuticals delivery are nano-sized self-assembled structured liquid (NSSL) technology. [49]This technology protects the nutraceuticals products from the acidic behavior of the gastrointestinal tract in addition to bioavailability enhancements. The surface geometry of delivery devices formed using NSSL technology reveals micellar structure which enlarges into fortifying nano-vehicles (FNVs) after association with targeting ligands. [50]

7. MARKET GROWTH OF NUTRACEUTICALS

The nutraceuticals market size has the potential to grow by USD 216.23 Billion during 2021-2025 and the market's growth momentum will acerates during the forecast period (Figure 5).

This report [51]provides a detailed analysis of the market by product (functional food, functional beverages, and dietary supplements) and geography (APAC, EUROPE, MEA NORTH AMERICA & SOUTH AMERICA) also the report analyzes the market's competitive landscape and offers information on several market vendors, including Abbott Laboratories, Archer Daniels Midland Co, BASF Se Cargill Inc. Danone SA, General Mills Inc., KelloggCo., Nestle SA, PepsiCo. NC and Coca-Cola Co**.**

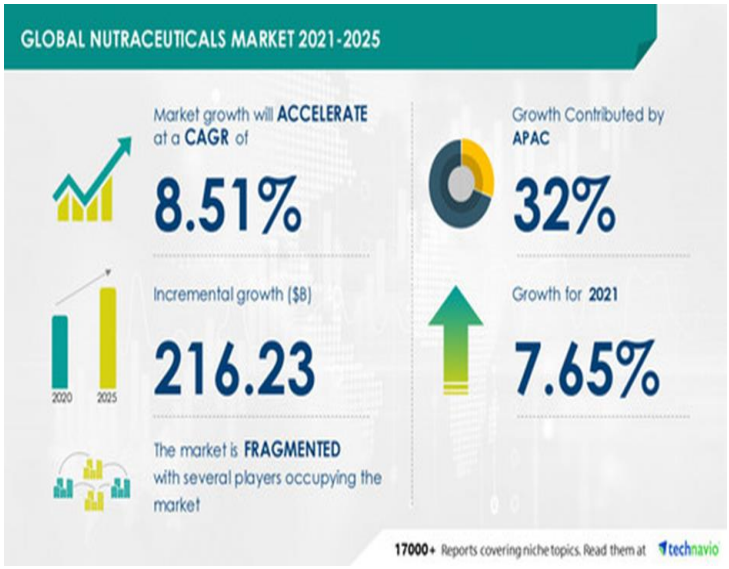


Figure 5. Market Growth of Nutraceuticals

Chawanprash is one, of the highest marketing nutraceutical product in INDIA. It contains spices ingredients such as cinnamon, clove. Curcuma spp., saffron, and long pepperare good sources of vitamins C and are rich in antioxidants that help in increasing immunity, increase digestion, and prevent cough, asthma, fever, heart disease, impotency, and coarseness speech.

8. IMPLICATIONS FOR PHARMACY

Speculation about who the winners of the nutraceutical project will be is becoming a popular topic in articles discussing the pharmaceutical industry. Because new drugs are harder to find and more expensive and riskier to develop than ever before, many companies are merging, e.g., Du Pont, Abbott Laboratories, and Warner-Lambert, who had previously produced conventional drugs, now to survive or turn to nutraceuticals.[52] This gives them a chance in a very large market. Datamonitor, a website that follows market trends, estimates the nutraceutical market at $ 17 billion, and Dr. Felice himself spoke at a conference in 1998 and estimates the figure at $ 250 billion in America alone.[53] Although these estimates vary widely, the market for nutraceuticals is undoubtedly very large and growing. As companies grow in size, more jobs can be created for industrial pharmacists, but the real impact of nutraceuticals on the pharmacy will be in the community.

It has been suggested that there could be a shift from dietary supplements, which are sold in health food stores and most pharmacies, to nutraceuticals targeting the prescription market. This would not necessarily be in the interest of producers as it would limit the size of the market. However, many indications being investigated are for serious disease states that do not require self-medication. Currently, consumers can try supplements for many indications, believing that they are safer than synthetic drugs and this kind of safety is false. In either case, the logical place of delivery of these supplements is the pharmacy, where pharmacists can provide professional advice, whether prescribed by a physician or a physician of their choosing. The challenge, therefore, is to keep abreast of research developments so that both conventional practitioners and members of the public can obtain accurate information.

Future articles in this short series will provide an overview of the scientific and medical claims related to nutraceuticals that do not fall into the more well-known and well-researched categories, such as vitamins, amino acids, and herbal remedies. Most of the products reviewed are naturally occurring biochemicals that are effectively used to rebuild endogenous levels of these compounds that occur naturally in human metabolism, be it single-component products such as glucosamine or more complex products such as proanthocyanin.

9. CONCLUSION

Nutraceuticals have proven health benefits and disease prevention capabilities, which should be taken under their acceptable recommended intake. Nutraceuticals play an important role in therapeutic development in the current self-medication landscape, but their success depends on maintaining their quality, purity, safety, and efficacy. At present, a wide range of nutraceuticals have been successfully marketed due to their excellent therapeutic activity against various diseases, there is

currently a great demand for natural products in the market, and the nutraceutical industry in the food industry and pharmaceutical industry is also developing faster and faster. The global market is currently in a post-recession experimental growth phase, although the impact of the recession has diminished; the nutraceuticals market is expected to remain in a growth phase, driven by new markets in countries such as India, China, Brazil, the United States, Europe, etc. People have changed their minds and decided to adopt a new healthy lifestyle and diet, creating a new concept of **"Health for All".**

10. ACKNOWLEDGEMENT

The authors would like to acknowledge the Head of the Department, Institute of Pharmacy, Bundelkhand University, Jhansi, UP for providing the support and desired facility and information.

REFERENCES

1. Nasri H, Baradaran A, Shirzad H, Rafieian-Kopaei M. New concepts in nutraceuticals as alternative for pharmaceuticals. Int J Prev Med. 2014;5(12):1487-1499.
2. Brower V. Nutraceuticals: poised for a healthy slice of the healthcare market? Nat Biotechnol. 1998; 16:728-731.
3. Zeisel SH. Regulation of "Nutraceuticals". Science. 1999;285:185-186.
4. Cencic A, Chingwaru W. Role of functional foods, nutraceuticals and food supplements in intestinal health. Nutrients. 2010; 2(6):611–625.
5. RajasekaranA, SivagnanamG and Xavier R. Nutraceuticals as therapeutic agents: A Review. Research Journal of Pharmacy and Technology.2008; 1(4): 328-340.
6. Pandey M, Verma KR, Saraf A.Nutraceuticals: New Era of Medicine and Health. Asian Journal of Pharmaceutical and Clinical Research. 2010; 3(1): 1-2.
7. Allen LV. Nutritional products, In: Covington TR, Berardi RR, Young LL, Kendall SC, Hickey MJ, editors. Handbook of Nonprescription Drugs. Washington DC: American Pharmaceutical Association (1997).
8. Kasbia GS. Functional Foods and Nutraceuticals in the Management of obesity. Nutrition and Food Science. 2005; 35: 344-351.
9. Elizabeth AC. Over-the-counter products: nonprescription medications, nutraceuticals, and herbal agents. Clin Obstet Gynecol. 2002; 45(1):89-98.
10. Whitman M.Understanding the perceived need for complementary and alternative nutraceuticals: lifestyle issues. Clin J Oncol Nurs. 2001; 5:190-194.
11. Adom KK, Liu RH. Antioxidant activity of grains. J Agric Food Chem. 2002; 50: 6182-6187.
12. Alasalvar C, Shahidi F, Quantick P. Food and health applications of marine nutraceuticals:AReview.SeafoodsQuality,technology and nutraceutical applications. New York (2002) 175-204.
13. Halliwell B, Antioxidants in human health and disease. Ann Rev Nutr. 1996; 16: 33-50
14. Bickford PC, Tan J, Shytle RD, Sanberg CD, El-Badri N, Sanberg PR.Nutraceuticals synergistically promote proliferation of human stem cells. Stem Cells Dev. 2006; 15:118-23.
15. Jha SK, Roy P, Chakrabarty S. Nutraceuticals with pharmaceuticals its importance and their application. International journal of drug development and research. 2020;1.
16. NwosuOK, UbaojiKI. Nutraceuticals: History, Classification and Market Demand. Functional Foods and Nutraceuticals. 2020; 13–22.
17. Chauhan B, Kumar G, Kalam N, Ansari SH. Current concepts and prospects of herbal nutraceutical: AReview. J Adv Pharm Technol Res. 2013; 4(1):4–8.
18. Ehrlich SD. Peppermint (Mentha piperita): private practice specializing in complementary and alternative medicine. Phoenix, AZ. Review. VeriMed Healthcare Network. 2009.
19. Zhao J. Nutraceuticals, nutritional therapy, phytonutrients, and phytotherapy for improvement of human health: a perspective on plant biotechnology application. Bentham Science Publishers. 2007; 1: 75-97.

20. Michail S, Sylvester F, Fuchs G, Issenma R. Clinical efficacy of probiotics: Review of the evidence with focus on children. Clinical practice guideline. J Paediatric Gastroenterol Nutrition. 2006; 43(4): 550-557.

21. Holzapfel WH, Haberer P, Geisen R, Bjorkroth J, Schillinger U. Taxonomy and important features of probiotic microorganisms in food and nutrition. Am J Clin Nutr. 2001; 73(2):365–373.

22. Oak SJ, Jha R. The effects of probiotics in lactose intolerance: A systematic review. Crit Rev Food Sci Nutr. 2019; 59(11):1675–1683.

23. Verma G. International Journal of Pharmacy & Therapeutics, 2016; 7(4): 152-160.

24. Sazawal S, Dhingra U, Hiremath G, Sarkar A, Dhingra P, Dutta A, Verma P, Menon VP, Black RE. Prebiotic and probiotic fortified milk in prevention of morbidities among children: community-based, randomized, double-blind, controlled trial. PLoS One. 2010; 5(8):12164.

25. Hyvonen P, Suojala L, Orro T, Haaranen J, Simola O, Rontved C, Pyorala SP.Transgenic cows that produce recombinant human lactoferrin in milk are not protected from experimental Escherichia coli Intramammary Infection. Infect Immun. 2006; 74:6206–6212.

26. Bickford PC, Tan J, Shytle RD, Sanberg CD, El-Badri N, Sanberg PR.Nutraceuticals synergistically promote proliferation of human stem cells. Stem Cells Dev. 2006; 15: 23-118.

27. Devi VK, Rehman F. Nutraceutical antioxidants-An overview, Indian journal of pharmaceutical education. 2002; 36(1):3-8.

28. Bell SJ, Goodrick GK. A Functional Food Product for the Management of Weight Critical Reviews in Food Science and Nutrition. 2002; 42: 163-178.

29. Brouns F. Soya isoflavones: a new and promising ingredient for the health foods sector. Food Research International. 2002; 35: 187-193.

30. Sirtori CR, Galli C.Fatty acids and the Omega 3.Biomedicine and Pharmacotherapy. 2002; 56: 397-406.

31. Bland JS. Phytonutrition, phytotherapy, and phytopharmacology. Altern Ther HealthMed. 1996; 2:73-76.

32. Ernst E. Functional foods, nutraceuticals, designer foods: innocent fad or counterproductive marketing ploy. Eur J Clin Pharmacol. 2001; 57:353–355.

33. Dr. Zeeshan Afsar. Essential of herbal drug technology. 2020 edition. PV publication, Panjab, India (2020) Page No. 33.

34. Verma G. International Journal of Pharmacy & Therapeutics. 2016; 7(4): 152-160.

35. Verma G. International Journal of Pharmacy & Therapeutics. 2016; 7(4): 152-160.

36. Anwar F, Latif S, Ashraf M, Gilani AH. Moringa oleifera: a food plant with multiple medicinal uses. Phytother Res. 2007; 21(1): 17-25.

37. Larussa T,Imeneo M,Luzza F. World J Gastroenterol, 2017; 23(14): 2483-2492.

38. Caterson ID, Gill TP. Obesity: epidemiology and possible prevention. Best Pract Res Clin Endocrinol Metab. 2002; 16(4): 595-610.

39. Cencic A. The Role of Functional Foods, Nutraceuticals, and Food Supplements in Intestinal Health, Nutrients. 2010; 2: 611-625.

40. Mishra MK. International Journal of Pharmacy & Therapeutics. 2016; 7(4): 152-160.

41. Pandey M. Nutraceuticals: new era of medicine and health. Asian journal of clinical nutrition. 2010; 3(1):

42. Witkamp RF, Van Norren K. Let thy food be thy medicine when possible. Eur J Pharmacol. 2018; 836: 102-114.

43. Subbiah MR. Understanding the nutrigenomic definition and concepts at the food-genome junction. Omics A journal of integrative Biology. 2008; 12: 229-235.

44. Zelig R,Rigassio RD. Understanding the properties of common dietary supplements: Clinical implication for healthcare practitioners. Nutr Clin Pract. 2012; 27: 767-776.

45. Costello RB, Coates P. In the midst of confusion lies opportunity: Fostering quality science in dietary supplement research. J Am Coll Nutr. 2001; 20: 21-25.

46. Pawar RS, Tamta H, Ma J, Krynitsky AJ, Grundel E. Updates on chemical and biological research on botanical ingredients in dietary supplements. Anal Bioanal Chem. 2003; 405: 4373-4384.

47. Huang Q, Yu H, Ru Q. Bioavailability and delivery of nutraceuticals using nanotechnology. J of food sci. 2010; 75: 50-57.

48. Shoji Y, Nakashima H. Nutraceuticals and delivery systems. J Drug Target. 2004; 12: 385-391.

49. Nasri H, Baradaran A, Shirzad H, Rafieian-Kopaei M. New concepts in nutraceuticals as alternative for pharmaceuticals. Int J Prev med. 2014; 5: 1487-99.

50. Gulati OP, Berry OP. Legislation relating to nutraceuticals in the European Union with a particular focus on botanical-sourced products. Toxicology. 2006; 221: 75-87.

51. Nutraceuticals Market by Product and Geography - Forecast and Analysis2020-2025 by https://www.technavio.com/report/nutraceuticals-market-industry-analysis.

52. Brower B. Nutraceuticals: Poised for a healthy slice of the market. Nature Biotechnology. 1998; 16:728-33.

53. Mannion M. Nutraceutical revolution continues at Foundation for Innovation in Medicine Conference. American Journal of Natural Medicine. 1998;5:30-3.