

Nutraceuticals: A New Growth of Pharmaceuticals

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ABSTRACT:

Nutraceuticals are medicinal foods that play a role in maintaining well being, enhancing health, modulating immunity and thereby preventing as well as treating specific diseases. In the current scenario people are deeply concerned about their health because of lifestyles have changed drastically due to increase in working hours and various psychological pressures, which have led to an increased incidence of various life- threatening diseases. In addition to this they are frustrated with the expensive, high-tech, disease-treatment and management approach. The demand for nutraceuticals and phytonutrients has increased over the past few years and they are being used by people for various therapeutic outcomes. The nutraceutical products are recognized not only for their health benefits to reduce the risk of cancer, heart diseases and other related ailments, but also to prevent or treat hypertension, high cholesterol, excessive diabetes, degeneration, cataracts, menopausal symptoms, insomnia, diminished memory and concentration, digestive upsets Nutraceuticals weight, osteoporosis, arthritis, macular and constipation.

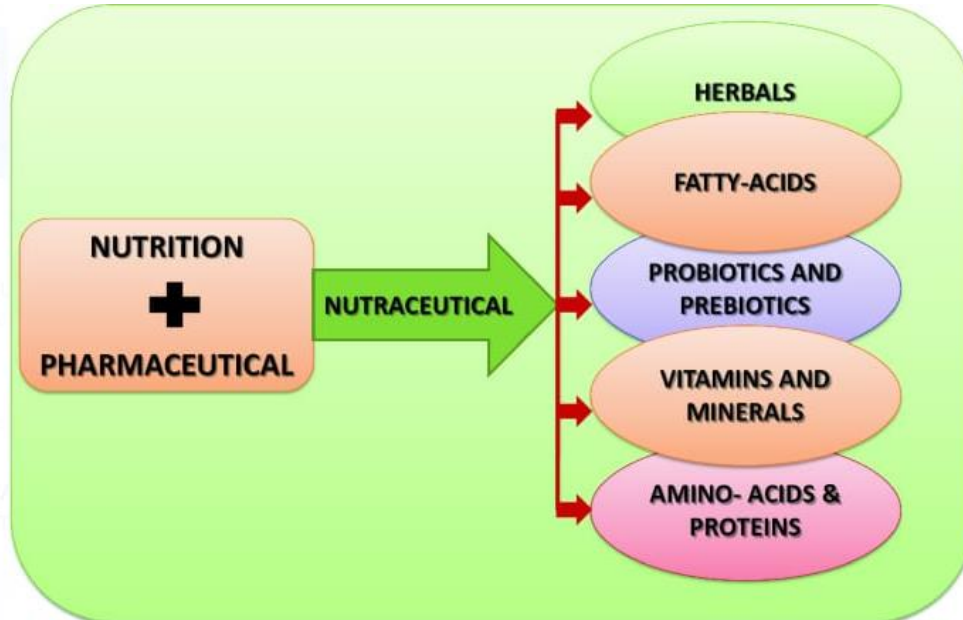
KEYWORDS: Nutraceuticals, antibiotics, probiotic

Introduction

The term 'neutraceutical' was coined from the words 'nutrition' and 'pharmaceutical' by Dr. Stephen L. DeFelice in 1989 (Brower, 1998). He defined neutraceutical as "a food or part of food that provides medical or health benefits including the prevention or treatment of disease". Since the term was coined by Dr. DeFelice, its meaning has been modified by Health Canada as "a product isolated or purified from foods, and generally sold in medicinal forms and demonstrated to have a physiological benefit or provide protection against chronic diseases". Human interest and search for definite constituents of plants, animals, minerals and microbial origin which are helpful to our entire health have cost coining of terms such as Nutraceuticals.

Nutraceuticals have progressed from the respect of the link between food as well as health. Nutraceuticals can be defined which delivers medical or else health profits including the anticipation as well as/or treatment of a disease. Nutraceuticals are bioactive compounds derived from plants, animals, minerals, and microbes that benefit human health. They are associated with preventing and treating chronic diseases like cancer, diabetes, heart diseases, and more 35% of cancer cases are linked to diet and dietary habits. Many nutraceuticals originate from plants, which produce natural defense compounds like alkaloids. For instance, Taxol, extracted from the American yew tree, is used to treat ovarian

cancer. Flavonoids and plant compounds act as antioxidants and are promising in managing inflammatory diseases and cancer. Researchers screen crude plant extracts based on folk medicine usage. Promising compounds are identified, purified through chromatography.



US FDA do not support term nutraceutical and is generally referred as a food derived product which add some extra value to the basic nutritional component present in that specific food. Another term which is often used as a misnomer for nutraceuticals is “functional foods”. It can be defined as any food which is being cooked or prepared using "scientific intelligence" with or without knowledge of how or why it is being used [2]. Nutraceuticals include a huge product bouquet ranging from isolated nutrients, plant products, diet supplements, processed cereals/ drinks to genetically modified products [3]. Apart from life-style disorders nutraceuticals are used in diverse array of clinical conditions like inflammation, immuno-deficiency, allergy, arthritis, malignancies, indigestion, depression, sleep dysfunctions, hypertension and blood cholesterol control [4].

Nutraceuticals are natural medically beneficial foods or bioactive phytochemicals that are health-promoting, illness-defeating, rehabilitative, functional foods and beverages that contain specific components (vitamins, lipids, proteins, carbohydrates, minerals, etc.) that have healthful profits. In 1989, the term "nutraceutical" was coined by combining the words "nutrition/nutrients" a nourishing dietary component and "pharmaceutical" a medicine or a chemical used as a drug and implying use for illness prevention and/or therapy (Pastor et al., 2021).

HISTORICAL BACKGROUND

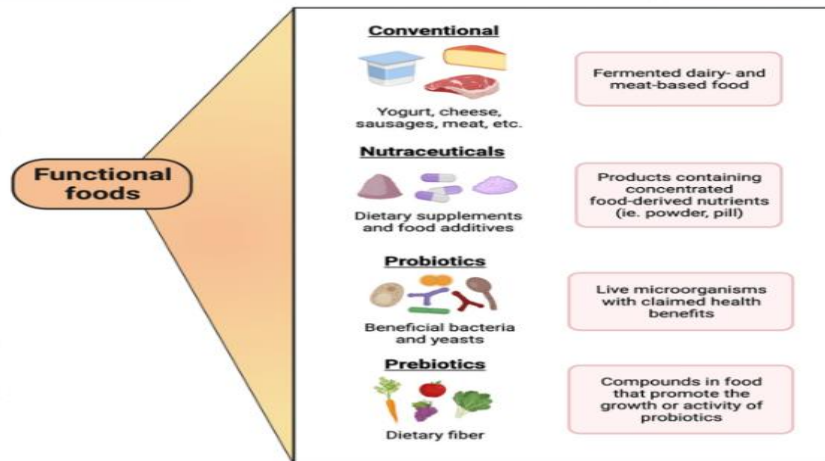
Father OF Nutraceuticals Dr Stephen de Felice {in 1989} Hippocrates (460–377 BC), the father of modern medicine paved the foundation stone for modern day nutraceuticals through his epic statement “Let food be thy medicine and medicine be thy food”. He was the pioneer to bring forward the concept that specific food can also be the solution for the prevention/ treatment of a disease apart from drug moieties. Roman Physician Galen enforced trust in the expertise and knowledge base of his profession to design and formulate diet regimen which would maintain health standards of the entire population. Early nineteenth century marked the initiation of nutrition research by François Magendie. His research based on experimental evidences provoked the question that whether foods devoid of nitrogen do provide

nutrition [5]. This modulated scientific minds to think beyond proteins, carbohydrates, fats, and minerals to achieve proper nutrition. This hypothesis was supported by experiments on mice by Nicolai Lunin which produced interesting results. He proved that certain component present in milk was essential for nutrition of mice which cannot be classified as proteins, carbohydrates, fats, and minerals [6,7]. This fact and similar research findings by several researchers ultimately led to the discovery of the vital nutrient vitamin. From the birth of human race we are depended on offerings of Mother Nature to manage our physiological dysfunctions. One such finding presents the botanicals obtained from plants like Vinca Rosea and Taxus brevifolia which are used in cancer management till date. Ginseng has been another such traditional drug used as chemotherapeutic even today but its history as herbal medicine in China is beyond 2000 years. Ayurveda, the bible of Indian healthcare science also provides substantial evidence of food being used for prevention/ treatment of disease [8].

Egyptians valued the medicinal importance of different spices like coriander, fennel, cumin, garlic, turmeric etc. and even considered equivalent to precious metals like gold. Honey is a popular natural antioxidant with multiple pharmacological effects like wound healing, antibacterial, anti-inflammatory, antifungal, antiviral, and antidiabetic but its reference can be traced back to Bible (Old Testament, proverb 24:13). People learned from their experiences and slowly clinical problems were provided with scientific explanations. On many occasions dietary alterations became the remedy instead of medicines. Ship crew reported high mortality due to scurvy and this problem was solved by vitamin C rich diet. Similar findings were also observed with goitre affected patients where iodine rich salt did the trick. In a nutshell it can be concluded that with the passage of time as scientific knowledge developed, food habits were intelligently modulated for prevention/treatment of disease and this may spark which produced the modern.

SOURCE OF NEURACEUTICALS

Many products endorsed to treat various disease states, whether as given medication or as supplement, find their origin in the plant kingdom. This is unsurprising in view of the fact that plants produce many secondary compounds, such as alkaloids, to protect themselves from infection as well as these constituents are often useful in treatment of human disease.. One example is recently introduced Taxol, derived from taxoids of the American yew tree then now used in ovarian cancer. Similarly, the role of flavonoids besides other plant compounds as antioxidants and free-radical scavengers is beginning to have profound effects in area of chronic inflammatory disease as well as cancer. Crude extract of different parts of plant are screened for pharmacological activity, often based on usage in folk medicine. Once a result is found, the substances are identified by chromatography as well as purified further before in vivo testing is started, A few of these lead compounds may eventually become licensed as medicines. However, the main drawback to this process is the vast cost involved.



CLASSIFICATION OF NUTRACEUTICALS

The classification of Nutraceuticals grounded upon its therapeutically usefulness for the cure or anticipation of exact condition may produce a big list. Some of the important conditions in which the Nutraceuticals are mainly attentive for its cure, anticipation or support are given in Table 1

Table 1: Therapeutically classified Nutraceuticals

Class	Example
Inorganic mineral supplements	Minerals
Vitamin supplement	Vitamins [B12,D]
Probiotic	Lactobacillus acidophilus
Prebiotic	Digestive Enzyme
Antioxidant	Polyphenols Carotenoids
Fatty Acid	Omega-3-Fatty acid
Proteins	Soya proteins
Lipids	Spingolipids

1. INORGANIC MINERAL SUPPLEMENTS.

a) Calcium

Calcium is a significant element in the treatment of decalcification of bone. Calcium deficiency is found in 25% of women, although much higher percentages have osteopenia or osteoporosis. Prepuberty is the best time to begin supplementing the diet with calcium rich minerals along with exercise regimen. Sufficiently intake of calcium and vitamin D post-menopausal can significantly reduce the risk for fracture.

b). Magnesium

Magnesium is a crucial element involved in various enzymatic procedures and critical in the proper use as well as maintenance of calcium. Many folks with calcium deficiency are actually magnesium deficient which prevent proper use of calcium.

c) Copper

Copper is a crucial component desirable in all tissues in the body. Copper as well as Zinc essential in appropriate development. Copper is best absorbed when bound to amino acids.

d) Zinc

Zinc is furthestmost vital trace mineral. Zinc supports the bodies overall antioxidant system by scavenging free radicals. It also performs many other vital functions.

2.VITAMIN SUPPLEMENTS

2.1. Vitamin B-Complex

High homocysteine levels are a risk factor for heart disease and can result from excessive meat consumption. Vitamin B1 (thiamin) deficiency is common in those who mainly eat white rice. Riboflavin-5-phosphate is a cofactor for vitamin B2, which is essential for those who can't process vitamin B2 due to dietary or health reasons. Niacinamide deficiency can lead to neurological and skin issues. Vitamin B6 is crucial for glucose production, hormone regulation, and neurotransmitter synthesis. Vitamin B12 deficiency is often found in vegetarians since plants don't contain significant B12. Folic acid, a B-complex vitamin, is essential for healthy bone formation. Vitamin C is vital for tissue development, collagen formation, wound healing, and maintaining skin, cartilage, bones, and teeth. Its deficiency can lead to various health problems.

Name of vitamin	Source	Deficiency disease
Vitamin A1	Fishliver oil, liver	Night blindness , exophthalmia
Vitamin A2	Kidney,Cheese,Butter,Carrote,Spinach, Pumpkins, Papaya	Keratomalacia
Vitamin D	Fish liver oil, Wheat germ oil, Egg yolk, milk, butter	Ricket in children ,Osteomalacia in adults
Vitamin E	Wheat germ oil , cotton seed oil , peanut oil	Sterility degenerative changes in muscles , ageing of skin
Vitamin K	Cabbage , Cauliflower , Tomatoes , alfalfa	Hemorrhagic condition
Vitamin B1	Careals , pulses	Beriberi
Vitamin B2	Nuts , Yeast	Cheilosis , Corneal opacity
Folic acid	Rice Polishing , Yeast , egg , milk	Macrocytic anemia
Biotin (Vitamin H)	Rice Polishing , Yeast , egg , milk	Anemia , Nausea , Glossaries

3.PROBIOTICS AND PREBIOTICS

Probiotics can be definite as a living microorganism which when ingested with or without food improves the intestinal microbial balance as well as the health and functioning of large intestine. The key sources are the cultured dairy products such as natural cheese, yogurt, as well as kefir and butter milk lactobacillus also in green foods such as wheat grain, spirulina and chlorella. Probiotics fast position against helicobacter pylori infection, colonic cancer, irritable bowel syndrome, pancreatitis, antibiotic induced diarrhea, Cohn's disease and pouchitis. Probiotics are food components that escape digestion by the normal human digestive enzymes and safety in intact form, reach the colon after passage through the stomach and small intestine where they selectively promote the growth of probiotics.Probiotic category includes the live microbial food ingredients which are advantageous to health. Their action includes adhesion to gastrointestinal tract at specific sites and their survival lead to elimination of pathogens.[6,18,43,44] Prebiotic category includes selectively fermented ingredients or a fiber that promote changes in gastrointestinal microflora and its activity providing good effects to the health of

host. They are the fertilizing agents for the probiotic bacteria in colon. These are not affected by gastric pH and digestive acids. The example includes inulin which on further hydrolysis gives oligofructose and galactooligosaccharide

4. PROTEINS

4.1. Soya products

Soybean is also a foremost spring of lecithin's which harvests liposomes used to express stable emulsions and finds major use in food technology. The main isoflavones in soya, genistein as well as daidzein are anatomically like to the estrogenic steroids and have been stated to have estrogenic as well as ant estrogenic activities. South East Asian populations who ingest 20-80 mg of genistein per day are found to have expressively lower incidence of breast then prostate cancer. Genistein has been conveyed to be a potent as well as specific inhibitor of protein tyrosine kinase. Genistein also hinders DNA topoisomerase II activity, alters cell cycle specific events, induce apoptosis and inhibits angiogenesis process which is vital for lump growth

5. ANTIOXIDANTS

Antioxidants are essential for combating oxidative stress and its associated disorders. They neutralize free radicals like Reactive Oxygen Species (ROS), preventing damage caused by lipid peroxidation. Natural antioxidants such as carotenoids, tocopherols, ascorbates, lipoic acids, and polyphenols scavenge free radicals effectively. Additionally, endogenous antioxidant enzymes like superoxide dismutase (SOD), minerals like Se, Mn, Cu, Zn, and vitamins A, C, and E work together to combat free radicals. Many common diseases, including cardiovascular issues, diabetes, cataracts, high blood pressure, and neurodegenerative diseases, are linked to antioxidant deficiency.

Oxidative stress is a major factor in neurodegenerative diseases like Alzheimer's, Parkinson's, and Huntington's disease, and it's exacerbated by aging and a lack of dietary antioxidants. Research shows that a high dietary intake of antioxidants can reduce the risk of Alzheimer's disease, emphasizing the importance of prevention over treatment. Using antioxidants as a strategy for slowing disease progression holds promise and is relatively straightforward

FATTY ACID

Omega-3 Fatty Acids: These are a type of polyunsaturated fat that have been shown to have numerous health benefits, such as reducing inflammation and improving heart health.

LIPIDS

Lipids in nutraceuticals play a crucial role in various health benefits. They can include:

- 1. Omega-3 fatty acids:** Found in fatty fish, flaxseeds, and walnuts, these lipids have anti-inflammatory and heart-healthy properties.
- 2. Phytosterols:** Plant-derived lipids found in nuts, seeds, and vegetable oils, which can help lower cholesterol levels.
- 3. Medium-chain triglycerides (MCTs):** Often derived from coconut oil, MCTs are easily digestible and provide a quick source of energy.
- 4. Conjugated linoleic acid (CLA):** Naturally occurring in meat and dairy products, CLA is associated with potential weight management and metabolic benefits.

5. **Phospholipids:** Essential components of cell membranes and found in sources like soy lecithin, they support various bodily functions.

6. **Squalene:** Found in olive oil and shark liver oil, it's touted for potential antioxidant and skin health benefits.

These lipids are often used as nutraceutical ingredients to promote health and well-being when consumed as part of a balanced diet or in supplements form.

THERAPEUTIC POTENTIAL

The extensive researches have revealed the involvement of nutraceuticals in the treatment of many disorders such as insomnia, digestion problems, cancer, blood pressure abnormalities, cold and cough, depression, coronary heart disease, delayed gastrointestinal emptying, and many more conditions which need special care.[4]

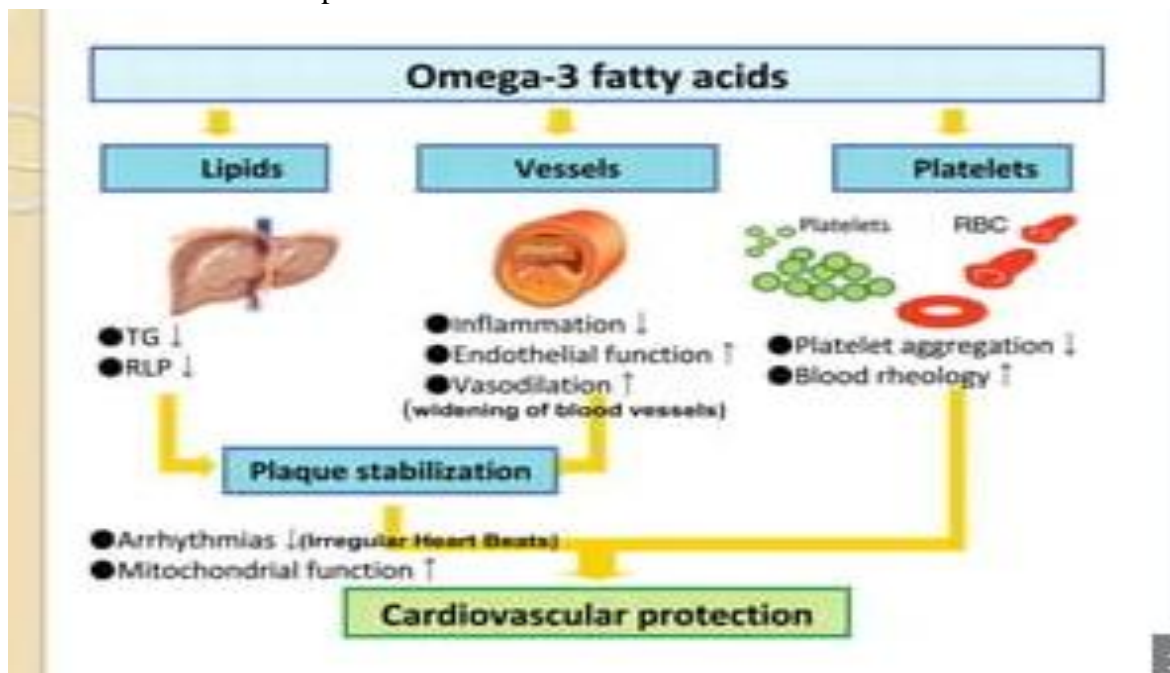


THERAPEUTIC POTENTIAL OF NUTRACEUTICALS IN HUMAN HEALTH:

Nutraceuticals in Cardiovascular Diseases (CVD): Heart disorders, such as hypertension (high blood pressure), coronary heart disease (heart attack), and various forms of cerebrovascular disease (stroke), are all associated with cardiovascular diseases (Arora, 2019). Overconsumption of calorie- dense, nutrient-deficient, deeply processed, and easily absorbable meals can result in systemic inflammation, decreased insulin sensitivity, including several metabolic abnormalities, including obesity, hypertension, dyslipidemia, and glucose intolerance (Taiwo et al., 2017). Polyphenols present in grape and grape derivatives, cocoa, and tea have been studied for their potential to reduce cardiovascular disease. By altering cellular metabolism, vitamin D, coenzyme Q10, folic acid, omega-3 fatty acids, and polyphenols help to prevent artery disease. Flavonoids found in onion, grape, apples, and cherries inhibit the Angiotensin Converting Enzyme (ACE), lowering blood pressure and reducing the risk of coronary

artery disease and myocardial infarction (Swarupananda and Sohini, 2019; Taiwo et al., 2017) [25]. Flavonoids prevent platelet stickiness and accumulation (by opposing the "suicide" enzyme cyclooxygenase that breaks down prostaglandins), and they also keep the vascular system and support small capillaries that carry oxygen and necessary nutrients to the entire cell.

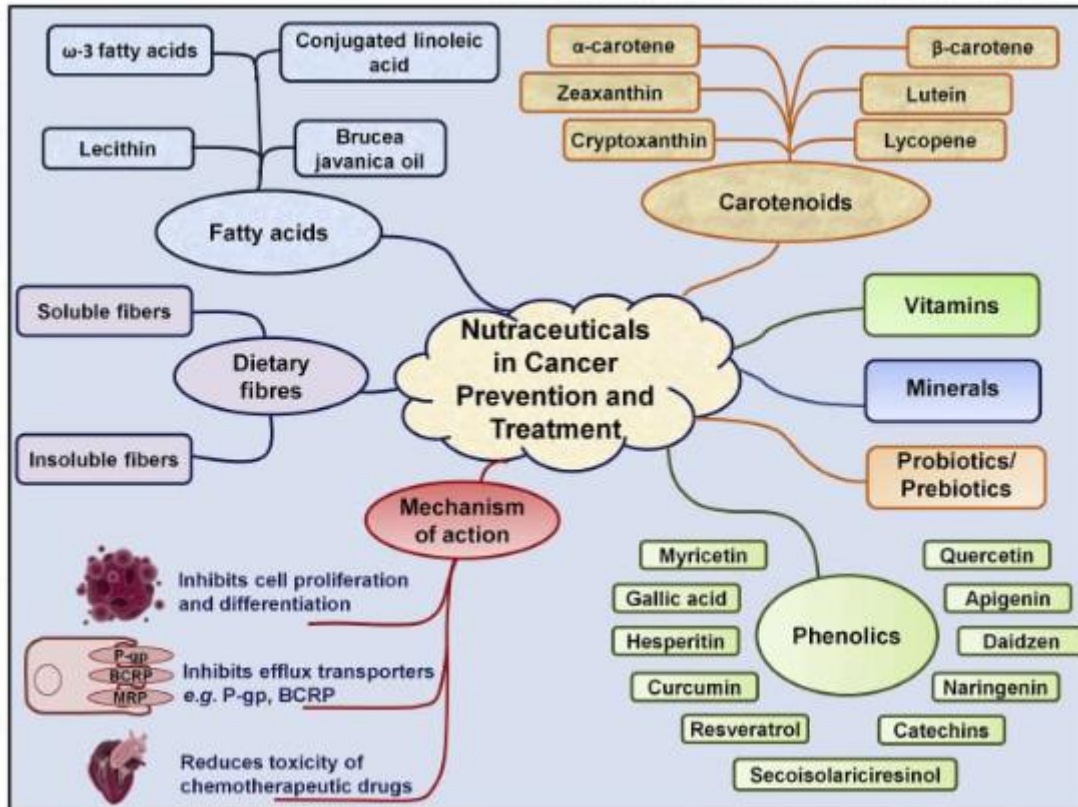
The major risk factors of cardiovascular diseases are hypertension, hyperlipidemia (particularly, high levels of low density lipoprotein cholesterol) and mental stress associated hormones. Anti-atherogenic/anti-atherosclerotic, anti-hyperlipidemic and anti-inflammatory nutraceuticals given below as well as strong antioxidants provide cardiovascular support. High intake of fruits, vegetables, vitamins and minerals are recommended for prevention and treatment of cardiovascular diseases.



NUTRACEUTICALS IN CANCER:

Cancer is defined as abnormal cell division in any part of the body, and malignant cells can influence our normal cells. Cancer is caused by a combination of complicated elements that develop in a stepwise manner, eventually leading to the uncontrolled spread and proliferation of malignant cells throughout the body, a process known as metastasis. It is one of the most important global health firms, with continuing increases in revenue and mortality. Oxidative stress and redox waving, in addition to environmental variables, are important in the origin and spread of cancer. Cancer cells' receptivity to therapeutic interventions is also harmed by reactive oxygens (Roy et al., 2019) [26]. Chronic inflammation is linked to a higher risk of cancer. Chronic inflammation has also been linked to immunological suppression, which is a cancer risk factor. At the molecular level, free radicals and aldehydes produced by chronic inflammation can promote gene alterations and posttranslational modifications of cancer-related proteins. Natural products or antioxidants (e.g., microbial and plant secondary metabolites) are employed as adjuvants to chemotherapy medications to increase their effectiveness, rather than other pharmaceutical drugs. Ginger, garlic, flaxseed, cabbage, soybeans, fenugreek, green tea, and umbellifers vegetables are examples of foods and herbs with high anticancer activity. Nutraceuticals, especially phytochemicals, play a role in cancer recovery. To date, all widely used cancer medications have come

from natural sources. Cancer patients should eat foods that have a low carbohydrate content and a moderate amount of protein, dietary fiber, and fat (Roy et al., 2019).



Fruits and vegetables with vitamins A, C, E and trace elements like selenium may prevent cancer development to a large extent (Ranzato et al. 2014). Examples of anti-carcinogenic nutraceuticals include leaves and unripe fruits of drumstick tree (*Moringa oleifera*), thymoquinone from black cumin (*Nigella sativa*), curcumin (turmeric), genistein (soybean), quercetin (many fruits and vegetables), resveratrol (grapes, groundnut, etc.), limonene and *Lactobacillus acidophilus*.

NUTRACEUTICALS IN DIABETES MELLITUS:

Diabetes mellitus is a chronic metabolic illness in which the body's ability to utilize carbohydrates is harmed due to an absolute or relative lack of the hormone insulin produced by the β -islets of Langerhans in the pancreas. Diabetes mellitus is characterized by abnormally high levels of blood glucose, either due to inadequate insulin production or its ineffectiveness. Nutraceuticals and a wide range of bioactive components, such as phenolic compounds, sulfur compounds, herbs, and natural antioxidants, are all involved in glucose metabolism and may help to prevent the development of diabetes and other complications. Some dietary supplements, such as L-carnitine-lipoic acid, omega-3 fatty acids, berberine, chromium, soy and phytoestrogens, are currently available in markets and are widely prescribed by clinicians.

These include fenugreek seed, ginger, coriander seed, cluster bean, bitter melon, lady's finger (okra), gooseberry, ivy gourd, sweet potato, cucumber, almond, rind of water melon fruit and mango fruit peel (Subramoniam, 2016).

NUTRACEUTICALS IN OBESITY:

Obesity develops as a result of excessive consumption of high-fat and energy-dense foods, which leads to the formation of fatty plaques on the inside surface of arteries, which restrict blood flow to various sections of the body. Angina pectoris, heart attack, cardiac arrest, transient ischemic attacks, and stroke can all be caused by a lack of blood supply in certain organs. It is characterized by an excess of body fat; however, the threshold value that defines what amount of body fat is "unhealthy" is unclear, and the ability to reliably degree body fat mass necessitates specialized equipment that is not readily available in most clinical settings. Following that, body mass index 449 (BMI) records are used to define people as "normal weight" (BMI 18.5-24.9 kg/m²), "overweight" (BMI 25-29.9 kg/m²), or "obesity" (BMI 30 kg/m²), which stratifies health risk based on the link between weight and height. Fortified margarine (Plant sterol and stanol esters), oolong tea (catechins), green tea (Organosulfur compounds), garlic (Organosulfur compounds), Psyllium (Soluble fiber), and soybean (protein) are all beneficial in the treatment and prevention of obesity. These functional foods remove excess fat from the body by a variety of processes, including inhibiting pancreatic lipase, increasing thermogenesis, limiting adipocyte differentiation, improving lipid metabolism, and decreasing hunger [27] Nutraceuticals like hydroxycitrate from *Garcinia cambogia* fruit, pterostilbene from blue berries etc, anthocyanins from kokum (*Garcinia indica*), fruits of bitter melon (*Momordica charantia*), rhizome of nut grass (*Cyperus rotundus*), common bean (*Phaseolus vulgaris*), raw butter milk (contains conjugated linoleic acid), etc. possess anti-obesity activity.

NUTRACEUTICALS IN ALZHEIMER'S DISEASE:

Alzheimer's disease is the most common form of dementia and a degenerative neurological illness. This sickness has no cure and will ultimately kill everyone. Necrobiosis in Alzheimer's disease results from the mass of beta-amyloid protein fragments forming solid plaques that affect the ability of acetylcholine to affect synaptic communication and initiate inflammatory progression and variations in the chemical nature of the specific proteins and also leads to necrobiosis in Alzheimer's disease wherein neuron's microtubules couples with other tubules creating neurofibrillary tangles that cause tubule. β -carotene, curcumin, lutein, lycopene, and turmeric have antidisease Alzheimer's properties by neutralizing the negative effects of oxidative stress, mitochondrial malfunction, and neuronal degeneration [28].

NUTRACEUTICALS IN OSTEOPOROSIS:

Low bone mass, thinning bone tissue, and disruption of bone microarchitecture are all symptoms of osteoporosis. Many factors that influence low bone mass are divided into two categories: those that cannot be changed and those that can. Gender, age, body size, and race are unchangeable, whereas hormonal status, lifestyle factors such as food, smoking, and alcohol consumption patterns, and physical activity levels can be changed. Nutraceuticals such as herbs, minerals, and dairy products are increasingly being utilized to combat this condition. Calcirol D-3 is a popularly marketed nutraceutical product that contains calcium and vitamins to aid in the treatment of osteoporosis. Probiotics are effective in alleviating osteoporosis symptoms and lowering osteoporosis risk.

Phyto-estrogens present in nutraceuticals such as soybean products (genistin and daidzein) and stem of *Cisus quadrangularis* provide bone health, particularly to postmenopausal woman. Examples of other nutraceuticals believed to be beneficial to bone health are spinach and other leafy vegetables, flax seed, inulin (naturally occurring polysaccharide) and conjugated linoleic acid (present in raw butter milk).

NUTRACEUTICALS IN OSTEOARTHRITIS:

Osteoarthritis is characterized by articular cartilage loss, synovial membrane inflammation, and subchondral bone resorption. It is the most well-known form of arthritis, afflicting millions of individuals all over the world. When the protecting cartilage on the extremities of the bones breaks down over time, it causes this condition. It can cause pain in any joint in the body. It most usually affects the joints of the hands, knees, hips, and spine. Although there is no cure for osteoarthritis, there are therapies that can help with pain relief and joint mobility. Chondroitin Sulfate (CS) and Glucosamine (GLN), also known as 2-amino-2-deoxy-d-glucose (C₆H₁₃NO₅), are widely utilized to alleviate the symptoms of osteoarthritis. MSM (Methyl Sulfonyl Methane) is a synergistic combination of glucosamine and chondroitin that is used to treat osteoarthritis and joint problems. Glucosamine (GLN) is an amino monosaccharide that is found in the exoskeletons of crustaceans and mushrooms. It is a component of glycosaminoglycan (GAG) chains. GAG is made up of two sugars that alternate: glucuronic acid and acetyl-d-galactosamine sulfate

NUTRACEUTICALS IN PARKINSON'S DISEASE:

It is a neurodegenerative disease characterized by a shortage of dopaminergic neurons in the substantia nigra, resulting in striatal dopamine exhaustion. Numerous nutraceuticals have been proven to provide neuroprotection in animal settings and may be useful as alternatives to synthetic pharmacological molecules such as L-Dopa, which has a long list of negative side effects. Iron chelation, modulation of cell signaling pathways, Reactive Oxygen Species (ROS)/free radical scavenging, anti-inflammation, anti-apoptosis, and mitochondrial homeostasis are some of the mechanisms by which they work, although several nutraceuticals essentially work through a slew of unthinking pathways rather than a single mechanism. Plant polyphenols, stilbenes, soybeans, and other phytoestrogens, as well as vitamins C, D, E, coenzyme Q10, and unsaturated fatty acids, have been shown to protect against Parkinson's disease progression (Dutta et al., 2018)[29]

NUTRACEUTICALS IN COVID-19:

SARS-CoV-2 has affected global health and economic well-being since its emergence in early 2020. The virus infection was initially reported in Wuhan by the World Health Organization's (WHO) regional office in China on December 31, 2019, and the infection was declared an epidemic on March 11, 2020 (Savant et al., 2021). SARSCoV-2, also known as COVID-19, is a coronavirus with high pathogenicity. It is a single-stranded positive-sense RNA virus, which means its RNA can be immediately translated into viral proteins in infected cells. Fever, gastrointestinal problems, and memory loss are just a few of the symptoms that SARS-CoV-2 infection can cause (Akula et al., 2020). The current COVID-19 virus has increased the demand for immune-boosting foods, vitamins, and nutraceuticals. Food bioactive and nutraceuticals have been suggested as an alternative therapy for COVID-19 disease based on their anti-inflammatory properties as well as their capacity to inhibit virus activity [30].

SCOPE AND TYPE OF PRODUCTS AVAILABLE IN MARKET

Nutraceutical from Nutrition and Pharmaceutical, in 1989 refers to foods having a medicinal effect on health of human beings. It consists of food supplements, herbal products, probiotics and prebiotics, medical foods meant for prevention and treatment of diseases. Major Nutraceuticals possess multiple therapeutic effects with lacking of unwanted effects. A Nutraceutical is demonstrated to have a physiological benefit or provide protection against chronic disease. I try to redefine functional foods and Nutraceuticals. When food is being cooked or prepared using scientific intelligence with or without knowledge 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, treatment of disease and disorder other than anemia, it is called a Nutraceutical. Nutraceuticals are non-toxic food components which claimed to possess multiple therapeutic benefits. Some popular Nutraceuticals include glucosamine, ginseng, Echinacea, folic acid, cod liver oil, omega-3 fatty acid (MUFA, PUFA), calcium-enriched orange juice, green tea, plant phenols etc. Nutraceuticals can be organized in several ways depending upon its easier understanding and application, i.e. for academic instruction, clinical trial design, functional food 0 50 100 150 200 250 300 350 400 450 India Japan Europe US development or dietary recommendations. Some of the most common ways of classifying Nutraceuticals can be based on food sources, mechanism of action, chemical nature etc.

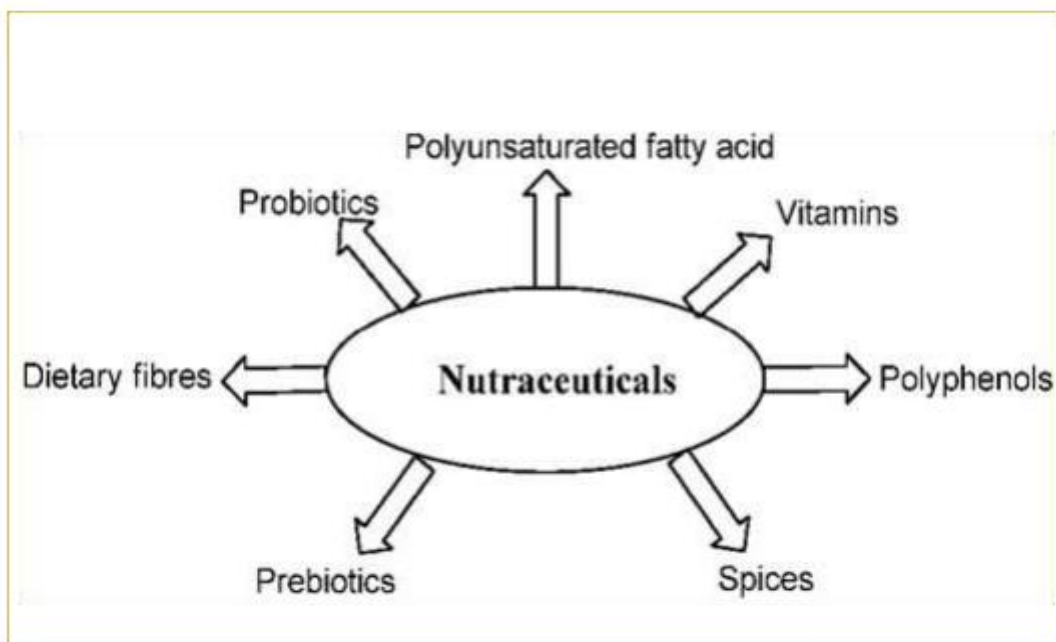


Figure 4 :Types of Nutraceuticals available in market

Market growth

In India, functional foods are expected to see increased consumption over the next five years resulting in functional foods and beverages garnering greater product share in the market as opposed to dietary supplements. The total Indian Nutraceuticals market in 2015 is expected to be roughly US \$ 5 billion. In each product segment, manufacturers can expect a minor shift in consumption, driven by the demand for new and improved product as well their health claims. Interestingly, in the Indian market, the consumption of alternative herbal medicines and supplements (usually Ayurvedic and Homeopathic) is expected to have a detrimental effect on the Nutraceutical market and is considered as a loss to the unorganized market by manufacturers. This segment promises huge potential to Nutraceutical product manufacturers, through customization of their products to include natural and herbal ingredients. The

success of the chyawanprash supplements market being case in point. Increased life expectancy, globally, has led to an increase in the incidence of lifestyle (age related) diseases such as diabetes, high blood pressure and cholesterol, obesity etc. As a result, there has been a significant increase in the deaths due to lifestyle diseases worldwide. Consumers worldwide are looking to follow healthy lifestyles to obtain optimum nutrition to keep these diseases at bay, leading to an increase in Nutraceutical consumption by health conscious consumers.

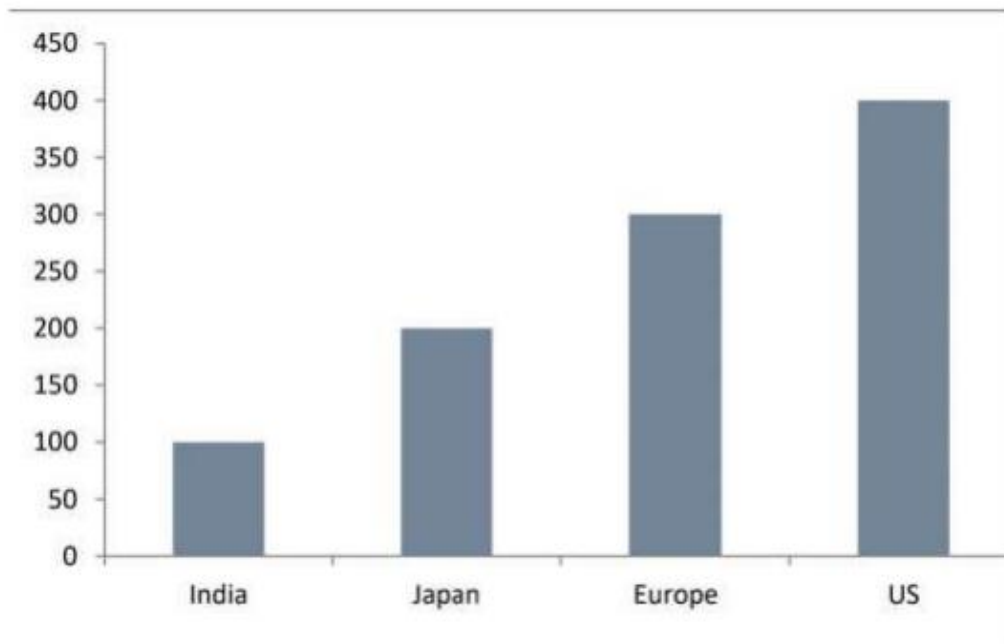


Figure 5 : Nutraceuticals Market in different Countries

ADVANCEMENT IN DRUG DELIVERY SYSTEM IN NEUTRACEUTICALS:

The increasing preferences of consumers to eat healthy food products and the nutraceuticals showing up to be favorable in preventing as well as curing many diseases impelled scientists and researchers to look for efficient delivery systems. The use of novel drug delivery system to deal with the efficacy issues of the products is drawing more and more attention of the researchers. **Nanoemulsions**

Nanoemulsion is the nano-sized formulation in which two immiscible liquids are mixed to form a single phase, thermodynamically stable isotropic system with the help of an emulsifying agent. The droplet size ranges from 20 to 200 nm.[48] Resveratrol which is a natural compound found in red grape skin, peanuts, and blueberries has been found to possess powerful antioxidant properties. However, the problem with the compound is the poor bioavailability. Therefore, to overcome the problem and enhance the effect, it has been encapsulated in the nanoemulsion formed with spontaneous emulsification method which has resulted in better retention and enhanced properties of the system.[49] Similar researchers have proven curcumin to be effective in the form of nanoemulsion for the treatment of inflammation in mice by the inhibition of inflammatory mediator.[50]

Liposomes

Liposomes are the spherical vesicles composed of phospholipids consisting lipid bilayer. These are spherical in shape and can be formulated using cholesterol and natural phospholipids.[51,52] Liposomes are also preferred to be an advanced delivery system for nutraceutical products. Intranasal quercetin

liposomes is one of the examples which have been reported to enhance the penetration of quercetin through blood brain barriers and increase the therapeutic anticancer efficacy of the product.[53] Similarly, buccal liposomal formulation of silymarin has also been proved to offer hepatoprotective effect with enhanced bioavailability of the product resulting into better therapeutic response.[54,55] The antigout topical liposomal preparation of colchicine has also been proven very effective in the treatment of gout.[56]

Phytosomes

Phytosomes are the complex of phospholipids and the biologically active ingredients.[57,58] Oral formulation of Ginseng phytosomes, prepared using phospholipid complexation has been found to overcome the problem related to the low solubility of Ginseng and results in the increased absorption in the body which enhances the therapeutic effect of Ginseng as an immunomodulator.[59] Oral phytosomal preparation of Hawthorn (Flavonoid) having cardioprotective and antihypertensive properties has also been reported to offer enhanced efficacy. Quercetin, possessing the properties of an anticancer as well as an antioxidant compound was also subjected to the oral preparation of Quercetin phytosomes providing better therapeutic efficacy of the drug.[60] Furthermore, curcumin phytosomal oral preparation, using curcumin-phospholipid complexation method has also been researched on, and it has offered elevated bioavailability and increased antioxidant activity.[61]

Microspheres

Microspheres are the spherical vesicular particles falling within the diameter range of 1-1000 μm . Due to their small size, microspheres can be ingested or injected, can be adjusted to any desired release profile and can also exhibit site-specific as well as organ targeted drug delivery. Intravenous preparation of camptothecin (natural product) loaded microspheres, formulated using oil-in-water evaporation method has been reported to provide prolonged anticancer effect.

Transfersomes

Transfersomes are also known as the ultradeformable vesicles consisting of an aqueous phase as a core surrounded by the lipid bilayer complex which makes the formulation selfoptimizing and self-regulating. Therefore, the transfersomes are capable of crossing several transport barriers conveniently and acts as the carrier in the non-invasive techniques of delivery.[66] The researchers have proven topical preparation of capsaicin transfersomes to offer enhanced skin penetration with improved analgesic effect.[67] Colchicine transfersomal formulation has also been studied to provide better penetration and thus advanced treatment of gout.[68] Similarly, in vitro preparation of vincristine transfersomes exhibits increased entrapment efficiency and improved skin permeation and results into the better therapeutic effect of the anticancer drug.

CHALLENGES AND LIMITATIONS ASSOCIATED WITH DELIVERY OF NUTRACEUTICALS:

The nutraceutical formulations are been taken not as medicines but as diet. Hence, unlike the pharmaceutical preparations, nutraceuticals preparations need to fulfill a whole lot more requirements. Since, the nutraceuticals include dietary supplements, functional foods, etc., the components used in the formulation must be of food grade. This limits the choices for the researchers and decreases the scope of

innovations in the nutraceutical domain. Therefore, selection of suitable material for the preparation of the formulation is a great challenge.[70] After the selection of the materials, the next challenge appears in the selection of the delivery system. The nutraceuticals materials consist of the biological products such as herbal extracts, proteins, peptides, vitamins, and hormones which have the tendency to degrade easily. The stability of the formulation is a factor which cannot be compromised. Furthermore, the core ingredient should be released only when triggered by any external stimulus such as pressure and pH or temperature. Thus, a suitable delivery system must be chosen on the grounds of its ability to deliver the food product effectively, exerting its desired effect.[70] After the preparation of the formulation, testing of the products again requires attention. The in vitro tests performed for this purpose allows us to get an insight about the pharmacokinetic mechanism and the rate and extent of the release of the core active ingredient. However, these tests have the limitations as they are unable to provide the data for the active uptake of the product, their metabolic responses, the biological variability of the nutraceutical product. Therefore, complete testing is required to analyze the influence of factors like food on the Ruchi, et al.: Role of nutraceuticals in health care: A review International Journal of Green Pharmacy • Jul-Sep 2017 (Suppl) • 11 (3) | S392 response of the product.[8] Nutraceuticals is a subject which is not so known to the people and it still needs awareness in common people regarding its use and ability for its potential. The lack of recognition in the market paired with the deficit marketing and distribution leads to the shortfall in the investments in the food research, and this is creating a huge challenge to the growth of nutraceutical industries in India. Due to this insufficient awareness in nutraceuticals, the manufacturing processes in several firms give negligible consideration to product extraction, enhancement of the shelf life, storage of the crude and prepared materials, meeting the quality standards of the ingredients and prevention from the contaminations.

CONCLUSION

Health and well-being could be improved with appropriate use of nutraceuticals coupled with physically and mentally active life style and reduced mental stress. Nutraceuticals is growing wellbeing maintenance trade in India. They have significant character in expansions of upcoming therapeutics then it be influenced by on control of purity, usefulness as well as security. Nutraceuticals products are used in prevention of disease not in cure of disease. Nutraceuticals Products is collaborative research effort of Pharma, food and chemical industry. There is a long history of nutraceutical use in the treatment of illness, and these chemicals have a position in current and future medicine. However, additional research is needed to ensure the items' safety, enhanced quality, purity, efficiency, health-promoting, and disease-curing effects, as well as a greater awareness of the various methods that go into item development. When taking supplements, extreme caution is very essential. As a result, there is a need for basic discussion and studies on the benefits, suggested, daily consumption, and potential side effects of supplement use. The studies have confirmed in many ways the crucial role of nutraceuticals in prevention and treatment of various diseases. Most of the people prefer the treatment of any ailment in a natural way which can be achieved by including nutraceuticals in regular use. The consumption of nutraceuticals provides best option to stay natural and to improve the quality of life. In addition, nutraceuticals can also provide an alternative for patients who are unwilling to go through chemical therapy.

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