



## A Review on Nutraceuticals with its Recent Advancement (An Overview)

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### Abstract

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 [1]. 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 outcomes. Nutraceuticals have also found considerable trust in treating headaches and migraines resulting from stress. Other related nutraceutical products are touted as cures for thinning hair, lack of confidence poor complexion, varicose veins, alcoholism, depression, and lethargy. In this chapter we made an attempt to classify all types of nutraceuticals with examples followed by their application in the treatment of various disorders. Furthermore, the implantation of the designing and development of dosage forms for offering better delivery nutraceuticals carrier of the importance and challenges have also been enumerated. Products known as nutraceuticals can be used as medication in addition to being nutritional. A substance that has physiological benefits or offers protection against chronic disease may be referred to as a nutraceutical product. Nutraceuticals can be used to boost wellbeing, slow down aging, stop chronic diseases from occurring, lengthen life expectancy, or support the body's structure or functions [1,2]. Due to their potential for having nutritional, safe, and therapeutic impacts, nutraceuticals have recently attracted a lot of attention. These medicines have demonstrated promising outcomes in a variety of problems, according to recent investigations. Much work has gone into the current review to propose novel ideas regarding nutraceuticals based on their potential to treat or prevent diseases. The presentation of herbal nutraceuticals that are helpful against difficult-to-treat oxidative stress-related diseases like allergies, Alzheimer's, cardiovascular obesity, diabetes, Parkinson's disease, ocular, immunological, inflammatory, and cancer. employing scholarly websites including Medline, PubMed, and Google Scholar, searches were conducted on recently published studies regarding various elements of employing nutraceuticals as a pharmaceutical substitute. The terms used were nutraceuticals and allergy, Parkinson's, Alzheimer's, cardiovascular, cancer, and diabetes [2].

**Keywords:** Phytochemicals; Diabetes; Obesity

### Introduction

- Nutraceutical products can be considered non-specific biological therapies used to promote general well-being, control symptoms, and prevent malignant processes. The term "nutraceutical" combines the two words of "nutrient", which is a nourishing food component, and "pharmaceutical", which is a medical drug [2,3].
- Nutraceuticals are the type of products that are utilized for medicinal purposes apart from nutrition. Obtained from the animal, plant, and microbial, nutraceuticals comprise food additives, whole foods, herbs, phytonutrients, vitamins, minerals, probiotics, and herbal products [3].

- A nutraceutical product offered by a reliable Nutraceutical Supplier in India may be used for physiological purposes or to treat a chronic illness. Nutraceuticals are additionally popular by the following terms:
  - Functional foods
  - Medical foods
  - Designer foods
  - Phytochemicals
  - Nutritional supplement

### History

- Nutraceutical is derived from the amalgamation terms nutrition and pharmaceutical and was coined by Stephen De Felice in 1989. However the terminology is not very popular globally and mostly substituted by the term “dietary supplement to meet the stringent regulatory requirements. But microscopically cross-sectioning of both the terms reveals some basic differences like nutraceuticals.
- The words “nutrition” and “pharmaceutics” were combined to create the phrase “nutraceutical.” The word is used to describe items that are isolated from herbal products, dietary supplements (nutrients), certain diets, and processed meals like cereals, soups, and drinks that are also utilized as medicines.
- Contrary to medications, nutritional supplements typically lack patent protection. It is possible to treat or prevent diseases with both pharmaceutical and nutraceutical chemicals, however only pharmaceutical compounds are approved by the government.
- Glucosamine, omega-3 fatty acids, green tea, ginseng, Echinacea, lutein, folic acid, and cod liver oil are a few well-known nutraceuticals. Most nutritional supplements have several different therapeutic qualities.
- Due to the possible nutritional, medicinal, and safety impacts, nutraceuticals have recently attracted a lot of attention. The global nutraceuticals industry is growing, according to a new market study, and it will reach US \$250 billion by 2018.
- New ideas on nutraceuticals based on their potential to treat diseases have been presented in great detail in the current study. Emphasis has been placed on showcasing herbal nutraceuticals that are helpful against difficult-to-treat conditions linked to oxidative stress, such as obesity, allergies, Alzheimer’s, cardiovascular, cancer, and diabetes.

- Since ancient period the mankind made medicine from extracts of natural material and has been used for various purposes.
- Nutraceuticals have advanced significantly since the 1990s, when a new movement in companion animal care and a corresponding trend in human health developed. The term “nutraceutical” has been defined to encompass vitamins, minerals, herbs, and other botanicals, amino acids, and dietary substances for human use as a supplement diet since the dietary supplement health and education act of 1994 was passed [2].
- The success of the traditional therapies is essentially due to art of balancing the effect of one variety of food with other so that all complimented each other. Currently, the medical practitioners are considered as magic wand to cure disease. A recent study reports that 70% of patients typically consult a medical practitioner before or during the traditional therapy, indicates the disapproval of natural therapy. This review gives highlights of some important facts regarding therapeutic use of nutraceutical as the commercial and rational remedies.

### Nutraceuticals can be studied under the following 3 broad categories such as

- **Nutrients:** Nutrients are substances that have been demonstrated to have nutritional significance. These compounds include fatty acids, amino acids, vitamins, and minerals. This includes dietary fiber, polyunsaturated fatty acids, probiotics, prebiotics, and other naturally occurring antioxidants [4].
- **Herbals:** Herbs have been utilized by humans as all-natural remedies for a variety of ailments since the beginning of time. Conventional medicine holds that herbs have the inherent ability to heal illness and can be beneficial to people. The biological activity and toxicity of chemical components present in plants have been the subject of several investigations. Phytochemicals found in herbal and botanical products are included in this class. An essential component for boosting humoral and cell-mediated immunity is green tea. It contains potent antioxidant qualities. Apart from colours, Sulphur compounds, phenolic chemicals, and other phytoconstituents like terpenoids, herbs can also contain entire grains, vegetables, fruits, nuts, and seeds. These are various concentrations and extracts from herbs and plants.

- **Dietary supplements:** These involve substances that are used for specific objectives, such as meal replacements, help in weight reduction, and sports nutrition; examples of these include pyruvate, chondroitin sulphate, and other substances sourced from various sources.
- The material and bulk are other terms used to describe dietary fibers. The parts of plants called particles are difficult for the body to digest. Dietary fiber is abundant in fruits, vegetables, whole grains, legumes, and bean products. Constipation should be avoided or treated as soon as feasible. There are two types of fibres: soluble and insoluble [2-4].

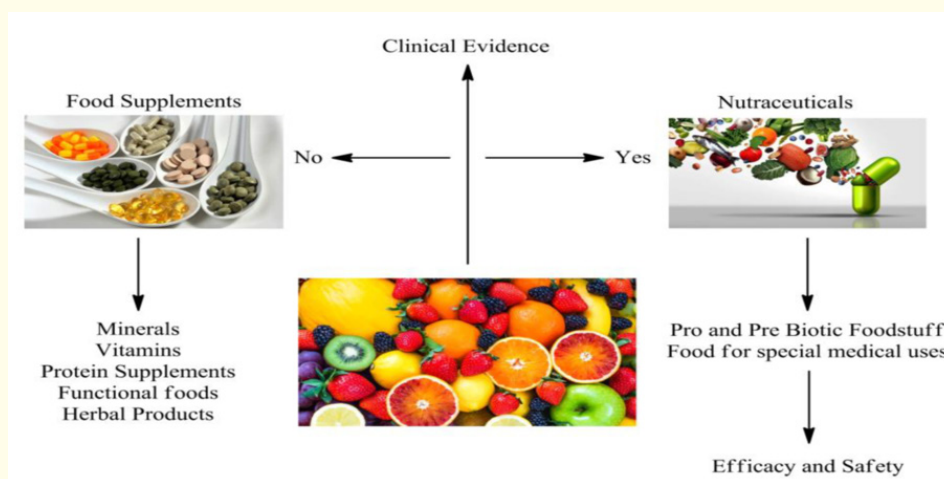


Figure 1

### Definition

- A nutraceutical is any substance considered as a 'food' or its part which is an addition to its normal nutritional value provides health benefits including the prevention and treatment of disease or promotion of health.
- It is any 'nontoxic ; food component that has scientifically proven health benefits , including disease treatment or prevention.
- The functional component of the food must be standardized in the nutraceutical product and produce under manufacturing practices [5].



Figure 2

### Types of foods used in nutraceuticals

- Probiotics
- Dietary Fiber
- Prebiotics
- Polyunsaturated fatty acids
- Antioxidant vitamins
- Polyphenols

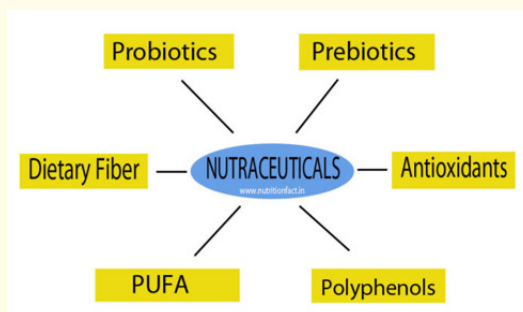


Figure 3

### Probiotics

These are living, beneficial microorganisms that are used as culinary ingredients. They are gastrointestinal tract-adherent and pathogen-competitive exclusion. The primary goal of introducing probiotics is to change the harmful flora of the large intestine into a colony of *Bacillus bulgaricus* that is friendly to the host.

These also raise health. after the GI tract, the probiotic population is highest here. It has the ability to bind to pancreatic juice. It competes with harmful bacteria for space on the gut wall. to hinder nutrition and boost immunity. The equilibrium of the intestinal microbiota is changed. It enhances intestinal health by preventing the formation of dangerous bacteria, which helps with digestion.

Probiotics are available in various forms like powder form, liquid form, gel or paste or granule forms, capsule forms etc. [5].

Food Source: Yogurt, kombucha, sauerkraut, pickles, kimchi, certain bread and some cheeses.

### Dietary fiber

Dietary fiber is the food material, found in the plant material that is not hydrolysed by digestive tract enzymes, but can be digested by microflora in the gut. Dietary Fibers are mostly found in celluloses, hemicelluloses, gums and pectin's, lignin, resistant dextrin's and resistant starches.

Dietary fibers are classified into two types based on their water solubility: –

- Water Insoluble Dietary Fiber and
- Water Soluble Dietary Fiber

### Dietary insoluble fiber

Water cannot dissolve this insoluble fiber. We are aware that fiber, which the body cannot digest and absorb, is often present in diets that are mostly plant-based. Dietary fiber that is insoluble helps food pass more readily through the digestive system, loosens feces, and lessens constipation. It is beneficial for removing harmful cholesterol from the body as well.

Water insoluble fiber contains-glucans, pectin's, gums, mucilage's, and hemicelluloses that are fermented in the colon [5].

### Water soluble dietary fiber

This fiber is water soluble and takes on the texture of a gel, binding to the feces and preventing non-propulsive colon contraction. It also aids in bulking the stools and enables rapid passage through the digestive system, reducing constipation or irregular stools. The rate of digestion and the absorption of nutrients are both impacted by this fiber. In addition to lowering blood LDL cholesterol, soluble fiber increases glucose tolerance. Fiber also reduces hunger by making you feel fuller longer.

Psyllium, a popular fiber supplement, also contains it. Certain varieties of soluble fiber may reduce the risk of heart disease.

### Prebiotics

Prebiotics are substances found in food that prevent beneficial microbes like bacteria and fungus from growing or proliferating. Prebiotics have the ability to change the makeup of the bacteria in the gut microbiome. The digestive system is the most typical example. Prebiotics are dietary components that selectively change the composition or metabolism of the gut microorganisms in a way that is favorable to the host [2].

Food Source: whole grains, bananas, greens, onions, garlic, soybeans.

### Polyunsaturated fatty acid (PUFA)

PUFA are fatty acids with many double bonds throughout their structure. Heart disease risk can be lowered by substituting PUFA-rich oils for saturated fats and other harmful fats. Omega 3 fatty acids, which are found in PUFA, have potent anti-inflammatory qualities that help to enhance eyesight, protect against cataracts, and protect against Alzheimer's disease while lowering risk of heart disease and other diseases.

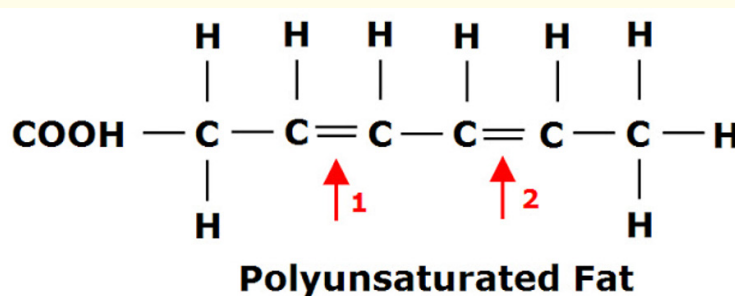


Figure 4

Food Source: Walnuts, soya bean oil, flax seeds, sunflower seeds, Salmon fish, mackerel, tuna, poultry and eggs [5].

### Antioxidant vitamins

The nutrients copper, beta-carotene, zinc, selenium, and the vitamins A, C, and E are antioxidants. These could mitigate the harm that free radicals do to cells. The finest sources of antioxidants are foods that are derived from plants. Along with phenols, tannins, and lignins, flavonoids are also naturally occurring antioxidants.

Food Source: All berries like strawberry, blackberry, raspberry, Blueberries etc., pecans, sweet potatoes, cabbage, beetroot, kale, spices and other vegetables [5].

### Polyphenols

Micronutrients known as polyphenols are mostly present in fruits and vegetables but are lacking from animal meals. These include leucon anthocyanins, hydroxy acids, catechins,

and antioxidants. These may be found in woody plants' tissues, including those of apples, almonds, peaches, and grapes. Fruit quality is impacted by polyphenol presence. The control of weight, diabetes, cardiovascular disease, and digestive issues may all be improved by polyphenols.

Food Source: Seasonings like cloves, ginger, garlic, rosemary saffron etc., berries, cocoa powder, all fruits and vegetables, nuts, soy products, green tea [5].

### Different search engines

Employing academic search engines like Medline, PubMed, and Google Scholar, we looked for recently published publications on various aspects of employing nutraceuticals as a pharmaceutical substitute. Nutraceuticals and allergies, Parkinson's, Alzheimer's, cardiovascular disease, cancer, and diabetes were among the phrases utilized [6].

### Disease of nutraceuticals

#### Allergy and nutraceuticals

An immune system hypersensitivity disease is called an allergy. An allergic response often happens when a person's immune system responds to generally safe chemicals. The increased activation of particular white blood cells called mast cells and basophils by a kind of antibody called immunoglobulin E is what makes allergic responses different. This reaction causes an inflammatory response, which can be unpleasant or harmful.

Low-density lipoprotein (LDL-C), particularly in blood arteries, is shielded against damage by quercetin. Heart disease has a root cause called LDL-C, and quercetin works as an antioxidant and free radical scavenger. Patients with diabetes are more likely to experience blood vessel damage from oxidative stress. Quercetin is therefore advantageous for these patients as well [5,6].

#### Alzheimer's disease and nutraceuticals

The most prevalent type of dementia is Alzheimer's disease. The illness has no known treatment and finally results in death. The majority of the time, AD is identified in patients over the age of 65, while the less common early-onset Alzheimer's disease can start considerably younger. In 2006, there were 26.6 million sufferers worldwide, and by 2050, it's expected to afflict 1 in 85 individuals worldwide.

Men and women are impacted differently, with a ratio of roughly 2:1 favoring women. Oxidative stress may be linked to several neurodegenerative diseases, including AD, according to a number of lines of evidence. By reducing oxidative stress, dietary antioxidants including curcumin, lutein, lycopene, turmeric, and -carotene may have a favorable impact on a variety of disorders. The assumption that these substances can delay the onset of dementias like AD is what has led to increased trends in the use of nutraceuticals. Recently released studies demonstrate the beneficial effects of certain dietary supplements including *Ziziphus jujube* and *Lavandula officinalis* on AD, memory, learning, and other cognitive functions [7].

#### Cardiovascular diseases and nutraceuticals

The incidence of CVD is rising globally, as are the number of studies conducted in this area. The word "CVD" refers to conditions affecting the heart and blood vessels, and it encompasses conditions like coronary heart disease (heart attack), peripheral vascular

disease, cerebrovascular disease (stroke), hypertension, heart failure, and more. It is thought that a poor consumption of fruits and vegetables is linked to a high death rate for cardiovascular disease. The majority of CVD may be avoided. A diet high in fruits and vegetables has been shown in several trials to be protective against CVD.

Exercise and nutritional supplements in the form of vitamins, minerals, antioxidants, dietary fiber, and omega-3 polyunsaturated fatty acids are advised for the prevention and treatment of CVD. The compounds, like polyphenols, change cellular signaling and metabolism, which is thought to lessen artery disease [7].

Flavonoids, which come in the forms of flavones, flavanones, and flavanols and are abundant in fruits and vegetables such as grapefruits, apples, cherries, pomegranates, berries, black grapes, and red wine, have a significant role in preventing and treating cardiovascular disease (CVD). In addition to preventing platelet aggregation, flavonoids also inhibit the cyclooxygenase enzymes that break down prostaglandins and the angiotensin-converting enzyme. They also defend the circulatory system, which supplies cells with oxygen and nutrition.

Plant-based diets are thought to have health advantages due to their anthocyanins, tannins (proanthocyanins), tetrahydro-carbolines, stilbenes, dietary indoleamines, serotonin, and melatonin content. Flavonoids are plentiful in orange juice with pulp. Citrus bioflavonoids like hesperidin are classed as flavanone glycosides. The richest dietary sources of hesperidin are tangelos and citrus sinensis. Hesperidin concentrations are higher in lemon and orange peel and membranous portions. Vein insufficiency and hemorrhoids are both treated with hesperidin.

The omega-3 fatty acids (fatty acids) found in fish are dietary elements that have an impact on plasma lipids and CVD, including arrhythmias. Octacaine is a lipid-lowering compound that may be found in whole grains, fruits, and leaves of many plants. It has no negative side effects.

#### Cancer and nutraceuticals

Cancer has emerged as a major public health problem in developing countries. According to the World Cancer Report the cancer rates are increasing and it would be 15 million new cases in the year 2020 that is, a rise in 50%. A healthy lifestyle and





Figure 5

diet can help in prevention of cancer. Carotenoids are a class of phytochemicals that give foods their various colors. They function as antioxidants and are useful at preventing cancer. The function of lycopene in human health, particularly in the treatment of cancer, has drawn recent attention to carotenoids. Prostate cancer cell proliferation is also inhibited by plants high in daidzein, biochanin, isoflavones, and genistein. Because lycopene is unsaturated, it is thought to be a strong antioxidant and a singlet oxygen quencher. The prostate, testicles, epidermis, and adrenals are where lycopene accumulates and offers cancer protection. The connection between carotenoids and the prevention of cancer and CAD has increased the value of fruits and vegetables in the human diet [2-4].

Lycopene contained vegetables and fruits exert cancer-protective effect via a decrease in oxidative stress and damage to DNA. Lycopene is one of the major carotenoids and is found exclusively in tomatoes, guava, pink grapefruit, water melon and papaya. Cancer and other diseases can be avoided because of  $\beta$ -carotene's antioxidant properties. The antioxidant with the highest antioxidant activity is  $\beta$ -carotene. Epsilon carotene has antioxidant activity that is 42–50% lower than that of alpha-carotene, which has 50–54% of alpha-carotene's antioxidant activity. An elevated risk of cancer is linked to chronic inflammation. Immune suppression, which is a risk factor for cancer, is connected to chronic inflammation as well. A common actor in the inflammation-to-cancer chain that is targeted by ginseng is an anti-inflammatory molecule. The importance of phytochemicals with cancer-preventing capabilities has increased recently. Fruits and vegetables include chemo preventive elements that may have anticarcinogenic and antimutagenic properties in addition to other positive health effects. For the prevention of prostate and breast

cancers, a wide variety of Phyto-pharmaceuticals with a purported hormonal action, or "Phyto-estrogens," are advised.

Citrus fruit flavonoids function as antioxidants and help prevent cancer. Isoflavones, the polyphenolic phytochemicals represented by epigallocatechin gallate from tea, curcumin from curry, and soya isoflavones contain cancer chemo preventive characteristics, are a unique dietary supply found in soy foods. Breast, uterine, lung, colorectal, and prostate cancers appear to be resistant to soy. Winter squash, tomatoes, lettuce, oranges, sweet potatoes, broccoli, cantaloupe, and other yellow, orange, and green leafy vegetables and fruits contain  $\beta$ -carotene, which has anticancer properties. Saponins are reported to possess antimutagenic and antitumor activities and might lower the risk of human cancers, by preventing cancer cells from growing. Saponins are phytochemicals which can be found in peas, soybeans, and some herbs with names indicating foaming properties such as soapberry, soapwort and soapbark. They are also present in tomatoes, potatoes, alfalfa, spinach, and clover. Commercial saponins are extracted mainly from *Yucca schidigera* and *Quillaja saponaria*.

Tannins also detoxify carcinogens and scavenge dangerous free radicals. Tannins are a known anticarcinogen used in complementary medicine and to prevent cancer. They are found in foods including grapes, lentils, tea, blackberries, blueberries, and cranberries. Ellagic acid is an anticancer agent found in the seeds of red raspberry fruits and vegetables, strawberries, cranberries, walnuts, pecans, and pomegranates. It has been demonstrated that the soluble fiber pectin, which is present in apples, prevents prostate cancer spread by preventing the cancer cells' adhesion to other cells in the body. It has been demonstrated by several research

that pectin lowers blood cholesterol levels. Derivatives of phenolic acid that exist naturally are said to have anticancer potential. There is evidence that phenolic substances such curcumin, gallic acids, ferulic, and caffeic acid have anticancer properties.

Low risk of gastrointestinal and lung cancer has been linked to high consumption of cruciferous vegetables, glycosylates, and the hydrolysis products they produce, such as indoles and isothiocyanates. Dithiol thiones, isothiocyanates, and sulforaphane are examples of glycosylates' bio-transformation products. In particular, they inhibit the enzymes that encourage the formation of tumors in the liver, colon, lung, breast, stomach, and esophagus. The sulfur compounds, in garlic have been found to boost the immune system and reduce atherogenesis and platelet stickiness and cancer. Sulforaphane rich in broccoli is a potent phase 2 enzyme inducer. It produces D-gluconolactone, a significant inhibitor of breast cancer. Sulforaphane is an antioxidant and stimulator of natural detoxifying enzymes. Sulforaphane has been reported to reduce the risk of breast cancer and prostate cancer. Curcumin is a polyphenol derived from the plant *Curcuma longa*, commonly called turmeric. Curcumin has been reported to possess antioxidative, anticarcinogenic, and anti-inflammatory properties. Consuming foods rich in cysteine, glutathione, selenium, vitamin E, vitamin C, lycopene, and other phytochemicals boosts the body's ability to fight off free radicals. To ascertain their beneficial effects in the treatment or prevention of cancer, additional research is required [2-5].

A number of substances, including green tea, the vitamins D and E, selenium, lycopene, soy, anti-inflammatory drugs, and 5 $\alpha$ -reductase inhibitors, have been shown in large-scale clinical studies to be useful in preventing prostate cancer. In smokers,  $\beta$ -carotene, N-acetylcysteine,  $\alpha$ -tocopherol, retinol, retinyl palmitate, or isotretinoin did not prevent cancer. The definition of novel chemoprevention pathways may be aided by ongoing experiments. Numerous studies have demonstrated the benefits of complementary and alternative medicine when used in conjunction with chemotherapy or radiation therapy. For patients with prostate cancer, complementary treatment may be a dependable and practical supporting approach. The majority of studies have indicated that nutraceuticals help prevent cancer, although more thorough research is required [6].

### Diabetes and nutraceuticals

Kind type 2 diabetes, which has a 95% incidence and is linked to obesity, is the most prevalent kind of the disease. Even though a variety of medications have been developed for the prevention and treatment of diabetes, the overall number of persons with the disease, which has many different causes, is rising internationally. Diabetes throws a significant financial strain on society in addition to placing a significant financial burden on each patient and their family.

In recent years, a variety of herbal dietary supplements and herbal medications have been shown to scientifically help type 2 diabetes mellitus in preclinical research; however, only a small number of these benefits have been demonstrated in well conducted randomized clinical trials. The most extensively researched isoflavone is found in soy, and it has been linked to a decreased incidence and death rate for type II diabetes, heart disease, osteoporosis, and several malignancies. Isoflavones, or phytoestrogens, are compounds that resemble human estrogen in structure and action. The blood glucose tolerance of people who are prone to diabetes may be reduced by omega-3 fatty acids. The heart may thus be particularly vulnerable to their depletion in diabetes since long chain n-3 fatty acids require insulin for production. In people with diabetes, n-3 fatty acid ethyl esters may be helpful.

In addition to being used as a long-term dietary supplement to prevent difficulties in diabetics, lipoic acid, an antioxidant, is also used to treat diabetic neuropathy. Psyllium-derived dietary fibers have been widely utilized as food additives, pharmacological supplements, and components in processed foods to help people lose weight, regulate their blood sugar levels when they have diabetes, and lower their cholesterol levels when they have hyperlipidemia. Numerous plant extracts, including those from *Teucrium pallium*, cinnamon, and bitter melon, have been demonstrated to either prevent or treatments diabetes [5-7].

### Eye disorders and nutraceuticals

Age-related macular degeneration (AMD) may be prevented or at least slowed with a healthy lifestyle and diet rich in antioxidant-rich foods including n-3 fatty acids, lutein, and zeaxanthin. The





Figure 6

antioxidant efficacy of nutraceuticals with high polyphenolic flavonoid concentration has been demonstrated. Green tea, Allium spp., Vitamins C and E, polyphenols, carotenoids (primarily lycopene and -carotene), and coenzyme Q10 are examples of herbs or herbal extracts that have antioxidant characteristics and are useful in treating AMD. Salmon trout, sea bream, and shrimp are some examples of marine organisms that naturally contain the carotenoid astaxanthin. It has a variety of vital biological properties, including the ability to preserve aquatic creatures' pigmentation, immunological response, and against the impacts of ultraviolet radiation and the oxidation process. It has a strong antioxidant effect as well. Strong eye protection is provided by astaxanthin, which also delays macular aging. Astaxanthin strengthens the immune system and guards against oxidative damage to the heart and the brain system, which can lead to disorders like Alzheimer's disease [7].

Several fruits and vegetables, such as sweet potatoes, carrots, squash, tomatoes, mangoes, maize, and leafy greens like kale and collards, contain lutein, a carotenoid. Using lutein and zeaxanthin, visual problems are treated. Egg yolks, corn, green vegetables and fruits including Brussel sprouts, cabbage, kale, broccoli, green beans, green peas, lettuce, kiwi, collard greens, spinach, and honeydew are food sources of zeaxanthin. Plants also contain lutein and zeaxanthin as mono- and diesters of fatty acids. The marigold flower (*Tagetes erect*), which contains around 86% of the carotenoids zeaxanthin and lutein by weight, is a novel source of these pigments [6,7].

### Immune system and nutraceuticals

Nutraceuticals provide preventive, health-promoting, and therapeutic effects against diverse pathological conditions, such

as diabetes, hypertension, arthritis, obesity, and allergy. Various nutraceutical compounds can modulate innate and adaptive immune responses.

Numerous nutraceuticals have been demonstrated to have important roles in immune function and a person's vulnerability to certain illnesses and disorders. Immunological boosters are a class of nutraceuticals that are beneficial for enhancing immunological performance. They consist of plants from the genus *Echinacea*, such as *Echinacea angustifolia*, *Echinacea pallida*, and *Echinacea purpurea*, as well as extracts from coneflowers. Particularly the coneflowers, which are native to the central United States, are utilized as a common herbal treatment there. Other members of the *Astragalus* genus, such as *Astragalus Mongolicus* and *Astragalus membranaceus*, are also powerful immune boosters. *Astragalus* promotes the growth and differentiation of lymphatic and bone marrow stem cells into functional immune cells. The majority of the time, phytoestrogens are advised for the prevention of numerous disorders linked to hormonal imbalance. The possible superiority of soy isoflavones over synthetic selective estrogen receptor modulators, which are presently used in hormone replacement treatment, is of particular interest. A notable example of a nutraceutical that stimulates or suppresses the immune system is morphine, as well as garlic.

Nutraceuticals and probiotics are now more widely used in clinical settings due to the impact of bacteria and herbal medications on the immune system and intestinal epithelial cell function. Children's infectious diarrhea and recurring infections brought on by *Clostridium difficile* are two illnesses that probiotics are useful in treating.

Antibiotics (living, viable microbial organisms) supplementation may enhance the harmony of pro- and anti-inflammatory cytokines and give lymphoid tissue with maturational signals. To keep a healthy balance between pathogenic and nonpathogenic bacteria, probiotics modify the gut microbiota. The use of these drugs to treat certain diseases has grown into the capacity for a very high index of safety, a decrease in the use of antibiotics, and the public's favorable impression of "alternative" or "natural" medicines. One or more lactic acid bacteria are present in the majority of probiotic formulations. The most often employed strains of this category are those of *Lactobacillus*, *Bifidobacterium* sp., and sporadically *Streptococcus* [8-10].

### Inflammation and nutraceuticals

Inflammation is the body's reaction to irritation or damage and is characterized by swelling, discomfort, redness, and heat.

Nutraceuticals such as ginger, soybean, unsaponifiable, glucosamine, chondroitin, and S-adenosylmethionine have had their effects on osteoarthritis put to the test. The variety of the trials and uneven outcomes, despite the fact that they are safe and well tolerated, impair the results [2,8,11,42,43]. The benefits of vitamins C and D as micronutrients have been demonstrated. A strong anti-inflammatory agent is cat's claw. The active ingredients in cat's claw, known as oxindole alkaloids, are thought to be responsible for the herb's effectiveness; however, water-soluble cat's claw extracts deficient in alkaloids do not exhibit potent antioxidant and anti-inflammatory properties. The certain-like deacetylase activity of resveratrol, which is found in the fruits of *Vaccinium myrtillus*, *Vaccinium angustifolium*, *Vaccinium ashes*, and *Vaccinium corymbosum*, is the strongest of any known phytochemical. Sirtuins are substances that prevent the cyclooxygenase-1 enzyme from working and can increase the lifetime of fruit flies and yeast. They have anti-fungal and anti-inflammatory properties.



Figure 7

The omega-3 and omega-6 series have a significant role on diseases by generating potent modulatory molecules for inflammatory responses, including prostaglandins, leukotrienes, and interleukins. Gamma linolenic acid (GLA) is produced in the body from linoleic acid, an essential fatty acid of omega-6 series. GLA is a nutraceutical used to treat autoimmune disorders and inflammation-related issues. Nuts, green leafy vegetables, and vegetable oils including seed oil, borage oil, *Oenothera* Bennis oil, blackcurrant oil, and hemp seed oil all contain trace levels of preformed GLA. GLA undergoes oxidative metabolism to become dihomogamma linolenic acid, which is then processed by the enzymes lipoxygenase and cyclooxygenase to create anti-inflammatory eicosanoids [10].

There are also herbal nutraceuticals on the market with anti-inflammatory properties. A potent anti-inflammatory substance is gentianine, which is found in gentian root. Bromelain, a proteolytic enzyme, has anti-inflammatory properties and may be found in stinging nettle, pineapple, turmeric, and tea extracts. Osteoarthritis is a painful joint condition that affects a large portion of the population. The total cost of arthritis in 2004 was estimated to be at 86 billion dollars. Joint pain from any joint problems may cause patients to become less active, which can lead to an energy imbalance and weight gain. Increased weight can make existing issues worse by putting more strain on the joints. Many people take glucosamine and chondroitin sulfate to relieve osteoarthritis.

symptoms. These dietary supplements appear to control NO and PGE2 generation and gene expression, which is a reasonable explanation for their anti-inflammatory effects [10].

### Methods of preparation of Nutraceutical

The statistical techniques used in the first edition to account for significant advancements in this area. It contains more than 85% fresh or amended material while providing current and reliable information with contributions from national and international specialists. Three completely new chapters on the developing topic of polyphenol analysis have been added to the book, reflecting the increased interest that the scientific and general public have in antioxidants.

The publication, which is broken up into ten parts, compiles up-to-date, comprehensive studies of the analytical techniques for phytoestrogens, fatty acids and conjugated linoleic acid, flavonoids, anthocyanins, carotenoids and provitamin A, chlorophylls, water soluble vitamins, amino acids, and carbohydrates. Specialty information is also included, such as how vineyard leftovers are used and how phenolic chemicals are produced in oil.

The second edition of this hugely popular book, which has been rigorously evaluated by a distinguished panel of scientific peers, is a priceless resource for laboratories working in the food, dietary supplement, and pharmaceutical industries [11].

- **Identify the nutraceutical ingredients:** Choose the exact components you wish to include in your nutraceutical product. Vitamins, minerals, herbs, amino acids, and other bioactive substances could be among them.
- **Formulation:** Create a formula that specifies the quantity and proportions of each ingredient. Consider factors such as the desired health benefits, bioavailability, and any potential interactions between ingredients.
- **Ingredient Sourcing:** Procure high-quality raw materials from reputable suppliers. Ensure that the ingredients meet quality and purity standards.
- **Manufacturing Process:** Nutraceutical products can be made into liquids, powders, capsules, pills, or functional foods, among other forms. The form selected will determine how the manufacturing process is carried out.
- **Quality Control:** To ensure that the materials and the finished product are pure and potent, use strict quality control

procedures. Testing for pollutants, heavy metals, and label claims compliance may be necessary for this.

- **Regulatory Compliance:** Make sure your nutraceutical product conforms to all applicable national and international laws. This might entail making sure proper labeling and marketing are done as well as securing the required licenses.
- **Packaging:** The nutraceutical product should be packaged to preserve stability and guard against contamination. It is imperative that products be properly labeled with directions and details regarding their advantages.
- **Storage:** Store the finished nutraceuticals in controlled conditions to maintain their shelf life and efficacy.
- **Distribution:** Make arrangements for your nutraceutical product to be sold and distributed via reputable channels, such internet retailers, pharmacies, and health shops.
- **Marketing:** Create marketing plans that highlight the nutraceutical product's unique selling proposition and health advantages [10-13].

### Advantages of nutraceuticals

There are countless advantages to using supplements, and new applications are being researched daily. Nutraceuticals are medicines that may cure a wide range of illnesses and afflictions, from physical to mental health. Choose dietary supplements from reputable manufacturers in India to get the advantages outlined below: -

- Boost energy
- Improve overall health
- Improve Eye Health
- Treat Inflammation
- Relieve Anxiety
- Prevent chronic diseases
- Support and regulate bodily functions
- Increase life expectancy
- Improves sleeping pattern [14]

### Boost energy

Nutraceuticals, of which there are many varieties, do, in fact, help us increase our energy levels in the same way as all the vitamins, especially those of the B group. The vitamin D group also aids in maintaining your level of activity. Since B-12 is mostly found in milk and meat, which are not included in their diets, vegans and vegetarians need to make an effort to improve their intake of the vitamin [14,15].

### Improve overall health

Nutraceuticals help to enhance our overall health. As was previously said, a balanced diet is beneficial to our health. It gives

our bodies more nutrients and supports the enhancement of both physical and emotional well-being [16].



Figure 8

### Improve eye health

Patients with eye disorders and conditions such as age-related glaucoma, macular degeneration, and visual disorders can benefit from certain nutraceuticals.

Nutraceuticals such as zeaxanthin, vitamin C, lutein, and vitamin E reduce the danger of cataracts. Essential fatty acids like omega-3s are crucial for visual development and retinal function [15-17].

### Treat inflammation

Because of the phytochemicals they contain, nutraceuticals are showing encouraging results in the management and prevention of inflammation. They have the potential to reduce oxidative stress in autoimmune disorders, cancer, rheumatoid arthritis, osteoarthritis, and asthma, among other chronic inflammatory illnesses

### Relieve anxiety

A few vitamins, such as vitamin D, are crucial in determining our mood. There is little doubt that vitamin B raises the risk of anxiety and depression. Riboflavin, often known as vitamin B2, is a crucial nutrient that is largely present in meat. Vegetarians can thus take vitamins for it.

### Prevent chronic diseases

Nutraceuticals play a vital role in preventing the onset of chronic diseases and reducing the complications involved. Evidence

suggests they are used to prevent and treat cardiovascular diseases, cancer, diabetes, obesity, and inflammatory-based diseases.

### Support and regulate bodily functions

Nutraceuticals can additionally play a significant role in the body's biological processes and immune status.

These include:

- Protection of mitochondrial integrity
- Antioxidant defence
- Gene expression
- Cell proliferation

Nutraceuticals can help our bodies thrive and prevent disease by playing a role in these biological processes [18-20].

### Increase life expectancy

- Preventive treatment, such as nutraceuticals, has greatly extended life expectancy. Early detection of illnesses facilitates prompt treatment and recovery, either before they worsen or before they impact the patient. Furthermore, therapy might not even be necessary.
- Furthermore, it has been demonstrated that using nutraceuticals might delay the aging process, extending your life expectancy.

- Apart from these health advantages, new research has shown that herbal nutraceuticals may be beneficial in treating oxidative stress disorders such as Alzheimer's, obesity, diabetes, allergies, cancer, Parkinson's disease, and cardiovascular disorders [21,22].

### Improves sleeping pattern

It's also thought that nutraceuticals help with sleeping habits. A good night's sleep may be helped by a variety of natural nutraceuticals, such as Valeria roots and mineral supplements like calcium. Additionally, it facilitates better sleep routines for us [23-25].



Figure 9

### Side effects of nutraceuticals

A few components included in certain supplements have the potential to significantly affect our bodies. Excessive intake of anything, including multivitamins, is bad for the health [2,33,41,44]. Numerous goods that have been supplemented with vitamins and minerals are readily accessible in stores. There may be issues if you use over-the-counter nutraceuticals in your diet in addition to fortified foods or continuous prescriptions. Nutraceuticals may have the following adverse effects: [27-29].

- Headache
- Dizziness
- Elevated blood pressure
- Digestion problems

### Headache

Headache is linked to vitamin A excess. Headache and nausea can also be brought on by a single high dosage. Depending on the individual, it might be minor to severe. It is crucial to follow the doctor's advice and take the vitamins as prescribed.

### Dizziness

A high level of vitamin A can also result in birth defects and vertigo. To prevent this adverse effect, you should consume the

correct meals and take nutraceuticals in the recommended dosage. It is your responsibility as a patient to make sure you get the proper dosage from your doctor before taking any supplements [38-40].

### Elevated blood pressure

Some minerals also have a tendency to raise blood pressure, which is bad for humans. For someone with heart problems, it may prove to be lethal. Dietary supplements are taken by a sizable segment of the general public. It is important for medical professionals to be aware of this, therefore they should ask patients about their supplement usage [30-33].

### Digestion problems

Constipation, loose motion, and vomiting are just a few of the digestive issues that can result from taking some nutrients in excess. Constipation and high vitamin C intake are frequently linked [34,35].

### Conclusions

The market for nutraceuticals has proven to improve the health but it is not necessary that these products are safe for everyone. Supplements with active ingredients can also cause adverse





Figure 10

effects in selected individuals, just like drugs. Before advising a regimen involving these substances, physicians and users must consult updated literature. You should also inform him about the pre existing allergies. You should take care that you inform your doctor about any supplements you have been taking, because some nutrients can interfere with the working of anaesthesia [2,36,38].

Nutraceuticals might be defined as substances that have physiological benefits or provide protection against chronic diseases. Nutraceuticals may be used to improve health, delay the aging process, prevent chronic diseases, increase life expectancy, or support the structure or function of the body [44,45].

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