



## Review on Nutraceutical

<sup>1</sup>Jadhav P.R., <sup>2</sup>Lasure A.B., <sup>3</sup>Dr.Bawage S.B.

<sup>1,2</sup>Department of Pharmaceutical Analysis, Latur College of Pharmacy Hasegaon, Tq. Ausa, Dist. Latur, Maharashtra, India 413512

<sup>3</sup>Department of Pharmacognosy, Latur College of Pharmacy Hasegaon, Tq. Ausa, Dist. Latur, Maharashtra, India 413512

### 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. 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 nutraceuticals 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 weight, osteoporosis, diabetes, arthritis, and constipation. Nutraceuticals have also found considerable trust in treating headache and migraine resulting from stress. Nutraceuticals are food supplement and have nutritional value. The present food will not provide any nutritional value rather it adversely effect the body. In this chapter we made an attempt to classify all types of nutraceuticals With their examples followed by their application in the treatment of various disorders.

Keywords: Lifestyles; Life-threatening diseases; Disease – treatment; Nutraceuticals; Health benefits; Therapeutic Outcomes; Nutraceuticals products.

### INTRODUCTION: -

Since ancient times, conventional food and herbal extracts have been recognized as a fundamental part of the holistic approach to achieve complete wellness and health, especially in the ancient ayurvedic system in India, in addition to traditional Chinese, Roman, and Greek medicine. The Greek physician Hippocrates adopted the philosophy of food as medicine, with his renowned quote “Let food be the medicine and medicine be the food” [1].

Throughout human history, many natural sources were utilized for their healing and strength restoring effects upon consumption, such as cinnamon, saffron, honey, garlic, ginger, pomegranate, mint and many more [2].

Nutraceuticals are known as bioactive substances that are present in common food or botanical-based sources that can be delivered in the form of dietary supplements or functional food, supplying beneficial effects in addition to the nutritional essential components [3].



Nutraceuticals comprise a wide range of bioactive derivatives accumulated inedible sources including antioxidants, phytochemicals, fatty acids, amino acids, and probiotics. With either established previously or potential effects, nutraceuticals are well-known for their role of being involved in disease treatment and prevention, anti-aging properties and malignancy prevention. Consuming probiotics is encouraged due to its significant role in the treatment and prevention of gastroenterological diseases. Garlic, for example, has-been suggested as a complementary therapy for high blood pressure and cholesterol [4].

As we approach towards the 21st century nutritional science has an essential factor by all manufacturers and consumer placing for more emphasis on the benefits to be derived from food. Designing a proper food maintain proper health has gained recognition and acceptance world wide. Due to this the food industries in many countries are modifying their products as a response to consumer demands. In recent years many of the natural products from India are gaining popularity in USA and Europe has nutraceutical.

Nutraceutical or functional food have been found to be associated with the prevention and or treatment of many chronic diseases and ailment such as cancer, diabetes, heart disease, hypertension, arthritis, osteoporosis etc. Statistical data indicates that 35 % of all cancer are related to the food that we eat and also associated with certain dietary habits. It is certainly makes the old saying “you are what you eat “. More relevant in context of the health benefits of the food. As the importance of dietary change to optimize health in gaining recognition and acceptance, the food industry is responding to consumer demands for a more healthful nutrient rich food products [2].

American association of nutritional chemist mentioned nutraceuticals as a product that has been isolated or purified from food and generally solved in medicinal forms not usually associated with Food. When food is been cooked or prepared using “scientific intelligence with or without knowledge of how or why it is being used, the food is called functional food. Functional food are ordinary foods that have components, ingredients, incorporated in them to give them a specific medicinal or physiological benefits other than a purely nutritional effects [3].

## HISTORY:-

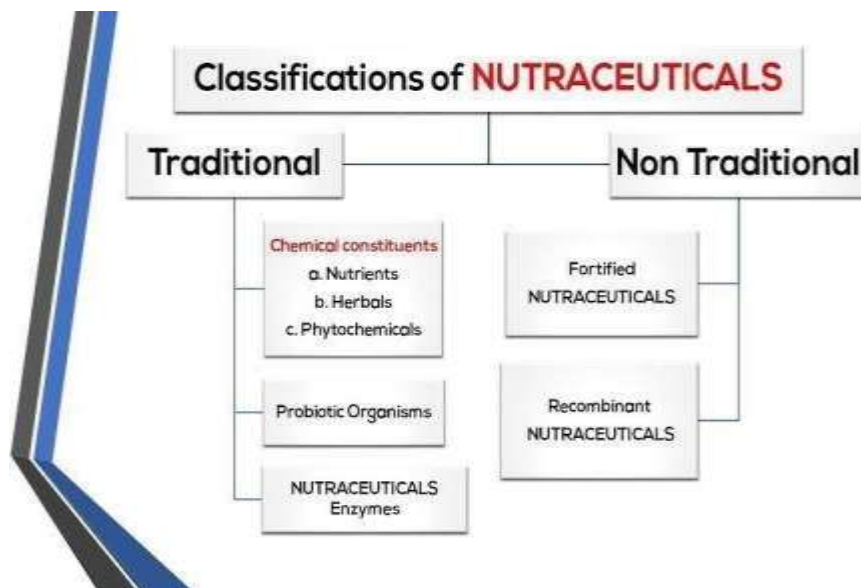
The term nutraceutical was coined from “nutrition”and pharmaceutical in 1989 by Stephen Defelice MD, founder and chairman of the foundation for innovation in medicine cranford, New Jersey according Defelice nutraceutical can be defined as a food or part of food that provides medical or health benefits including the prevention and or treatment of a disease [5]. The modern nutraceutical market began to develop in Japan during the 1980s. In contrast to the natural herbs and spices used as folk medicine for centuries throughout Asia, the nutraceutical industry has grown alongside the expansion and exploration of modern technology.

One example is a traditional Japanese drug called ‘Kampo’ which is derived from many medicinal plants. This test was done to investigate the pharmacological effects of functional foods and Kampo medicine. The experiments were performed using disease models. When extracts were taken from Kampo and functional foods and were administered there was a lowered pro-inflammatory rate. In India, nutraceuticals are seen as the food components. Made from herbal or botanical raw materials, which are used for preventing or Treating different types of chronic and acute maladies [6].

## CLASSIFICATION:-

Based on Source, Nature and Application

- Nutraceuticals have been classified based on their application into traditional, nonTraditional, fortified, recombinant, phytochemical, herbal, functional foods, dietary supplements, probiotics and prebiotics. Nutraceuticals with their different classes have a variety of applications and uses depending on their nature. The following subsections will discuss different nutraceutical classes [7][8].



### A. Traditional Nutraceuticals and Product-

#### 1. Functional Food:-

Functional foods are foods with benefits in health improvement and disease prevention other than only providing nutrients [9]. These foods have ingredients that enhance antioxidant and anti-inflammatory activities, which are functional to prevent diseases such as type-2 diabetes. These foods are made available for daily consumption for a specific population with a similar quality of other traditional foods in the market. Examples of these functional foods are rice, wheat, kidney beans, soybeans, lentils, chocolate, citrus fruits, nuts, and fermented milk [10].



Rice is the first staple food consumed by the majority of populations; its nutritional value is as a source of carbohydrates, containing low levels of fat, salt and sugar, because all types of rice are gluten free and contain resistant starch that helps in the growth of healthy bowel bacteria. Traditional rice varieties in India represent a great origin of minerals and vitamins such as niacin, thiamine, iron, riboflavin, vitamin D, and calcium; in addition, they hold higher fiber and lower amounts of sugar [11].

Wheat is the second staple food consumed across the world: wholegrain wheat is made up of three layers which are the bran, the endosperm, and the germ; whole-grain wheat can be processed to produce wheat bran and wheat germ. Wheat bran represents the most beneficial part of wholegrain wheat due to its fiber content which is believed to play an important role in improving gastrointestinal health. Additionally, carrots and broccoli are examples of functional foods due to their active components such as sulforaphane, and lycopene [12].

Although functional foods have various health benefits due to several active ingredients, more studies with scientific evidence are needed to provide these products with health claims in their labels. Some of the active ingredients in functional foods are carotenoids, collagen hydrolysate, dietary fibers, and fatty acids that possess various health benefits such as anti-inflammatory activity and enhance body immunity [13].

## 2. Carotenoids: -

Carotenoids are natural compounds and sources of pigmentation that accumulate abundantly in plants, fruits and vegetables, and algae. A wide range of carotenoid derivatives are found in the human diet, including  $\alpha$ -carotene,  $\beta$ -carotene,  $\beta$ -cryptoxanthin, Lutein, lycopene, zeaxanthin, crocetin, fucoxanthin and astaxanthin. They are renowned for their wide spectrum of beneficial effects to health, including antioxidant and anti-inflammatory properties [14].

In addition, carotenoids exert health benefits over human vision, cognitive functions, heart functions, cancer prevention, immune prevention. A study revealed the anti-inflammatory activity of two forms of carotenoids, astaxanthin and  $\beta$ -carotene, where both were found to be able to suppress the inflammation induced by *Helicobacter pylori* by inhibiting the production of reactive oxygen species and diminishing the level of inflammatory mediators being expressed [15].

Carotenoids are also known for their antioxidant activity, which is credited to their chemical structure consisting of a series of conjugated C=C bonds. This structure provides carotenoids with the ability to interact with free radicals and act as effective antioxidant agents. Although carotenoids exhibit radical scavenging activity, which aids in diseases associated with increased oxidative stress, they also exhibit cytogenetic activity.

Carotenoids are also important components of the dark brown pigment melanin, which is found in hair, skin, and eyes. Melanin absorbs high-energy light and protects these organs from intracellular damage. [16].

### Active ingredients of carotenoids with their examples :

Functional components	Source	Potential Benefits
Alpha carotene	Pumpkin, Beets.	
Beta carotene	Carrots, Fruits, Vegetables	Neutralize free radicals, which damage to cells
Lutein	Green vegetables	Reduce the risk of macular degeneration
Lycopene	Tomato products	Reduce the risk of prostate cancer

## 3. Collagen Hydrolysate: -

Collagen is a primary protein in mammals that can be extracted from bovine connective tissues such as skin, bone, cartilage, and tendons. Collagen extraction is obtained by subjecting it to sources of hot water; this provides a partially hydrolyzed product called gelatin. In order to completely hydrolyze gelatin, a process of enzymatic hydrolysis takes place to produce collagen hydrolysates. Collagen hydrolysates provide various beneficial effects such as antioxidant, antiaging, antitumor, anti-inflammatory and anti-obesity effects [17].

A study has shown the immune-boosting effects of collagen hydrolysates that Have been extracted from domestic yak (*Bos grunniens*) bone and its potential in improving The adaptive and innate immunity in mice. Furthermore, a study conducted to investigate the health benefits of collagen hydrolysate in females diagnosed with photoaged skin showed a remarkable improvement in skin hydration, wrinkling, and elasticity [18].

#### 4. Dietary Fibers:-

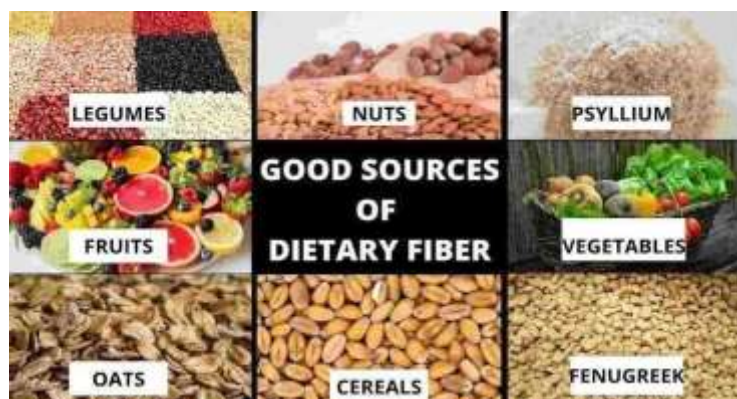
Fibers are plant-based non-starch carbohydrates that are poorly digestible and provide various health benefits, as mentioned in many studies, and can be found naturally in a wide variety of foods including vegetables, fruits, wheat bran, oats and ispaghula husk. Dietary fibers can be classified into more than two categories on the basis of their solubility In hot water, waterretaining capacity, and viscosity into soluble and insoluble fibers. Soluble fibers comprise viscous components such as  $\beta$ -glucans, fructans, and non-viscous fibers such as hemicellulose

[19].

Insoluble fibers tend to lose the characteristic of viscosity and they are insoluble in water; insoluble fibers tend to accelerate gastric emptying time which helps in relieving constipation, while soluble fibers tend to delay gastric emptying time. High fiber diets are found to have a positive impact on inflammatory bowel disease , because they can lessen the risk of Crohn's disease and ulcerative colitis [20].

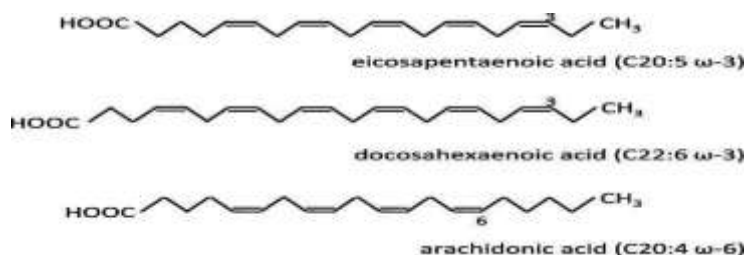
Following table indicates the source of dietary fibers :-

Sr. No	Soluble dietary fibers	Insoluble dietary fibers
1	Oat-meal	Whole-wheat
2	Oat-bran	Wheat-bran
3	Nuts	Carrots
4	Seeds	Cucumbers
5	Legumes	Barley
6	Blue-berries	Brown rice
7	Black-berries	Whole-grains



#### 5. Fatty Acids:-

Fatty acids are the component of oils and fats that are present in animal fats, fish oil supplements, seeds, olive oil, and coconuts. Aside from their role in energy storage, they have been documented for their ability to act as an anti-inflammatory and immunomodulatory component in various studies. In one study, the omega-3 polyunsaturated fatty acids (PUFAs) administered at a dose of  $>2.7$  g/day for at least three months to patients with rheumatoid arthritis (RA) showed reductions in the severity of rheumatoid arthritis symptoms [21]. Polyunsaturated refers to the fats chemical structure. PUFAs contain two or more double carbon bonds within this chain. There are several types of PUFAs, primarily omega-3 and omega-6. Omega-3 fatty acids are essential for the functioning of the body cells. They help with energy production and play important roles in the heart, lungs, blood vessels, and immune system. These omega-3s are present in, salmons, some eggs, fish oil, algal oil. PUFAs benefits in preventing heart disease, pregnancy and fetal development and brain function [22].



### 6. Phytochemicals:-

Phytochemicals are beneficial, concentrated or purified chemicals from plants that have active components for biochemical and metabolic reaction in human such as lutein and lycopene. Phytochemicals can help in maintaining chemical balance of the brain thus providing neuroprotective activity. Additionally high consumption of vegetables and fruits that contain phytochemicals can reduce the risk of cancers, cardiac and neurodegenerative disorders [23].

Lycopene	Kale, broccoli, tomatoes, red pepper, watermelon
Lutein	Collard greens, spinach, Brussels sprouts, artichokes
Resveratrol	Red wine, peanuts, grapes
Anthocyanins	Blueberries, blackberries, plums, cranberries, raspberries
Isoflavones	Soybeans

### 7. Herbs:-

Herbs are plants that have no woody tissue and can be processed in many ways depending on each individual preference. Herbs can be dried; however, the drying process leads to a reduction in the effectiveness of herb [24].

Herbs that are rich in antioxidant have been used in flavouring and aroma for more than two thousand years. Garlic extracts, ginger root, and aloe gel are herbs that have health benefits such as reducing cholesterol, wound healing, and anti-ulcer and antioxidant activities. The common herbals used as nutraceutical :-

Biological Name	CommonName	Part of thePlant	Bioactive Components	Benefits to Health
Zingiber officinale (Zingiberaceae)	Ginger	Rhizomes	Zingiberene and gingerol	Hyperglycemia, bronchitis and throat ache
Allium sativum (Liliaceae)	Garlic	Bulbs	Alliin and Allicin	Antibacterial, antiinflammatory, antifungal
Aloe Barbadensis Mill. (Liliaceae)	Aloe vera	Gel	Aloins and aloesin	Antiinflammatory, emollient, wound healing properties
Curcuma longa (Zingiberaceae)	Turmeric	Rhizome	Curcumin	Anticancer, antiseptic, antiarthritic

### 8. Probiotics:-

Probiotics are microbes that are beneficial to health and used in food, especially in milk products, which are important to promote health by providing immunologic and digestive properties. In addition, these live microbes can improve microbial intestinal balance. Lactobacillus with its different species is the most common probiotic used that will survive in the human gut. Currently, Bifidobacterium spp., and Streptococcus are also used as probiotic strains. They are friendly bacteria that promote healthy Digestion and absorption of nutrients [25].

They act to crowd out pathogens such as yeasts, Other bacteria and viruses that may otherwise cause Disease and develop a mutually advantageous symbiosis with the human gastrointestinal tract. They have an antimicrobial effect through modifying the microflora, preventing adhesion of pathogens to the intestinal epithelium, competing for nutrients necessary for pathogen survival, producing an antitoxin effect and reversing some of the consequences of infection on the intestinal epithelium, such as secretory changes and neutrophil migration.

Probiotics can cure lactose intolerance by the production of the specific enzyme (B- Galactosidase) that can hydrolyse the offending lactose into its component sugars [26].



**9. Prebiotics:-**

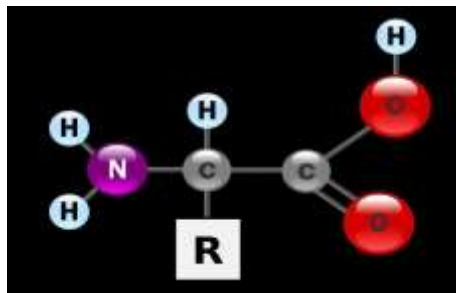
Prebiotics are ingredients consisting of short chain carbohydrates that improve the probiotics activity. These prebiotics are literally fertilizing agents for probiotics that are not affected by gastric pH and stomach acid. Prebiotics are non-digestible ingredients that promote the growth of



productive microorganism and affect the composition and activity of gut microbiota Fructooligosaccharides and inulin are examples of prebiotics used in functional foods to improve gastric health and pH [27].

PROBIOTICS	PREBIOTICS
Live microorganisms	Non-living, non-digestible by human ingredient (carbohydrates)
Bacteria or yeast	Serve as food for friendly bacteria within the gut
Available as food supplements and in certain foods containing live cultures such as yoghurt, kefir, aged cheese, kombucha, sauerkraut, or miso	Available as food supplements and naturally occurring in certain foods, such as chicory root, Jerusalem artichoke, onion, leek, garlic, raw oats, or banana
Probiotics may support the treatment of diarrhea, irritable bowel syndrome, certain intestinal infections, prevent or reduce the severity of colds and flu or aid digestion	Prebiotics aid digestion and may support the treatment of several chronic digestive disorders or inflammatory bowel disease

**10. Proteins: -**



(Amino acids are the building blocks of protein.)

Protein are essential nutrients for the human body. They are one of the building blocks of Body tissue and can also serve as a fuel source. As a fuel, proteins provide as much energy . The most important aspect and defining characteristic of protein from a nutritional Standpoint is its amino acid composition.

Proteins are polymer chains made of amino acids linked together by peptide bonds. During Human digestion, proteins are broken down in the stomach to smaller polypeptide chains via hydrochloric acid and protease actions. This is crucial for the absorption of the essential amino acids that cannot be biosynthesized by the body. There are nine essential amino acids which humans must obtain from their diet in order to prevent protein–energy malnutrition and resulting death. They are phenylalanine, valine, Threonine, tryptophan, methionine, leucine, isoleucine, lysine, and histidine .There has been debate as to whether there are 8 or 9 essential amino acids. The consensus seems to lean towards 9 since histidine is not synthesized in adults [28]. There are five amino acids which humans are able to synthesize in the body. These five are alanine, aspartic acid, asparagine, Glutamic acid and serine. There are six conditionally essential amino acids whose synthesis can be limited under special pathophysiological conditions, such as prematurity in the infant or Individuals in severe catabolic distress. These six are arginine, cysteine, glycine, glutamine, Proline and tyrosine. Dietary sources of protein include meats, dairy products, fish, eggs, grains , legumes, nuts and edible insects [29].



(Plant sources of protein)

Protein deficiency and malnutrition (PEM) can lead to variety of ailments including Intellectual disability and kwashiorkor. Symptoms of kwashiorkor include apathy, diarrhea, inactivity, failure to grow, flaky skin, fatty liver, and edema of the belly and legs. This edema is explained by the action of lipooxygenase on arachidonic acid to form leukotrienes the normal functioning of proteins in fluid balance and lipoprotein transport [30].

Dietary Requirements of protein for female was 69.8 gram/day and for male 98.3 grams/day.

### 11. Dietary Supplements:-

Although not entirely a traditional approach, dietary supplements are products that can be taken as a dietary ingredient by individuals to maintain and improve health and not to cure diseases. These supplements are found in various forms, such as tablets, liquid-based, capsules, powder, and concentrated with specific dose [31].

Omega-3, vitamins A, B, C, D, and E, iron, folic acid, minerals, calcium, magnesium, etc., are some examples of dietary supplements that can either be taken by an individual with or without prescription.

Moreover, these supplements can be consumed to ensure that a diet meets the sufficient nutrient requirements for the body and to prevent any deficiencies. At the beginning of the 20th century, food extracts that contain important nutrients such as vitamin C, and B were shown to be helpful to prevent some serious conditions such as scurvy, pellagra, and beriberi [32].

#### Calcium: -

Calcium, the most abundant mineral in the body, is found in some foods, added to others, present in some medicines (such as antacids), and available as a dietary supplement [33]. Calcium makes up much of the structure of bones and teeth and allows normal bodily movement by keeping tissue rigid, strong, and flexible. The small ionized pool of calcium in the circulatory system, extracellular fluid, and various tissues mediates blood vessel contraction and dilation, muscle function, blood clotting, nerve transmission and hormonal secretion. Sources of calcium include Milk, yogurt, and cheese are rich natural sources of calcium. Calcium is an important element in the treatment of decalcification of bone. Calcium deficiency causes osteoporosis most common in female. Prepuberty is the best time to begin supplementing the diet with calcium rich minerals significantly reduce the risk for fracture [34].

#### Zinc: -

Zinc is one of the most important trace minerals. Zinc support the bodies overall antioxidant system by scavenging free radicals. Zinc is an essential mineral that is naturally present in some foods, added to others, and available as a dietary supplement. Zinc is also found in many cold lozenges and some over-the-counter drugs sold as cold remedies [35].

Zinc is involved in numerous aspects of cellular metabolism. It is required for the catalytic activity of approximately 100 enzymes and it plays a role in immune function, protein synthesis, wound healing, DNA synthesis and cell division. Zinc also supports normal growth and development during pregnancy, childhood and adolescence and is required for proper sense of taste and smell. A daily intake of zinc is required to maintain a steady state because the body has no specialized zinc storage system [36].

Daily intake for adult male about 11mg/day and for female 8mg/day.

#### Vitamin B6: -

This vitamin is needed to form red blood cells. It is found in potatoes, bananas, chicken and fortified cereals Vitamin B6 is a water-soluble vitamin that is naturally present in many foods, added to others, and available as a dietary supplement. Vitamin B6 also plays a role in cognitive development through the biosynthesis of neurotransmitters and in maintaining normal levels of homocysteine, an amino acid in the blood. Vitamin B6 is involved in gluconeogenesis and glycogenolysis, immune function (for example, it promotes lymphocyte and interleukin-2 production), and haemoglobin formation [37].

Recommended Dietary allowances for Vitamin B6 to adult male 1.3mg/day and for pregnant women is 1.9mg/day.

**Vitamin B12: -**

Also known as cobalamin, is a water soluble vitamins involved in metabolism. It is a cofactor in DNA synthesis, in both fatty acid and amino acid metabolism. It is important in the normal functioning of the nervous system via it's role in the synthesis of myelin. Major source of vitamin B12 include Bacteria and archaea in the gut flora in humans and other animals, or by animal derived foods source from beef, shellfish and crab meat plant and algae sources of vitamin B12 include fermented plant food such as tempeh and seaweed derived foods such as nori and laver. Or by supplement.



(Fig. Dietary supplements, such as vitamin B12 supplement.)

The amount of vitamins B12 you need each day depends on your age for adults 2.4 mcg And for pregnant women 2.8 mcg.

Name of vitamin	Source	Deficiency diseases
Vitamin A1 Vitamin A2	Fish liver oil, cheese, spinach, pumpkin, papaya	Night blindness Keratomalacia Xerophthalmia
Vitamin D	Fish liver oil, wheat germ oil, egg yolk, milk, butter	Rickets in children Osteomalacia in adults
Vitamin E	Wheat germ oil, cotton seed oil, peanut oil	Sterility, ageing of skin, degenerative changes in muscle
Vitamin k	Cabbage, cauliflower, tomatoes, alfalfa	Haemorrhagic condition
Vitamin B1 Vitamin B2	Cereals, pulses, nuts and yeast	Beriberi, cheilosis, corneal opacity
Vitamin B3 (panthotemico)	Liver, meat and yeast	Chick dermatitis
Vitamin B5 (folic acid and nicotinic acid) Pyridoxine (B6)	Rice polishing, yeast, egg, milk	Mental confusion, anemia, nausea, glossitis.

**B. Non-Conventional Nutraceutical: -**

Non-traditional nutraceuticals, as a non-conventional approach, are artificially synthesized foods or food products. The application of biotechnology or agriculture breeding is used to add nutrient ingredients for the enhancement of food properties and human health. Based on the processing method, non-traditional nutraceuticals may be differentiated into fortified and recombinant nutraceuticals. Rice enriched with  $\beta$ -carotene, and cereals infused with vitamins and minerals are some examples of this class of nutraceuticals which contain provitamin A that can boost antioxidant activity [38].

**1. Fortified Nutraceuticals:-**

Fortified nutraceuticals such as orange juice with calcium added, or milk with cholecalciferol vitamin are foods that contain additional micronutrients or vitamins added to them to improve their value . These foods supply the body with important nutrients that can prevent anemia and improve health . For example, if calcium is added to specific food such as orange juice, the orange juice can enhance glycemic control [39].





## 2. Recombinant Nutraceuticals:-

Recombinant nutraceuticals are foods that are produced by both genetic recombination and biotechnology. This type of foods and crops are genetically modified to develop products that contain recombinant compounds and proteins that would be make them more beneficial to health

. Iron rice, golden rice, maize, golden mustard, multivitamin corn, and gold kiwifruit are examples of these nutraceuticals. Gold kiwifruit contains a recombinant gene that increases ascorbic acid level, carotenoids and lutein to enhance immune function. Additionally it is considered a source of potassium and fiber [40].

## Nutraceutical In Therapeutic :-

Nutraceutical products provide several pharmacological benefits like anti aging, protection against some chronic diseases, neurodegenerative disorders, metabolic disorders like diabetes, diseases like cancer, protein deficiency, ophthalmic complication, allergic problems. Which shows contribution of nutraceutical for management of diverse clinical conditions. A systematic classification on the basis of therapeutically important compounds of the nutraceuticals products responsible for the specific health benefit can be done as given below [41].



## Nutraceutical in Allergic Disorders:-

Allergy is a common disorder due to the hypersensitivity in human immune system. The clinical management is complex as most of the allergy causes are either unknown or difficult to trace. Allergy produces several effects in the body ranging from irritation to some fatal ones like acute respiratory distress. Allergic reaction is associated with haematological changes like enhancement of white blood cell and basophil count. Quercetin is a plant bioactive often used in nutraceutical for management of allergy due to its effects on low density lipoprotein [42].

## Nutraceutical in Cardiovascular Disease

Cardiovascular problems top the list of global mortality causes according to World Health Organization. This disease present itself in different forms like Cardiac failure, vesicular blockage, hypertension, stroke etc. and any of them result in death or warrant immediate surgical intervention like angioplasty and bypass surgery. But at least 50% cardio vascular disease can be prevented with timely precautions. Vitamins, antioxidant, omega-3 fatty acids, dietary fibers and minerals are the formulated as nutraceutical supported by physical exercise is recommended for cardiovascular disease management [43].

Flavonoid compounds abundantly found in vegetables and fruits are often designed as nutraceuticals for Cardiovascular problems. These plant bioactive block angiotensin converting enzyme and also prevent the platelet aggregation by blocking the cyclo oxygenase enzyme. Other substance like melatonin, serotonin, dietary indole amines, tannis etc are explored as nutraceuticals for minimizing cardiovascular risk. Omega-3 fatty acids found in fish lower the lipid and bad cholesterol levels so are used as nutraceuticals for treatment of cardiac arrhythmia. These products do not associate any residual effect.

## Nutraceuticals used in Cancer Therapy

Complexity in Cancer treatment today is mainly due to side effects of existing therapeutics and emergence of drug resistance. Cancer treatment till date mostly revolves round chemotherapy, radiation therapy and surgery. But a healthy life style with an antioxidant rich diet can be the best precautionary measure against cancer [44].

Recent research has shown that carotenoids like lycopene has reported potency in different cancers and so is an essential component of many nutraceuticals formulation. Nutraceuticals of plant extracts rich in biochanin, isoflavones, tannis and plant biocartives like curcumin, garlic acid, caffic acid remarkable potency against diverse cancer.

---

### Nutraceuticals in Management of Diabetes

Diabetes is a common metabolic disease and is one of the top ten mortality cause as per World Health Organization. In most of the cases it is related with obesity. More than 50% of global population are suffering from diabetes mainly type 2 (non-Insulin dependent mellitus) due to lifestyle changes . Available anti-diabetic medicines suffer from diverse adverse effects so there is huge demand for alternatives in this area. Lipoic acid and some dietary fibers like psyllium is incorporated in nutraceuticals to mitigate diabetic neuropathy, hyperlipidemia and control of blood sugar level [45].

---

### Nutraceuticals in Ophthalmic Disorders

Age related Macular Degeneration may lead to fatal effects like blindness which can be prevented by the use of vitamins and other components like lutein, n-3 fatty acid and zeaxanthin. Apart from this certain polyphenolic Flavonoid, carotenoids are strong antioxidant can prevent the age related macular degeneration. Astaxanthin a carotenoid found in sea animals like from shrimps, salmons and sea bream has potent activity in Ophthalmic problems. It finds from the marine [46].

---

### Single Cell Protein (SCP):-

The mass production of bioprotein from the single-cell organism like bacteria or fungi termed as microbial biomass or single cell protein (SCP). Sacchromyces, cerevisiae were first established for the production of single cell proteins. The biomass were utilized in the forms of soups and sausages. Single cell proteins has more nutritive value than the normal living cells. An ideal biomass consist of the components such as carbohydrates, proteins, vitamins, lipids and trace amount of mineral and salts.

---

### Spirulina :-

Spirulina plankton is a blue green vegetable micro algae is a good example of single cell protein. In India, research work is in progress at Central food Technology Research Institute, Mysore on spirulina to develop some single cell proteins as a supplement to food. Spirulina, which is the only natural source providing the highest amount of protein known to man that is, 71%, and it is three times that of soyabean and five times that of meat. It contain proteinous nitrogen (11.36%), total organic nitrogen (13.35%), nitrogen from nucleic acid (1.9%), lipid content is (56%), having more essential fatty acid (vitamin F) composed of oleic, linoleic, gamma linoleic, palmitic, palmitoleic, heptadecanoic acid . About 40% of the fats include glycolipids including sulpholipids (2-5%) which have significant anti-HIV activity. Spirulina contains the carbohydrate in the form of glycogen and rhamnose.

Because of the presence of b-carotene with 9-Cis-carotenoid isomer, it has more antioxidant activity. The mineral content (3-6%) mainly includes iron which has better absorption than natural iron. The better absorption is due to its soluble complexes with phycocyanin which is protein derived from algae having the linear tetra pyrrole viz phycocyanobilin and resembles haemoglobin. Phycocyanin enhances general immunity and useful in lymphocytic activity against cancer.

The enzyme content in spirulina is in the form of super oxide dismutae and it is known of its free radical scavenging effects and plays vital role in pathophysiological conditions like atherosclerosis, arthritis, cataract, diabetes and also in emotional stress and aging process. Gamma linolenic acid of spirulina helps to reduce cholesterol levels. It has appetite suppressing activity.

Water extract of spirulina inhibits HIV-I replicatoin in human derived T cell lines and in human peripheral blood mono nuclear cells. Like all other microbial cells, spirulina contains all natural vitamins, B complex, minerals and other growth factors. V. B12 can be utilized only from vegetable source.

The World Health Organization has found spirulina has an excellent food for human consumption. Spirulina is FDA approved food supplement and can be marketed in USA as a natural food.

---

### Spirulina capsule:-

Athletes and joggers take spirulina for quick energy synthesis. To a particular extend indicates immense progress in anemia, diabetes, healing of wounds and lowering of cholesterol. It acts as a protein supplement in diet for malnourished children and adults.



## Honey:-

It is a sugar like secretion deposited in honey comb by the bees *Apis mellifera*, *Apis dorsata* and other species of *Apis* belonging to family *Apidae*. Honey is an aqueous Solution containing 35% glucose, 45% fructose and 2% sucrose. It is used as demulcent, Sweetening agent, nutrient, antiseptic and expectorant



## List of market friendly nutraceuticals:-

Sr. No	Category	Use
1.	Antioxidant, Vitamins	Immune supplement
2.	Calcium and vitamin	Calcium supplement
3.	Vitamin D and Lignan	Cardiovascular agents
4.	Predigested proteins	Protein supplement
5.	Taurine, caffeine	Energy drink
6.	Vitamin and minerals	Daily health supplement
7.	Granulated-L-glutamine	Amino acid supplement
8.	Calcium and trace minerals	Calcium supplement
9.	Soya proteins	Nutritional supplement
10.	Omega-3 fatty acids, zinc, antioxidant	Improved vision
11.	Natural antioxidant	Dietary supplement

## Current Trends and Future Prospects of Nutraceuticals: -

Over the last 20 years, there has been a rapid increase in the use of nutraceuticals due to mass information available on internet sources coupled with increased public awareness of health issues. The marked side effects and ineffectiveness of modern pharmaceuticals have compelled people to look for nutraceuticals as alternative therapy. Nutraceuticals for a medicinal use have been justified on the basis that they treat disease caused by the deficiency of nutrients. Clear evidence has been reported that nutraceutical supplementation improves health and prevents diseases. The treatment through nutraceutical supplementation does not involve diagnosis by a trained practitioner, and nutraceuticals with antioxidant activity are expected to have beneficial effects on the whole body rather than to treat symptoms of a disease state. Consumers of nutraceuticals control their health comfortably without needing consultation with their physicians. Self medications with nutraceutical for the long term may result in cost implications to the consumers and may be more expensive as compared to other medications, despite their benefits[47].

This is due to glorification of the benefits of nutraceuticals via advertising and media coverage. Health professionals such as general physicians, nurses, pharmacists, and nutritionist are well aware of nutraceuticals, and educate their patients or consumers about the appropriate use of such products. Self-medication of nutraceuticals for serious diseases is inappropriate, while their long-term use is safe and beneficial for the prevention of chronic diseases. Nutraceuticals for serious diseases involve carnitine and flaxseed oil mostly used for cardiovascular disease, and antioxidants mostly for the prevention of cancer. Currently, many nutraceutical consumers believe that dietary supplements may be safer than other synthetic substances, but their presumption could be wrong and medical diagnosis is required for serious disease to prescribe effective conventional medicines. It has been reported that self-medication with complementary medicine has increased in diabetic patients. Manufacturers of nutraceuticals are well informed about the production cost and profit. Manufacturers of nutraceuticals are also frequently launching new products into the market to expand the nutraceutical industry [48].

## Future Prospective: -

- ❖ Nutraceutical is a pharma future and universal desire to be healthier is driving the nutraceutical market.
- ❖ High growth opportunities are likely to be seen in the coming years in soy protein nutrients, the functional food ingredients like Lutein, Lycopene, omega-3 fatty acid, Probiotics and sterol esters.
- ❖ The essential mineral calcium and magnesium, herbal extract like Garlic and green tea and the non-herbal extract like coenzyme Q 10.
- ❖ As per this study India will be a strong market for nutraceutical products as the players in this industry will be combination of large nations.
- ❖ Indian companies using proprietary formulation and the small players who constitute the unorganized market.

- ❖ Multinational companies have set up production facilities in India and this trend can only be expected to grow further.
- ❖ Conversion of food manufacturing companies with pharmaceutical companies to manufacture and market nutraceuticals is another upcoming trend that will catch on in the future.

---

**References: -**


---

1. Misra, L. Traditional Phytomedicinal Systems, Scientific Validations and Current Popularity as Nutraceuticals. 2013.
2. Petrovska, B.B. Historical review of medicinal plants' usage. *Pharmacogn. Rev.* 2012, 6, 1–5.
3. Nasri, H.; Baradaran, A.; Shirzad, H.; Rafieian-Kopaei, M. New Concepts in Nutraceuticals as Alternative for Pharmaceuticals. *Int. J. Prev. Med.* 2014, 5, 1487–1499.
4. Ried, K. Garlic Lowers Blood Pressure in Hypertensive Individual, Regulates Serum Cholesterol and Stimulates Immunity. *J. Nutr.* 2016, 146
5. Kalra EK "nutraceuticals definition and introduction. *APPS, pharm science* 5(3), 2003, 2728
6. Cardenas Diana e-SPEN Journal, 2013.
7. Ruchi, S. Role of nutraceuticals in health care: A review. *Int. J. Green Pharm.* 2017, 11.
8. Singh, J.; Sinha, S. Classification, regulatory acts and applications of nutraceuticals for health. *Int. J. Pharm. Bio Sci.* 2012, 2, 177–187.
9. Heldman, D.R. *Food Science Text Series*. 1994.
10. Sikand, G.; Kris-Etherton, P.; Boulos, N.M. Impact of functional foods on prevention of cardiovascular disease and diabetes. *Curr. Cardiol. Rep.* 2015, 17, 39.
11. Umadevi, M.; Pushpa, R.; Sampathkumar, K.; Bhowmik, D. Rice-Traditional Medicinal Plant in India. *J. Pharmacogn. Phytochem.* 2012, 1, 6–12.
12. Lobo, V.; Patil, A.; Phatak, A.; Chandra, N. Free radicals, antioxidants and functional foods: Impact on human health. *Pharmacogn. Rev.* 2010, 4, 118–126.
13. Wildman, R. E. ; Bruno, R., S. *Handbook of Nutraceuticals and Functional Food* 3rd Ed. P412.
14. Eggersdorfer, M.; Wyss, A. Carotenoids in human nutrition and health. *Arch. Biochem. Biophys.* 2018, 652, 18–26.
15. Cheng, H.M.; Koutsidis, G.; Lodge, J.K.; Ashor, A.W.; Siervo, M.; Lara, J. Lycopene and tomato *Food Sci. Nutr.* 2019, 59, 141–158.
16. Young, A.J.; Lowe, G.L. Carotenoids-Antioxidant Properties. *Antioxidants* 2018, 7, 28.
17. Song, H.; Li, B. Beneficial Effects of Collagen Hydrolysate: A Review on Recent Developments. *J. Sci. Tech. Res.* 2017, 1.
18. Fan, J.; Zhuang, Y.; Li, B. Effects of Collagen and Collagen Hydrolysate from Jellyfish Umbrella on Histological and Immunity. *Changes of Mice Photoaging. Nutrients* 2013, 5, 223–233.
19. Turner, N.D.; Lupton, J.R. *Dietary Fiber. Adv. Nutr.* 2011, 2, 151–152.
20. Hou, J.K.; Abraham, B.; El-Serag, H. Dietary intake and a systematic review of The literature. *Am. J. Gastroenterol.* 2011, 106, 563–573.
21. Lee, Y.-H.; Bae, S.-C.; Song, G.-G. Omega-3 Polyunsaturated Fatty Acids and the Treatment of Rheumatoid Arthritis: A Meta-Analysis. *Arch. Med. Res.* 2012, 43, 356–362.
22. Buckley MT, et al. (2017). *Mol Biol Evol.* 34 (6): 1307–1318
23. Kumar, G.P.; Khanum, F. Neuroprotective potential of phytochemicals. *Pharmacogn. Rev.* 2012, 6, 81–90.
24. Lust, J. *The Herb Book: The Most Complete Catalog of Herbs Ever Published*; Courier Corporation: North Chelmsford, MA, USA, 2014; P. 642.
25. Fuller, R. *Probiotics: The Scientific Basis*; Springer Science & Business Media: Berlin/Heidelberg, Germany, 2012. P. 405.
26. Kechagia, M.; Basoulis, D.; Konstantopoulou, Health Benefits of Probiotics ; A Review. *ISRN Nutr.* 2013.
27. Al-Sheraji, S.H.; Ismail, A.; Manap, M.Y.; Mustafa, S.; Yusof, R.M.; Hassan, F.A. Prebiotics as Functional Foods: A review. *J. Funct. Foods* 2013, 5, 1542–1553
28. Hermann, Janice R. *Division Of Agricultural Sciences and Natural Resources Oklahoma state University.*
29. *Dietary Reference Intake For Energy, Carbohydrates and Proteins.* Institute of Medicine. National Academy press-2005
30. Latham, Michael C. *Human nutrition in the developing world.* Food and agricultural Organization of the United nation-1997.
31. Gupta, S.; Chauhan, D.; Mehla, K.; Sood, P.; Nair, A. An Overview of Nutraceuticals: Current Scenario. *J. Basic Clin. Pharm.* 2010, 1, 55–62

32. Webb, G.P. *Dietary Supplements and Functional Foods*; John Wiley & Sons: Hoboken, NJ, USA, 2011; p. 297.
33. Institute Of Medicine. *Dietary Reference Intake For Calcium and Vitamin D*. Washington DC. The National Academies Press – 2011
34. Heaney RP. Calcium. In;Coates pm. Jm, Blackman MR.et.2010
35. Solomons NW. Mild Human Zinc deficiency produces and imbalance between cell mediated immunity – 1998 p-56
36. Prasad AS. Zinc;an overview nutritional source – 1995;11
37. Institute of Medicine. *Food and Nutrition Board*. Washington, DC. National Academy press-1998
38. Singh, J.; Sinha, S. Classification, regulatory acts and applications of nutraceuticals for health. *Int. J. Pharm. Bio Sci.* 2012, 177–187.
39. Gupta, S.; Chauhan, D.; Mehla, K.; Sood, P.; Nair, A. An Overview of Nutraceuticals: Current Scenario. *J. Basic Clin. Pharm.* 2010,, 55–62.
40. Stonehouse, W.; Gammon, C.S.; Beck, K.L.; Conlon, C.A.; von Hurst, P.R.; Kruger, R. Kiwifruit: Our daily prescription for health.*Can. J. Physiol. Pharmacol.* 2012, 91, 442–447.
41. Karla Ek Nutraceuticals \_Definition and introduction. *AAPS pharmsci.* 2003,5;E25
42. Zhao J nutritional therapy, phytonutrients, for improvement of human health. *Recent pat biotechnol.* 2007.1.75-97
43. Hardy G Nutraceuticals and functional food: Introduction and meaning. *Nutrition* 16.688689
44. Shirzad M, Kordyazdi R, shahinfard N, Nikolkar M Does Royal Jelly affect tumor cells med pharmacology 2:45-48.
45. Ramasamy k, agarwal R Multitargated therapy of cancer by silymarin. *Cancer lett* 269
46. Shahbazian h world diabetes day. *J renal inj prev* 2: 223-124
47. Santini, A.; Tenore, G.C.; Novellino, E. Nutraceuticals: A paradigm of proactive medicine. *Eur. J. Pharm. Sci.* 2017, 96, 53–61.
48. Brower, V. A nutraceutical a day may keep the doctor away. *EMBO Rep.* 2005, 6, 708– 711.