

Nutraceuticals Are For Healthy Life

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Abstract: Nutraceuticals are merged from two words i.e., nutrition and pharmaceutical in which nutrition means a nourishing food component like vitamins, minerals, fibres, fats, carbohydrates etc which are essentials for maintaining human health and pharmaceutical means a medical drug. Nutraceuticals known as the food component or dietary supplement which provide the nourishment to human health and give the beneficial effects on various pathological diseases such as CVD (Cardiovascular disease), cancer, diabetes, atherosclerosis and neurological disorders. This review shades light on the antioxidants present in plants, uses of those plants in preventing from different disease and products available in market. This review also contained the marketed growth of nutraceuticals globally and Indian nutraceutical market growth. Antioxidants are the agents which prevent or delaying the oxidation of oxidizable substrate. The Indian and global nutraceutical market are growing day-by-day because peoples nowadays needs good health and they are well aware for consuming nutraceuticals like health drinks, sports drinks, probiotics, prebiotics drinks etc to maintain the good health and prevent form diseases without taking allopathic medicines.

Keywords: Fibres, Fats, CVD (Cardiovascular disease), Atherosclerosis, Dietary supplement.

1. INTRODUCTION

Historically nutraceuticals initially evolved in survey conducted in U.K., France and Germany, where the people had a strong inclination towards diet over the exercise to achieve and maintain a good health. [1] About 2000 years ago, Hippocrates said that, "LET FOOD BE YOUR MEDICINE AND MEDICINE BE YOUR FOOD". Stephen De Felice, founder and chairman of FIM (Foundation for Innovation in Medicine), Cranford, NJ in 1989, according to him nutraceutical was combines from two words "nutrition" (a nourishing food component) and pharmaceutical" (a medical drugs). [2, 3] Nutraceutical is defined as, "A food or a part of food that delivers medical/health benefits, as well as prevention/treatment of a disease". And Health Canada defines as, "a product prepared from foods, but sold in the form of pills, or powder (potions) or in other medicinal forms, not usually associated with foods". Nutraceutical itself is a very wide term which means any substance extracted from food source with additional health benefits along with the basic nutritional value already present in them. Nutraceuticals and phytochemicals plays an important role in decreasing and preventing the adverse effects of radiotherapy and chemotherapy without reducing effectiveness. They generally used for promoting the health of the individuals and also prevent from virulent conditions. Nutraceutical industries have three main sections which comprise functional food, dietary supplement and last herbal and natural products. [4] The term nutraceutical is not well accepted on global, regulatory systems while the dietary supplements are considered to be more prominent. Currently, more than 470 nutraceuticals are documented with their health benefits and also available in market. [5]

NUTRICOSMETICS: These are the nutrition supplements which help the structure and function of skin. Micronutrients

such as Vitamin C.

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COSMECEUTICALS: Cosmetic and pharmaceuticals are combined to form cosmeceutical, which means the cosmetic products with bioactive ingredients combined in a formulation and have drug like benefits. [6]

FUNCTIONAL FOOD: The foods part of regular diet but also have the advantageous effects. Example: Omega-3 milk in prevention from CVDs, Yogurts is probiotics for intestinal health etc. [7]

BENEFITS: Nutraceuticals played major role in maintaining overall well-being of human's health. Many bioactive molecules are identified to maintain health and research is going on, to discover more safe and cost effective molecules for oral administration. [8] These days nutraceuticals received significant attention due to safety, therapeutic effects and potential nutrition. Recent studies show that the nutraceuticals have favorable results in various pathological complications for example cardiovascular diseases (CVD), cancer, diabetes, neurological disorders and atherosclerosis. Many nutraceuticals have antioxidant activity so they are measured as healthy source of health upgrade, principally prevention from life threatening diseases for example infection, gastrointestinal and renal disorders, diabetes. [9] Study reported that oral administration of pomegranate juice at dose of 10 mL/ kg body weight for 2 weeks show the significantly rise in index of depression in ovariectomized mice, honey (100 g/kg) in diet for 52 weeks show significantly improved spatial memory and reduced anxiety in rats and honey also have used for treating depression, nociception, convulsion and hypnosis. Curcumin have the antidepressant activity. [10] Categorizing nutraceuticals: Depending upon the easier understanding and application the nutraceuticals is organized in variety of ways, i.e. for clinical trial design, academic instruction, functional food development or dietary recommendations. Classification of nutraceuticals is based on some common ways like food sources, mechanism of action, chemical nature etc. There are some food sources which is used as nutraceuticals and completely natural and can be categorized as: [11, 12]

Dietary Fibres

Probiotics

Prebiotics

Polyunsaturated fatty acids

Antioxidant vitamins

Polyphenols

Spices

Nutraceuticals can also be categorized in two groups: [1]

Potential nutraceuticals

Established nutraceuticals

The nutraceuticals products are comes in the category of "potential" products.

Dietary fibre:

The plant material which is digested by micro flora (in gut) but they are not hydrolyzed by the enzymes those secrete from digestive tract, this type of material is called as dietary fibers. Mostly dietary fibers are non-starch polysaccharides like hemicelluloses, gums and pectin, resistant starches, lignin, resistant dextrin and celluloses. Fruits, oats, beans and barley are some food materials which is rich source of dietary fibers. These dietary fibers can't absorbed and digested by small intestine, because chemically these fibers are carbohydrate polymers having degree of polymerization is NLT (not less than) 3. According to their water solubility these dietary fibers are classified into two class:

1. Insoluble Dietary Fibre (IDF): Celluloses, some

hemicelluloses and lignins which is fermented to a limited extend in the colon.

2. Soluble Dietary Fibre (SDF): Mucilages, β -glucans, gums, hemicelluloses and pectins that are fermented in the colon.

The classes of insoluble and soluble dietary fibers are called as non-starch polysaccharides and these fibers promote the regularity. [13] Some dietary fibers give negative effect in body like decrease the absorption of calories, minerals, proteins, vitamins and it intake 20-35 g/day for adults [14], but if necessary to give dietary fibers to children only 14/1000 kCals range is recommended. [15] The consumption dietary fiber in excessive amount cause diarrhea. [16]

Polyunsaturated fatty acids (PUFA):

Polyunsaturated fatty acids are the "essential fatty acids" which is important for body's functioning and these are introduced through diet. PUFAs are subdivided into 2 category, omega-3-(n-3) fatty acids and omega-6-(n-6) fatty acids. The dynamic omega-3-fatty acid are DHA (docosahexanoic acid), EPA (eicosapentanoic acid) and ALA (α -linolenic acid),. The precursor of eicosapentanoic acid and docosahexanoic acid is α -linolenic acid. The EPA and DHA is establish in fatty fishes like salmon, trout, blue fin tuna and mackerel and the main source of α -linolenic acid is some nuts, soybeans, red/black currant seeds, Flax seeds and canola etc. [17] Omega-6PUFAs mainly involve of GLA (γ -linolenic acid), LA (linoleic acid) and ARA (arachidonic acid). Linoleic acid mainly found in vegetable oils for example sunflower, corn and soybean and animal products (meat, eggs and poultry) are the rich source of arachidonic acid. Omega-3-fatty acids cause major effect in body like cardiovascular diseases, anti-arrhythmic disease etc [18, 19], hypolipidemic [20, 21] and antithrombotic. [22] The benefits of Omega-3-fatty acids in pre-mature infant health [23], asthma [24], bipolar and depressive disorders [25], dysmenorrhea and diabetes [26] and these Omega3-fatty acids show positive effect in different stages of life. The infant's formulations which contains DHA along with ARA and mimic the breast milk. According to FDA the maximum concentration of EPA and DHA omega-3 fatty intake is 3 g/day not more than 2 g per day from a dietary supplement.

Probiotics:

Over the 2000 years ago, the first intake of fermented milk as probiotics. Probiotics is a live microbial feed supplement i.e., administered in a suitable amount and it affect the host animal and improve the intestinal microbial balance in body. [27] The bacteria in Probiotics is categorized in following types: Lactobacilli like Lactobacilli acidophilus, Lactobacilli.casei, Lactobacilli.delbrueckii subsp. bulgaricus, Lactobacilli.brevis, Lactobacilli.cellobiosus.

Gram-positive cocci like Lactococcus lactis, Streptococcus salivarius subsp. thermophilus, Enterococcus faecium. Bifidobacteria like Bifidobacteria bifidun, Bifidobacteria adolescentis, Bifidobacteria infantis, Bifidobacteria longum, Bifidobacteria thermophilum.

Mainly the probiotics are formulated in the form of gel, liquid, paste, capsules, powder and granules etc [28] and used to treat some type of infection such as gastrointestinal conditions like lactose intolerance, acute diarrhea associated gastrointestinal side effects. The Probiotic agents are non-toxic, resistance to gastric acid and also non-pathogenic in nature and these probiotics adherence to gut epithelial tissues and produce antibacterial constituents. Probiotics helps to

decrease the risk of systemic conditions like asthma, allergy, cancer and some types of infections like ear and urinary tract infection etc. [29]

Prebiotics:

Prebiotics positively affect the host cell and alter the metabolism of gut microbiota. Generally, the prebiotics are used as dietary ingredients and their ingestion promote Lactobacillus and Bifidobacterial bacteria in gut, which helps in metabolism. Prebiotics are short chain polysaccharides with exclusive chemical structure that cannot digested by humans. Oligosaccharides is fructose based, which is added or naturally exist in food mainly in vegetables like tomato, alliums, beans, peas and chicory roots etc. [30] Prebiotics can improve reduction of constipation, neutralization of toxins, and stimulation of intestinal immune system, blood cholesterol levels, antitumor properties, blood lipids and lactose tolerance,. The growth of bifidobacterial is promoted by daily intake of 5-20 g of insulin and oligosaccharides. If the oligosaccharides are consume in large amounts that causes abdominal distension, flatulence and diarrhea. [31]

Antioxidant vitamins:

Antioxidant vitamins are the group of some vitamins like vitamin C, vitamin E and carotenoids. Singly and synergistically vitamins act to prevent from oxidative reactions, leading to some deteriorating diseases like cancer, cardiovascular diseases, cataracts etc. [32] The rich source of vitamins is fruits and vegetables and use for their protective action by the mechanism of scavenging free-radical. Vitamin E contain tocopherols and tocotrienols and protection from peroxidation of PUFA in LDL and biological membrane. In the comparison of tocopherols the tocotrienols are more itinerant in biological membrane, because the unsaturated side-chain is present in tocotrienols and also the penetration of tissue in saturated fatty layers such as brain and liver etc. Tocotrienols are able in recycling and inhibition of liver oxidation. Vitamin C is also known as ascorbic acid. The mechanism of antioxidant is by the synergistic effect of ascorbic acid is shifting the aqueous radicals with tocopherol supplementation. [33] In biological system carotenoids (lycopene, β -carotene, lutein, and zeaxanthin) is well-organized singlet oxygen quencher. β -carotene traps the free radicals of peroxy in tissue at low concentration. So the antioxidant properties of vitamin E are complements by β -carotene.

Polyphenols:

A large group of phytochemicals leads the formation of polyphenols, the phytochemicals are produced from plant source and protect the plant from photosynthetic stress, reactive oxygen species. Polyphenols divided into about 8,000 classes for example, flavanols, flavones, flavan-3-ols, flavanones and anthocyanins etc. Numbers of polyphenols are synthesized by phenyl propanoid pathway. Most common polyphenols like flavonoids and phenolic acids etc are take place in food sources. Polyphenols are also comes in the category of antioxidant, anti-microbial, anti-inflammatory, cardio protective activities and prevent the neurodegenerative diseases and diabetes mellitus. As compare the vitamin E and C the polyphenols show more effective antioxidant activity. For determine the biological activity bioavailability of polyphenols is an important factor. [34]

Spices:

To enhance the sensory quality of foods, spices are used as esoteric food adjuncts. The important characteristics of spices are flavor, aroma or piquancy, improve texture of food and give color to foods and used to stimulate the appetite. The dietary spices influence the human health because of their anti-inflammatory, anti-oxidative, anti-mutagenic, immune modulatory, chemo-preventive, effects on cells and also beneficial for respiratory, gastrointestinal, metabolic, reproductive, neural, cardiovascular and other systems. Mostly spices are terpenes and other constituents of essential oils and these are effective in different forms. For example, to decrease the cholesterol amount in body approximately 50 gram raw onion, garlic and 5-6 clove is used. Sometime spices and herbs cause toxicity in body but harmless for body, when it is used in food, but as medicine purpose, the possibility of drug interaction with pharmaceutical medicines is increases. Over consumption of garlic cause adverse effects like weight loss, anemia, heart problems, dermatological problems and liver, kidney toxicity. Over consumption of onion may cause tissue and lung damage. [35]

Table no. 1: Nutraceuticals are used in various types of diseases.

Types Of Diseases	Nutraceuticals Used
Cardiovascular Diseases	Omega-3, anti-oxidants, poly unsaturated fatty acids, vitamins, dietary fibers and minerals for prevention and treatment of CVD Polyphenol found in grapes prevents and controls arterial diseases Flavonoids (in onions, vegetables, grapes, red wine, apples, and cherries) block the ACE and it make strong the tiny capillaries which carry essential nutrients and oxygen to all types of cells. Soya foods (min. of 25gm per day) reduce chronic heart diseases
Diabetes	Lipoic acid is an anti-oxidant used for curing from diabetic neuropathy. Dietary fibers from psyllium are used for reducing the high lipid level in hyperlipidemia and also for controlling the glucose levels in diabetic patients.
Obesity	Herbal stimulants, like green tea and caffeine help in body weight loss.
Cancer	Flavonoids, soy foods and lycopene Saponins found in clover, soybeans, alfalfa, some herbs, spinach, , peas potatoes, tomatoes and contain anti-tumor and anti-mutagenic activities Anti-tumor activity is possess in cucumber fruit, turmeric rhizomes, beet roots and spinach leaves.
Anti-Inflammatory Activities	Polyphenol of turmeric, has anti-carcinogenic, antioxidative and anti-inflammatory properties. Gamma linolenic acid found in nuts, green leafy vegetables, vegetables oils like hemp seed oil, blackcurrant seed oil is used in treatment of auto-immune diseases.
Allergy	Quercet found in onions, red wine and green tea is used for reducing the inflammation reduces which results from asthma, gout, hay fever, arthritis and bursitis.

Antioxidants: Antioxidants are the agents which helps to prevent or delaying the oxidation of oxidizable substrates when

are in lower concentration than substrate. Antioxidants can be synthesized in vivo (e.g., reduced glutathione (GSH), superoxide dismutase (SOD), etc.) or taken as dietary antioxidants. [36,37]. Plants are the main source of dietary/exogenous antioxidants, two-thirds of world's plant species have medicinal importance and also have the antioxidant potential. [38] The first discovery of exogenous antioxidants isolation from plants is ascorbic acid. [39] Currently, approx. 19 in-vitro and 10 in-vivo methods are available in market for assessing antioxidants activity of plants samples. [40]. Polyphenols is the major characterized antioxidant which is widely presented, such as flavonoids. Flavonoids are divided into three types: Aglycones (without attached sugar), Glycosides and Methylated derivatives.

Common antioxidants are:
CLA (Conjugated Linoleic acid)

- Lutein
- β-carotene
- Catechins
- Tannins (Proanthocyanidins)
- Lycopene
- Ascorbic acid
- Polyphenolics
- Tocopherols
- Indole-3-carbonyl
- α-tocopherols
- Ellagic acid
- Gallic acid
- Glythatione
- Hydroxytyrosol
- Luteolin
- Oleuropein
- Gingerol
- Eugenol
- Chlorogenic acid

2	Lycopene	Tomato, tomato products (Sauces and ketchup)	Reduce the risk of prostate cancer.
3	β-carotene	Various fruits and vegetables	Neutralized free radicals.
4	CLA (Conjugated Linoleic acid)	Cheese, Meat products	Improve body composition and decrease the risk of certain cancers.
5	Catechins	Tea	Neutralize free radicals, reduce risk of cancer.
6	Proanthocyanidins	Cranberries, Cranberry product, Cocoa, Chocolate	Improve urinary tract health, reduce risk of cardiovascular disease.

PLANT CONTAINING ANTIOXIDANTS WITH THEIR BENEFITS:

Table no. 3: Example of plants containing antioxidants with their therapeutic use.

S No.	Name of plant	Biological name	Part of plant	Antioxidant content	Use	Reference
1	Pomegranate	Punica Granatum		80% of juice and 20% of seed. Polyphenolic compounds: Anthocyanins (Potent antioxidant), hydrolyzed tannins.	Treatment of AIDS, cancer, allergic symptoms, CVD, oral hygiene, ophthalmic ointment.	
2	Green tea	Camellia Sinensis	Leaf	Phenolic compound: Catechins 30%	Anti-mutagenic, anticancer, antidiabetic, anti-inflammatory, anti-obesity.	
3	Cat's Claw	Uncaria tomentosa/guianensis	Bark	Polyphenols: flavonoids, Proanthocyanidins and tannins.	In the treatment of arthritis, bursitis, lupus, chronic fatigue syndrome and for stomach and intestine disorders	
4	Devil's Claw	Harpagophytum procumbens		Flavonoids	In the treatment of rheumatic entities.	
5	Turmeric	Curcuma longa	Leaf and root	Polyphenol, flavonoid, tannin, and ascorbic acid	Rhinitis, wound healing, common cold, skin infections, liver and urinary tract diseases, and as a 'blood purifier'	41, 42
6	Ginger	Zingiber officinale		Gingerol	Headaches, motion sickness, nausea, vomiting, vascular conditions, cold and arthritis, and as an antimicrobial and antifungal	
7	Indian Olibau	Boswellia serrata	Gum resin		treatment of arthritis and other inflammatory diseases	
8	Fried egg tree	Gordonia axillaris	Fruits, bark	Epicatechin, quercetin, ferulic acid	Antimicrobial, and anti-inflammatory activities	43
9	Amaranth	Amaranthus caudatus	Seeds and leaf	Ascorbic acid, tocopherols, carotenoids, Vitamin A, C.	Expelling tapeworms and for treating eye diseases, amoebic	44

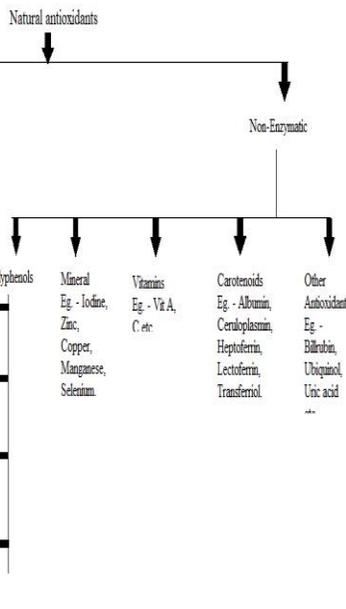


Figure no. 1: Types of natural antioxidants.

Table no. 2: Some examples of Antioxidants isolated from with their health benefits.

S no.	Anti-oxidants	Major source	Benefits
1	Lutein	Green vegetables	Contributes to maintenance of health.

10	Red sword bean.	Canavalia gladiata	Seed	Gallic acid, and gallotannins	dysentery, and breast complaints Anti-angiogenic, hepatoprotective, and anti-inflammatory activities	45
11	Bitter dock	Rumex obtusifolius L., Rumex crispus L.	Seed and leaf.	Antraquinones, stilbenes, flavonoids, catechins, leucoanthocyanins and phenolic acids	anti-aging, anti-inflammatory, and anti-proliferative properties, and effectiveness in reducing the risk of developing cardiovascular diseases, cancer, and diabetes	46
12	Thyme	Thymus vulgaris	-	Tocopherols, quercetin or Rosmarinic acid, Luteolin, lutein	antimicrobial	47
13	Coriander	Coriandrum sativum L.	Leaves and stem.	Gallic acid, quercetin	anti-microbial, antidiabetic, anxiolytic, antidepressant, neuro-protective, anti-mutagenic, anti-epileptic, anti-dyslipidemic, anti-hypertensive, anti-inflammatory and diuretic.	48
14	Celery	Apium graveolens L.	Leaves	Gallic acid, Vitamin C, β -carotene, Luteolin, tannin	Coronary heart diseases, diabetes and cancer.	
15	Curry leaf	Murraya koenigii L.	Leaf	Gallic acid, flavonoids.	Anti-diabetic, antioxidant, antifungal, antimicrobial, cytotoxic properties, anti-inflammatory, antitumor promoting, anti-hypercholesterolemic, kidney pain-relief, hepatoprotective activities.	
16	Onion	Allium cepa L.	Root	Vitamin C, folic acid, quercetin, flavanols, anthocyanins	Anti-inflammation, decrease triglycerides and reduce cholesterol levels	
17	Lemon	Citrus	Fruit	Vitamin C, flavonoids.	Help in control weight, prevent kidney stone, and reduce risk of cancer.	49, 50, 51
18	Blueberry	Cyanococcus corymbosus (L.)	Fruit	Vitamin C, anthocyanins, flavonoids and tannins.	Lower blood pressure, maintain brain function, improve memory, anti-diabetic, and reduce muscle damage.	
19	Airy Shaw	Goniothalamus velutinus	Bark and leaf	Gallic acid, flavonoids.	Anti-inflammatory, anti-malarial, anti-cancer.	52
20	Akash Bela/Dodder	Cuscuta reflexa Roxb.	Stem	Flavonoids, quercetin, myricetin,	Antihypertensive, Antidiabetic, Hair growth promoting,	53

	plant				carotenoids, lutein, lycopene.	Antimicrobial, Spasmolytic, Antitumor, Antiviral, Anti-inflammatory, Antipyretic effect.	
21	Amla	Phyllanthus emblica	Fruit		Vitamin C, polyphenols, Gallic acid, Ellagic acid and tannins.	Anti-inflammatory, anti-mutagenic, treatment of common cold, scurvy, cancer, heart diseases,	54
22	Mulethi/licorice	Glycyrrhiza glabra Linn.	Root		Flavonoids, liquirtin, isoliquirtin.	Digestive, analgesic, anti-cough and antiinflammatory, anti-protozoan, anxiolytic and antistress, antitumoral, antiulcer, hypertension.	55
23	Mango	Mangifera indica Linn.	Root, fruit, seed		Vitamin A, C, quercetin, Gallic and Ellagic acid, Carotenoids.	Prevent cancer, lower cholesterol, clears the skin, eye health, help in diabetes, improve digestion and boost immune system.	56
24	Karela	Momordica charantia L.	Leaf, stem and fruit		β -carotene, gallic acid, ellagic acid, catechin.	Treatment of cancer, diabetes and cardiovascular diseases	57
25	Holy basil/Tulsi	Ocimum sanctum Linn.	Leaf and stem		Eugenol	Anti-asthmatic, anti-inflammatory, antibacterial and antifungal	58
26	Ashoka	Saraca indica	Leaf, flower, fruit, bark.		Flavonoids, terpenoid, lignin, phenolic compounds, tannins.	Anti-hyperglycemic, antipyretic, antibacterial, anti-helminthic.	59
27	Small Cranberry	Vaccinium oxycoccos	Leaves, flower, fruit		Vitamin C, tannins, flavonoids, quercetin, proanthocyanidins.	Anti-inflammatory, antibacterial, cardioprotective effect, urinary tract protection and anticancer.	60
28	Cinnamon	Cinnamomum zeylanicum	Bark, leaves		Procyanidins, catechins, Eugenol, tannins.	Anti-inflammatory, antidiabetic, antimicrobial, anticancer, lipid-lowering, cardiovascular-disease-lowering compound and have activities against neurological disorders, such as Parkinson's and Alzheimer's diseases.	61
29	Broom creeper	Cocculus hirsutus (Linn.)	Root, stem and leaves.		Ascorbic acid and phenolic compounds.	Anti-inflammatory, analgesic, anti-diabetic and spermatogenic activities.	62
30	Ashwagandha	Withania somnifera	Root, bark, stem and		Phenolic compounds.	Anti-inflammatory, anti-arthritis agent, adaptogenic / anti-stress activities	63

			flower			
31	Neem	Azadirachta indica	Stem, fruit and leaves.	Quercetin and sitosterol	Antifungal, antibacterial, antifungal, anti-inflammatory, antiarthritic, β -antipyretic, hypoglycemic, antigastric ulcer, antifungal and antitumour activities	64
32	Beetroot/Chakunda	Beta vulgaris L.	Root	Flavonoids, Vitamin C, carotenoids, gallic acid, quercetin.	Treatment of hypertension, atherosclerosis, type 2 diabetes and dementia	65
33	Guava/Amrood	Psidium guajava L.	Leaves, stem fruit.	Vitamin C, Lycopene, quercetin, tannins, β -carotene, ellagic acid, Anthocyanin.	lower risk of cardiovascular disease and cancer, benefit for digestion, weight loss, boost immune system	66
34	Pears	Pyrus	Fruit	Vitamin C, Quercetin, isorhamnetin, myricetin, kaempferol, luteolin, betalains, taurine, carotenoids.	Decreases the risk of obesity, diabetes, heart disease, and overall mortality while promoting a healthy complexion, increased energy, and a lower weight.	67
35	Papaya	Carica papaya	fruits, stems, leaves, seeds and roots	Quercetin, lycopene and β -sitosterol.	Anthelmintics, stomachic, anti-dyspeptic, diuretics, emmenagogue, laxative, vermifuge, anti-asthmatic, anti-rheumatic, rubefacient, tonic, poultice, and as a cure for enlargement of liver, spleen, freckles, and cancerous growths	68
36	Watermelon	Citrullus lanatus	Fruit, seed.	Quercetin, lycopene, tannins, carotene, β -sitosterol.	hypertension, diabetes, cancer, cardiovascular diseases,	69
37	Apple	Malus domestica	Fruit, seed	Phenolics, flavonoids and carotenoids	Decrease the risk of chronic diseases, such as cardiovascular disease and reduced risk of some cancers, asthma, and diabetes. Inhibit cancer cell proliferation, decrease lipid oxidation, and lower cholesterol.	70
38	Plum	Prunus domestica L.	Fruit, seed.	Phenolics, flavonoids, anthocyanins and carotenoids	Relieves constipation, improve health of heart, protect against cancer,	71

					improve circulation of blood, lower the cholesterol level, boost immunity.	
39	Pea	Pisum sativum L.	Fruit	Tannins, carotene and flavonoids	β -hypcholesterolae and anticarcinogenic activity	72
40	Carrot	Dascus carota L.	Fruit	β -carotene, ascorbic acid, tocopherol, Vitamin C, Carotenoids, flavanoids.	Lower the cholesterol level, protect against cancer, weight loss, eye health	73
41	White cabbage	Brassica oleracea L.	Fruit	β -carotene, ascorbic acid, tocopherol, Vitamin C, Carotenoids, flavanoids.	Anti-inflammatory, antibacterial, gastrointestinal disorders (gastritis, peptic ulcers, duodenal ulcers, irritable bowel syndrome) as well as in treatment of minor cuts and wounds and mastitis.	74
42	Tomato	Solanum lycopersicum	Fruit	Phenolic acids, mainly β -carotene and other carotenoids, lycopene, flavonoids, phenolic acids and ascorbic acid	Maintain heart health, Prevent from cancer, make skin health,	75
43	White onion	Allium cepa L.	Fruit	Phenolic acids, β -carotene and other carotenoids, flavonoids, anthocyanins, Lycopene, and ascorbic acid.	Help to control blood sugar level, contain cancer fighting compound, boost bone density, antibacterial property.	76
44	Cauliflower	Brassica oleracea	Fruit	Phenolic acids, β -carotene and other carotenoids, flavonoids, anthocyanins, Lycopene and ascorbic acid.	Weight loss, keeps bone healthy, reduce high blood pressure and risk of cancer, boost the immune system.	77
45	Spinach	Spinacia oleracea L.	Leaves	Phenolic acids, β -carotene and other carotenoids, flavonoids, anthocyanins, Lycopene, and ascorbic acid.	Eye health, prevent from cancer, and maintain blood pressure.	78
46	Chili	Capsicum sp.	Fruit seed.	Phenolic compounds, Flavonoids, Carotenoids, β -carotenes	Effects on the gastrointestinal tract, the cardiovascular and respiratory system as well as the sensory and	79

					thermoregulation systems, analgesic against arthritis pain and inflammation.	
47	Banana	Musa Cavendish	Fruit, peel	Vitamin C, gallic acid, phenolic and flavonoids	Improve digestive health, weight loss, support heart health, and improve kidney health.	80
48	Potato	Solanum tuberosum L.	Peel	Lutein, Vitamin C, β -carotene, tocopherol, catechin and epicatechin, anthocyanins	Control sugar level, improve digestion and improve kidney health.	78
49	Coffee	Coffea	Coffee ground and residue	Polyphenols, tannins and gallic acid	Increase the fibre intake, lower the risk of type-2 diabetes, lower the risk of Alzheimer disease, and reduce depression and colorectal cancer risk.	81
50	Grapes	Vitis vinifera	Skin and seed	Gallic acid, Vitamin C, quercetin, anthocyanins	Protect from cancer, help in lowering the blood pressure and cholesterol, eye health, improve memory and maintain bone health	82
51	Bael/Golden apple/Sitona apple	Aegle marmelos	Leaves, fruit and bark	Flavonoids, β -Carotene, tocopherol, Ascorbic acid, flavonoids, polyphenols.	Anti-diarrheal, anti-proliferative, anti-inflammatory, antipyretic, antidiabetic, anti-lipidemic and hypoglycemic.	83

Europe.
Asia Pacific: India, China; Rapidly growing middle class and increasing disposable income will greatly expand Nutraceutical segment in China by 2020, Japan; Pioneers in natural Nutraceuticals & Dietary supplements. Huge market second to US, Rest of Asia-Pacific
LAMEA: Latin America, The Middle East & Africa, Brazil; Health-conscious, well-informed young middle class would drive growth

NUTRACEUTICAL MARKET ANALYSIS GLOBALLY: In 2017, the nutraceuticals market accounted for \$379.06 billion, and it is expected that the market grow at CAGR (Compound annual growth rate) of 7.6% to reach \$734.60 billion by 2026. There are many factors which helps in growing market like increasing chances of health diseases such as cholesterol, diabetes, obesity, high blood pressure and also increasing health care cost. Low awareness, unclear regulatory guidelines and ingredients are hampering the market. A nutraceuticals is a nutrients as dietary supplement and food additive which offers health and fitness benefits including both treatment and prevention of disease by improving the nutrition value in food. Nutraceuticals are used in wide areas like animal feed additives, food and beverages, pharmaceutical and in various personal products. Functional beverages such as energy drinks are help in making the brain little more active and relieve form tiredness because caffeine is present in such energy drinks and help in maintaining body fitness. The market of sports drink is increasing because the globalization and increase in fitness and sports related activities. [84]

In other research the Global market value of nutraceuticals are approx. \$202.2 billion in 2017 and it is expected to grow at a CAGR of around 6.8% to reach around \$317.3 billion at the end of 2024. Growing geriatric population is the main reason for rising healthcare expenditure and nutraceuticals market growth. North America was the important market for functional foods because of launch of new products by industries. Asia Pacific dominates the global nutraceutical market and gives the uppermost share in 2017. India, China and other emerging countries lead the market growth. The third largest nutraceutical market is from Europe and it is predictable that it show some significant growth. The research and development of products and regulatory approval processes which increase the cost of products that lead the industry growth. The Latin America, Africa and Middle East are have a profitable market. The nutraceuticals market growth is increasing day-by-day due to increasing trends of wellbeing and maintenance of health. [85]

According to a Grand View Research, Inc. reported that the nutraceuticals market to reach \$578 billion by 2025 and the dietary supplements segment will grow at CAGR of 9.7% because of increasing demands of products from India, South Korea, Mexico, China and Poland. North America nutraceuticals market is increasing at CAGR of 7.8% from 2016 to 2024. Asia Pacific nutraceutical market is expected to growing at fastest CGAR of 9.9%. [86]

NUTRACEUTICAL MARKET ANALYSIS OF INDIA: ASSOCHAM knowledge report, 2018 the Indian nutraceutical market is predicted to grow from \$4 billion to 18 billion from 2017 to 2025. "Nutraceuticals are consumed in regular basis to prevent sickness, so it is not shocking if the users are exceeds of pharmaceuticals in future" says Ajit Singh, President, Health

Market analysis of Nutraceuticals: Nutraceutical market is divided in two ways: By Type and By Geography.

Table no. 4: Different types of nutraceutical market by regions.

NUTRACEUTICAL MARKET	
BY TYPE	Functional food: Probiotics Fortified Food, Omega Fatty Acid Fortified Food, Branded ionized salt, Branded Wheat Flour Market etc.
	Functional Beverages: Fruit and vegetable, Dairy and Dairy Alternatives Drinks, Noncarbonated Drinks; Bottled Water, Tea, and Coffee and other; Herbal Tea, Sports Drinks, and Energy Drinks etc.
	Dietary Supplements: Proteins and Peptides, Vitamins and Minerals, Herbs; Ayurveda Extracts, Plant Extracts, Algal Extracts, Phytochemicals etc.
	Personal care
BY GEOGRAPHY	North America: US; Maturing market, growth with dietary supplements as healthcare costs increase, Mexico, Rest of North America;
	Europe: UK, France, Germany; Stringent Government regulation & approval process. Most players expanding product offerings, Rest of

Foods and Dietary Supplement Association. Euromonitor reported after the market research, the market size of Vitamins dietary supplements (VDS) in 2017 was projected to be at 9,400 crore, while only multivitamins market size was worth 780 crores. Arun Gupta, convener, Nutrition Advocacy in Public Interest says "People consume health supplements or drinks thinking these are health promoters, but don't know that these can be just tall claims made by the makers," it is important to evaluate the nutraceuticals and their mechanism of action before prescribing them. A small survey conducted in Delhi by organization in June among 52 peoples, it was found that 41.7% people of the age group of 15-25 years intake health drinks regularly, around 44.44% peoples said health drinks are important to be taken regularly because they provide essential nutrients and 22.22% peoples trust that the health drinks helps to improve immunity. [87]

Currently, Indian nutraceutical market is about \$3 billion in 2018, and the market is growing day-by-day because the pharma leading the market and peoples are now aware for their health maintenance. As per recent estimates, the nutraceutical market in India is significantly condensed in the South, followed by the East and is gaining serious traction in rural areas as well with the population there getting familiar with the concept of lifestyle diseases. [88, 89]

KEY INDUSTRIES OF NUTRACEUTICAL MARKET WORLDWIDE:

Table no. 5: Key players of nutraceutical markets worldwide.

S No.	Region	Company Names
1	USA Based	Amway
		Amyris
		Mead Johnson Nutrition
		Coca-cola
		Pepsico
		Kellyyogs
		Heinz
2	Europe Based	Abbott
		gsk (GlaxoSmithKline)
		Danone
		Nestle health Science
		DSM
		BASF (Baden Aniline and Soda Factory)
		Bayer HealthCare Pharmaceuticals
3	China Based	Unilever
		Kingdomway Nutrition, Inc.
4	India Based	Parry Nutraceuticals
		Patanjali
		Sanofi
		Emami
		Himalaya
		Dabur
		Bafna

SOME NUTRACEUTICAL FORMULATIONS AVAILABLE IN THE MARKET:

Table no. 6: Different market formulations of nutraceuticals are available worldwide.

S no.	Product name	Type of dosage form	Ingredients	Category	Company name
1	Chyawanprash	Semi solid	Amla, ashwagandha, pippali	Immune booster	Dabur India Ltd.
2	Calcirol D-3	Tablet	Calcium and vitamins	Calcium supplement	Cadilla healthcare limited, Ahmedabad, India.
3	GRD	Powder	Proteins, vitamins, minerals and carbohydrates	Nutritional supplement	Zydus Cadila Ltd. Ahmedabad, India
4	Protine X	Powder	Predigested proteins, vitamins, minerals and carbohydrates.	Protein supplement	Pfizer Ltd., Mumbai, India
5	Coral Calcium	Powder	Calcium and trace elements	Calcium supplement	Nature's answer, hauppauge, NY, USA
6	Amiriprash (Gold)	Semi solid	Chyawanprash Avaleha, Swarnabhasma and rasSindur	Good immunomodulator	UapPharma Pvt Ltd.
7	Omega woman	Liquid and capsules	Antioxidants, vitamins and phytochemicals (e.g. Lycopene and resveratrol)	Immune supplement	Wassen, Surrey, U.K.
8	Celestial Healthtone	Syrup	Dry fruit extract	Immune Booster	Celestial Biolabs Limited
9	Follihair	Tablets	Biotin, amino acids, vitamins, minerals and natural extract	Provide strengths, stimulates and nourishes hair	Abbott
10	Shallaki	Tablets	Shallaki pure herb	Reduce pain and Inflammation	Himalaya
11	Black Cohosh	Capsule	Black cohosh root	Dietary supplement	Biotrex nutraceuticals

12	Ensure Diabetes care	Powder	Milk protein, Soy protein, beta-carotene, vitamin A, tocopherols, vitamin D3, vitamin B12	Dietary supplement	Abbott
13	Resource diabetic	Powder	Vitamin A, D, B1, B2, L-carnitine, Folic acid, Protein	Dietary supplement	Nestle HealthScience
14	Cysteine	Capsules	N-Acetyl Cysteine	Nutrition supplement	Biotrex nutraceuticals
15	Lipidcare	Capsules	Arjuna bark, harjor bark, amalaki fruit, ocimum gratissimum	Immunomodulator	Organic India
16	Royal jelly	Tablets	Carbs, protein, fat, folic acid,	Dietary supplement	Forever Living
17	Svarn Saathi	Sachet (beads)	Curcuma longa, antioxidant	Dietary supplement, boost immunity	BigBrother NutraCare Pvt. Ltd.
18	Organic gotu Kola	Tablets	Gotu kola plant extract, acacia gum	Dietary supplement	Geo-Fresh Nutraceuticals
19	White Kidney Bean	Capsules	White kidney bean extract	Dietary food supplement	Biotrex nutraceutical
20	Multivitamin Daily Support	Tablets	Spirulina, Ginseng and Pine bark extract	Multivitamin supplement	NutriLeon
21	B Carotene	Capsules	Vitamin A	Dietary supplement	Biotrex nutraceutical
22	Biocart-MSM	Tablets	Glucosamine sulphate, methyl sulfonyl methane, rutin, quercetin	For optimal joint-cartilage support and pain relief	Shrey Nutraceuticals and herbals Pvt. Ltd.
23	Nutramore	Powder	Lactobacillus and bifidobacterium, Inulin and fructo oligosaccharide	Food supplement	Netsurf

24	Aloevera extract	Capsules	Aloevera extract	Dietary supplement	Nutriherbs
25	Aroma secret's Mogra	Oil	Mogra extract	Rejuvenate skin, nourishes and moisturize skin	Biotrex nutraceutical
26	Papaya leaf extract	Tablets	Papaya extract, giloy, tulsi, sadabahar	Immunity booster	Nutree pure
27	NATURYZ RE-TOXX	Powder	Milk Thistle extract, Glutathione, L-Acetyl cysteine, turmeric, vitamin C	Dietary supplement	Naturyz
28	Curcumin	Capsules	Turmeric curcumin extract, black pepper	Dietary supplement	Biotrex nutraceutical
29	Cholesterol-X	Tablets	Red yeast rice, coenzyme Q10	Dietary supplement	Biotrex nutraceutical
30	Obenyl nutra	Tablets	Garcinia indica extract, Chitosan oligosaccharides, conjugated linoleic acid, Vitamin C, inulin.	Dietary supplement	Charak pharma Pvt Ltd.
31	Safed Musli	Capsules	Safed musli 40% saponins	Dietary supplement	Om shakambhari herbals Pvt. Ltd.

CONCLUSION:

Nowadays, the development of nutraceuticals in the field of pharmaceuticals is exceeding day-by-day, because it is prophylactic i.e., prevention before the disease. The Indian and global nutraceutical market growth is increasing continuously at a CAGR of 6.5-9.5% and lead to around \$300-800 billion globally and \$4-18 billion Indian market growth in 2024-26. Here we concluded that, there are various leaf, vegetable, fruits, seed of different plants are used in the formulation of nutraceuticals. Many nutraceuticals have antioxidant activity so they are measured as healthy source of health upgrade, principally prevention from life threatening diseases for example infection, gastrointestinal and renal disorders, diabetes.

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