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NEW IDEAS ON NUTRITIONAL MEDICINE AS A DRUG ALTERNATIVE

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ABSTRACT

The term "nutraceutical" is a combination of "nutrition" and "pharmaceutical." Nutraceuticals, broadly speaking, are foods or components of foods that significantly alter and sustain the normal physiological function necessary to keep healthy humans alive. Nowadays, nutraceuticals have received considerable interest due to potential nutritional, safety and therapeutic effects. The present demographic and health trends are the main drivers of the global nutraceutical market's expansion. Dietary fibre, prebiotics, probiotics, polyunsaturated fatty acids, antioxidants, and other diverse kinds of herbal/natural foods are some of the food products used as nutraceuticals. Some of the biggest health issues of the century, including as obesity, cardiovascular disease, cancer, osteoporosis, arthritis, diabetes, and cholesterol, are fought off with the aid of these nutraceuticals. Overall, the term "nutraceutical" has ushered in a new era of medicine and health, in which the food sector has turned into a research field. In the present review much effort has been devoted to present new concepts about nutraceuticals.

KEYWORDS: Nutraceuticals dietary supplement, Antioxidants, Herbal neutraceuticals, nutraceutical product.

INTRODUCTION

In 1989, Stephen Defelice coined the term "NUTRACEUTICALS" by fusing the words "nutrition" and "pharmaceutical." Felice described nutraceuticals as meals with therapeutic or medical effects. They aid in toxin removal from our systems, the restoration of a healthy digestive system, and the promotion of general wellness. Nutraceuticals can be categorised

according to their dietary source, mechanism of action, and chemical make-up. They have grown in popularity as potent pharmacological alternatives. Isolated nutrients, dietary supplements (minerals, vitamins, amino acids, and herbs), complex diets to genetically modified designer foods, and phytochemicals (flavonoids, phytosterols, polyphenols, and tannins) are all guaranteed to have positive health effects in addition to the traditional nutritional values found in food. Dietary habits are associated with a number of chronic diseases, including cardiovascular disease, diabetes, gallstones, inflammatory disorders, Alzheimer's disease, and Parkinson's disease.[1]

As a result, nutritional supplements have been used to promote health, extend life, slow down the ageing process, stop chronic diseases, and preserve the body's structure and functions.

In the US, nutritional products fall under the categories of drugs, food additives, and dietary supplements. Despite the fact that each country has its own meaning of the term, it is generally recognised to refer to a substance that has been taken out of food and is normally sold in distinct medicinal forms. A nutraceutical product is a substance that has physiological advantages or provides defence against chronic illnesses.[2] Nutraceuticals can be used to improve health, delay the onset of chronic illnesses, prolong life expectancy, or support the structure or operations of the body.[3] Several well-known nutraceuticals include ginseng, Echinacea, green tea, glucosamine, omega-3, lutein, folic acid, and cod liver oil. The bulk of dietary supplements provide a number of therapeutic advantages.

Classification of nutraceuticals

There are various different chemical forms of nutraceuticals, and they may be found in plant-based meals. Others are mostly unknown, although some of them are well-known, such as resveratrol from red wine, vitamin from lemon, and catechin from green tea. The chemical structures of the many plant-derived antioxidants discussed in this article are shown in the figure below. Depending on dietary sources, modes of action, chemical makeup, etc., nutraceuticals can be broadly categorised in and in the text as follows.

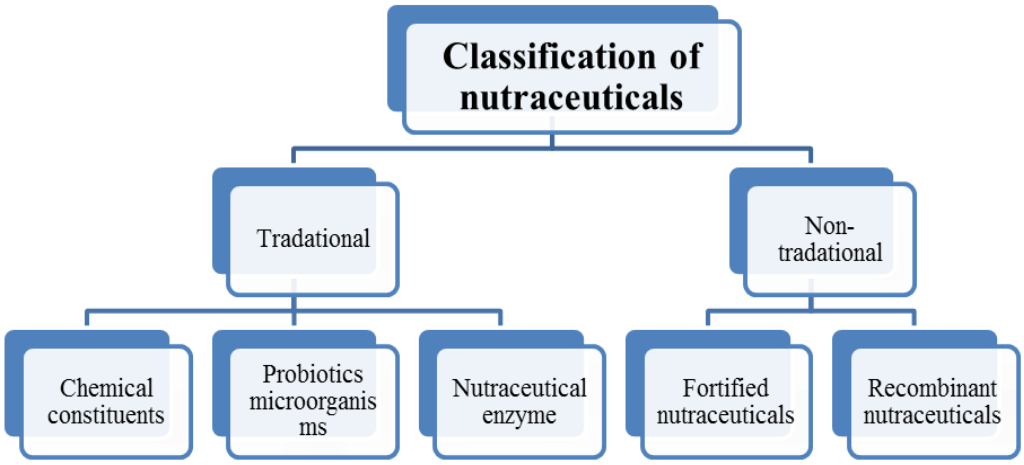

Figure 1 Classification of nutraceuticals.

Dietary fibre

Dietary fibre significantly affects the gut environment, preventing colorectal diseases.[4,5] Fibers offer protection by increasing faecal volume and lowering the increased bile acid concentration. Numerous dietary fibres are also said to decrease the formation of cholesterol, according to the research.[6] Dietary fibre is basically a kind of carbohydrate that human enzymes are unable to break down. The bulk of plant-based foods, such as cereals, fibrous fruits, green vegetables, dried peas, lentils, and grains, are rich in dietary fibres.[7]

Probiotics

Probiotics are live microbial dietary supplements that have more positive effects on health than any other traditional food. Probiotics may be effective in treating diarrheal disorders, irritable bowel syndrome, stomach infections, and colic diseases in babies by maintaining the gut microbiota and pH homeostasis in the intestine. They achieve this through enhancing the immune system as well as modifying and re-establishing the gut flora. Foods that include probiotics include curd, yoghurt, cheese, pickles, and beverages.[8]

Prebiotics

The majority of them are made up of short carbohydrate chains that cannot be digested by the enzymes in our upper digestive tract and cannot be absorbed by regular physiological processes in any area of the gastrointestinal system. Instead, the small intestine's lactobacilli and bifidobacteria ferment them. Examples include galacto-oligosaccharides, fructo-oligosaccharides, and inulin.[9]

Poly unsaturated fatty acid (PUFA)

Dietary PUFA affect a wide range of physiological functions. PUFAs, which contain omega-3 and omega-6 fatty acids, are beneficial for human health and are implicated in a range of inflammatory and systemic illnesses.[10] Cold water fish, fish oils, nuts, salmon, tuna, groundnuts, oysters, and flaxseeds are all excellent providers of essential fatty acids. The three primary omega-3 fatty acids—-linolenic acid, eicosapentanoic acid, and docosahexanoic acid—are known as essential fatty acids because of their indispensable benefits and various nutraceutical properties.[11]

Antioxidant vitamin

Vitamins like vitamin C, vitamin E, and carotenoids are examples of antioxidant vitamins. The oxidation of cellular organelles, membranes, and metabolic pathways that leads to a range of degenerative illnesses, including as cataracts, cardiovascular disease, and cancer, is prevented by these vitamins both individually and together.[12]

Spices

People have been using spices to enhance the flavour and quality of their cuisine for thousands of years. They alter food's texture while also giving it a unique flavour, fragrance, zest, and colour. This makes us more hungry. Recent research have demonstrated the health-promoting qualities of Indian dietary spices, which go beyond just enhancing food flavour. These capabilities include antioxidative, chemo preventive, antimutagenic, anti-inflammatory, and immunological modulator effects. They consist of essential oils, phytochemicals, and vitamins.[13]

Tarpenes

Terpenes, also known as isoprenoids, are most frequently found in green vegetables, soy plants, and cereals. Because of their hydrophobic carbon tails, which react with free radicals via partitioning into the lipid bilayer of the cell membrane, terpenes have a particular antioxidant effect.[14]

Polyphenols

These are secondary metabolites, which are plant chemicals that are typically employed in pathogen or UV radiation defence. The most important polyphenols include flavonols, flavones, flavan-3-ols, flavanones, and anthocyanins, out of roughly 8,000 distinct varieties.[15,16]

The flavonoids polyphenol

Low molecular weight flavonoids are secondary metabolites found in plants that have strong antioxidant and chelating effects. They are frequently present in foods like fruits, vegetables, wines, teas, and cocoa as glycosides, dimers, polymers, and in conjugation with other substances. These have positive effects on a number of diseases, such as cancer, cardiovascular disease, myocardial damage, and neurodegenerative disorders.[17,18] By interacting with protein kinase and lipid kinase signalling pathways, flavonoids undergo substantial metabolic processing in the digestive system and exert modulatory effect in cells. They also protect against illness by preventing low density lipoprotein (LDL) oxidation, which significantly alters their redox state. The three main flavonoids polyphenols are quercetin, catechin, and kaempferol. The richest sources are curly kale, broccoli, leeks, apples, onions, and leafy vegetables like lettuce and cabbage.[19]

Tea catechin

Although green tea is by far the most abundant source, catechin and epicatechin are found in many other kinds of fruits, including apricot, beans, cherry, grape, and peach.[20] During the fermentation and heating processes that turn green tea leaves (Camellia sinensis) into black tea, catechins are polymerized into more complex condensed polyphenols called theaflavins (dimers) and thearubigins (polymers).[21,22] Other isomers, in addition to the primary flavanols catechin and epicatechin, gallocatechin, epigallocatechin, and epigallocatechin gallate Tea catechins and polyphenols work as potent antioxidants in vitro by modulating cytokines and transcription factors. They also effectively scavenge reactive oxygen species (ROS). Cell culture and animal studies give experimental evidence that catechin and its derivatives have the bioactivity to affect the aetiology of a variety of chronic and systemic illnesses. Theaflavins and thearubigins, which are present in black tea, are considered to have significant anticancer, antibacterial, and antiviral effects and aid in the absorption of minerals in the gut. Catechins work to limit the invasion and expansion of smooth muscle cells in the artery wall.[23] A recent study found that catechins had strong anti-aging capabilities. EGCG activates a number of signalling pathways, including those involving Mitogen-Activated Protein (MAP) Kinases and protects neurons.[24]

Quercetin

Quercetin must be consumed by humans. It is an abundant flavonoid with the potential to prevent a wide variety of illnesses due to its wide spectrum of anti-inflammatory, anti-

thrombotic, anti-hypertensive, anticarcinogenic, vasodilatory, and immunomodulatory activities. Because quercetin is frequently available as a glycoside, which is then converted to glucuronide/sulfate conjugates after intestinal absorption[25], only conjugated metabolites are detectable in the bloodstream. Quercetin's anti-carcinogenic property is revealed by inducing apoptosis in tumour cells at a significantly higher dosage and acting as a potential chemotherapeutic drug. Huquercetin has favourable effects on a number of antioxidant markers, including antioxidant enzymes, plasma antioxidant capacity, resistance to LDL oxidation, and reduced lymphocyte DNA damage.[26] Quercetin is said to improve memory, regenerate cells, and counteract the harmful effects of metal ions.[27] Furthermore, it is widely known that quercetin has strong anti-diabetic effects that benefit patients by reducing induced alterations and lipid peroxidation. Quercetin also provides neuroprotection against colchicine, a drug that inhibits cognitive function.[28] Consequently, quercetin is a potential medication for the management of disease.

Non-flavonoid polyphenols

Reservatrol, caffeic acid, and curcumin are non-flavonoid phenolic chemicals originating from plants and are present in a wide variety of foods and drinks, including coffee beans, potatoes, fruits including apples and their juices, tobacco leaves, olive oil, and wines. There is a great deal of interest in the biological and pharmacological properties of phenolic compounds that are not flavonoids. They have been shown to have antioxidant, anti-inflammatory, anti-mutagenic, and anticarcinogenic properties.[29]

Resveratrol

The non-flavonoid polyphenol resveratrol has received a lot of attention and is the topic of intensive investigation right now. It may be found in both red wine and grapes. The activation of cell differentiation, anti-inflammatory actions, scavenging free radicals, and anti-aging capabilities of this polyphenol have all been demonstrated in disease models.[30] According to recent research[31], resveratrol may improve the prognosis of neurological diseases like Parkinson's, Huntington's, Alzheimer's, and stroke. Resveratrol reduces nuclear factor kappa B (NF-B) activation, which in turn inhibits the expression of many genes, including several cell adhesion molecules, including induced nitric oxide synthase (iNOS), cyclooxygenases (COX)-1 and 2, as well. Chronic NF-B and tumour necrosis factor (TNF)-activation is also associated with diabetes, cancer, and other systemic diseases.[32] Resveratrol encourages cellular mechanisms of oxidative resistance by activating mitochondrial superoxide

dismutase (SOD) in mammalian cells in culture. The ability of resveratrol to decrease LDL cholesterol oxidation may help explain some of its cardioprotective properties.[33]

Caffeic acid

Large amounts of caffeine, a hydroxycinnamic acid, are present in coffee beans, wine, cidar, olive oil, and many fruits in the chlorogenic acid form. Experimental evidence suggests that caffeic acid is a potent antioxidant. Caffeine has a wide range of biological and pharmacological properties, including immunomodulatory, antiviral, antioxidant, anti-inflammatory, anti-carcinogenic, and antimutagenic actions.[34] Caffeine also inhibits lipid peroxidation, LDL oxidation, and lipoxygenase activity. Caffeic acid, which completely inhibits the production of ROS and the xanthine/xanthine oxidase system, completely protects against in-vitro DNA damage.[35] Leukotrienes are especially restricted during synthesis because they are thought to contribute to immune-regulatory problems, asthma, and allergic responses. Caffeine and its derivatives have been shown to sequester the nitric oxide (NO) radical, which also protects the skin from UVA and UVB rays.[36]

Curcumin

Curcumin, a diferulolylmethane with two phenol moieties and a polyphenol, is found in turmeric, an Indian spice derived from the rhizomes of the annual plant Curcuma longa. Curcumin has received a lot of interest because of its broad availability and lengthy history of use as a medication. It has been shown via several preclinical and clinical investigations to be safe and non-toxic even when taken orally. Researchers have looked at the benefits of curcumin in treating disorders including diabetes, Alzheimer's disease, hepatitis, rheumatoid arthritis, and cancer. Curcumin has been shown to have antioxidant, anti-infective, anti-diabetic, wound-healing, and anticancer activities. By blocking a number of signalling pathways, such as COX-2, lipoxygenase, STAT-3, Nrf2, suppression of pro-inflammatory cytokines like NF-B, interleukins (IL)-1, -6, and -8, inducible nitric oxide synthase, and NO production in lipopolysaccharide-, interferon (IFN)-, or TNF-, the anti-inflammatory compound curcumin lowers Furthermore, it possesses strong antimicrobial properties. Due to their propensity to decrease tumours, curcumin and other chemotherapeutic drugs may prove to be more successful when administered in combination. Thanks to innovative techniques like liposomal and subiquitous presence, curcumin's efficacy and bioavailability have increased. Nanoencapsulated curcumin has demonstrated excellent efficacy in animal tests as a treatment for glioblastoma multiforme prevention.[40] In various in vitro and in vivo models,

curcumin can control adenosine monophosphate-activated protein kinase (AMPK) and the mechanistic target of rapamycin (mTOR) in addition to reducing inflammation. It appears that the chemical also regulates mitochondrial function when it kills tumour cells by apoptosis.[41]

Phenolic acids

A number of medicinal plants include phenolic acids, which are secondary aromatic plant metabolites generated from benzoic and cinnamic acids.[42] Sorghum and millet contain the highest concentrations of phenolic acids when compared to the other grains. They have to do with food's colour, flavour, and nutritional and antioxidant content. Recent study suggests that phenolic acids function as antioxidants as a result of the reactivity of the phenol molecule. Phenolic acids are often ingested by individuals. They also have hepatoprotective, anti-inflammatory, and antibacterial effects. The average daily dietary intake varies depending on the makeup of the food and is about 1g. Phenolic acids, such as grape seed extract or green tea extract, are widely offered as dietary supplements on the market. The following phenolic acids should be noted as neutraceuticals.[43]

Gallic acid

Gallnuts, grapes, berries, walnuts, apples, flaxseed, coffee, wine, and tea are just a few of the numerous plants that contain gallic acid. Gallic acid has been shown to selectively trigger apoptosis in cancer cells without harming healthy cells, and it has been effective in treating neuronal disorders and rejuvenating brain nerves. In addition to its antioxidant properties, research claims that gallic acid's anti-viral, anti-fungal, and anti-bacterial properties help build a stronger immune system.[44] This stops the tissues from deteriorating further. Gallic acid can be used to treat internal haemorrhages because it helps to constrict tissues, halt bleeding, and lessen inflammation. Gallic acid is already readily available as a refined supplement together with vitamins and other nutritional supplements.[46]

Ferulic acid

One of the many naturally occurring plant constituents is ferulic acid, which is produced by plants' metabolism of phenylalanine and tyrosine through Shikimate pathways.[47] Ferulic acid is mainly found in the cell walls of many plants, where it is typically found conjugated with lipids, mono- and polysaccharides, and other substances. It is widely found in grains, fruits, certain vegetables, sweet corn, and may be swiftly metabolised in the liver. It acts as an antioxidant by responding to free radicals by releasing hydrogen from its phenolic hydroxyl

group, which has been compared to that of SOD. It is more bioavailable compared to other dietary flavonoids and monophenolics, albeit its bioavailability is dependent on subsequent interactions with target tissues.[48]

Ferulic acid stays in the circulation for a longer period of time than other antioxidants like ascorbic acid. Ferulic acid and related ester derivatives have been shown to decrease the production and function of specific inflammatory mediators, such as prostaglandin E2, TNF, and iNOS, in cells activated by the bacterial endotoxin lipopolysaccharide.[49] Alkyl ferulate, a phenolic derivative, may have anti-carcinogenic properties. Additionally, some papers assert that giving ferulic acid to diabetic rats produced by streptozotocin decreases blood glucose levels. This works well in all herbal antioxidant formulae as well as vitamin and herbal health supplements. Consequently, ferulic acid may benefit our bodies' immunological systems. Along with being important for nutrition, it is widely used to make vanillin and is a common food ingredient.[50]

Rosmarinic acid

Rosmarinic acid, a diphenol, is found in rosemary, lemon, oregano, some higher plants, and several fern and hornwort species. It is an ester of caffeic acid and 3,4-dihydroxyphenyllactic acid. There have been claims that rosmarinic acid-containing extracts from the leaves of various herbs and spices have antioxidant, antimutagenic, antitumorigenic, anti-HIV, anti-proliferative, and anti-cyclooxygenase, anti-lipoxygenase, and other beneficial properties. The skin and digestive system can both easily absorb it. It is recognised as a potential medicinal plant product due to its anti-oxidant qualities and remarkably low toxicity.[51] In the pharmaceutical sector, rosmarinic acid-containing pills and lotions are so widely accessible.[52]

Organosulfur compounds

One of the functional groups in compounds containing organosulfur is sulphur. Pharmaceuticals, biochemicals, natural molecules, synthetic reagents, intermediates, and solvents are all applications for organosulfur compounds. There are numerous organosulfur compounds that can be found in living systems, including the sulfur-containing amino acids cysteine and methionine, peptides like glutathione, antibiotics like penicillin, cephalosporin, and bacitracin, co-factors and vitamins like thiamine, biotin, lipoic acid, co-enzyme A, S-adenosylmethionine, and others. Pineapple, onion, garlic, asparagus, cabbage, turnips, radish, horseradish, and many more fruits and vegetables contain sulphur.[54]

Allicin from garlic

Garlic is one of the main food ingredients having medicinal potential. Allicin, the main bioactive component derived from allicin by the action of allinase, a thiosulfinate from raw garlic, scavenges superoxide by inhibiting the production of superoxide by the xanthine/xanthine oxidase system.[55] Allicin also demonstrated hypolipidemic, anti-platelet, anti-bacterial, anti-cancer, chemo preventive, and procirculatory effects [They supposedly degrade to create sulfenic acid, which reduces free radicals and inhibits the oxidation of cellular macromolecules, according to certain publications. It is well known for having potent antibacterial qualities. The therapeutic benefits of garlic cover a broad spectrum of illnesses, including hepatic, cardiovascular, cancer, and microbial infections, to mention a few.[57]

Anthocyanins

Water-soluble pigments called anthocyanins may be found in many different coloured foods, such as berries, grapes, flowers, cereals, black soy beans, and others. They contribute to the vivid colours of fruits, vegetables, and flowers, assisting in pollination, in addition to having potent antioxidant/anti-inflammatory, antiviral, and neuroprotective properties.[58] They also scavenge lipophilic radicals and inhibit lipid peroxidation and the inflammatory mediators COX-1 and -2. Additionally, they are the most utilised natural food colouring in the beverage and food sectors. Numerous research have listed its anti-diabetic and anti-obesity capabilities through regulation of adipocytokine expression.[59]

Nutraceuticals in Allergic Disorders

The sensitivity of the human immune system makes allergies a common ailment. The majority of allergy causes are either unidentified or difficult to pinpoint, which makes therapeutic therapy tough. The symptoms of allergens on the body might range from minor aches and pains to ones that could be fatal, such acute respiratory distress. An increase in white blood cell and basophil counts are haematological changes associated with allergy diseases. Tive is widely used in neutraceuticals to treat allergies because of its effect on low density lipoprotein[60] Eucalyptus essential oil is another plant product that is largely used in neutraceuticals to treat allergies.[61]

Cardiovascular diseases and nutraceuticals

Globally, the prevalence of CVD and the number of research in this field are increasing.[62,63] Cardiovascular disease includes coronary heart disease (heart attack), peripheral vascular disease, cerebrovascular disease (stroke), hypertension, heart failure, and other disorders

(CVD). Poor fruit and vegetable eating is allegedly associated with a higher death risk from CVDs.[64] The majority of cardiovascular illnesses are preventable. Numerous studies have demonstrated a relationship between a diet rich in fruits and vegetables and a lower risk of CVD.[65,66] Nutraceuticals in the form of vitamins, minerals, antioxidants, dietary fibres, and omega-3 polyunsaturated fatty acids (n3 PUFAs) are recommended for the prevention and treatment of CVD, together with physical exercise. According to certain theories, the substances, like polyphenols, alter cellular signalling and metabolism, hence reducing the risk of artery disease.[67,68]

Flavonoids, also known as flavones, flavanones, and flavonols, are abundant in foods including onions, endives, cruciferous vegetables, grapefruits, apples, cherries, pomegranates, berries, black grapes, and red wine. plays a critical role in both preventing and treating the CVD.[69] Flavonoids suppress the angiotensin-converting enzyme, inhibit the cyclooxygenase enzymes that break down prostaglandins, and prevent platelet aggregation. They also protect the circulatory system, which delivers oxygen and nutrients to the cells.[70] The anthocyanins, tannins (proanthocyanidins), tetrahydro-carbolines, stilbenes, dietary indoleamines, serotonin, and melatonin found in plant foods are regarded to offer health benefits.[71]

The pulp-containing orange juice is rich in flavonoids. Hesperidin is one of the citrus bioflavonoids known as flavanone glycosides. The two foods that have the greatest hesperidin in the diet are citrus sinensis and tangelos. The peel and membrane parts of lemons and oranges have greater hesperidin contents. Hesperidin is used to treat venous insufficiency and haemorrhoids.[72]

Consumption of flavonoids was significantly negatively linked with coronary heart disease mortality and the frequency of myocardial infarction. Flavonoids, which are included in many regularly consumed foods, may reduce the risk of dying from coronary heart disease, particularly in older people.[73] Zingiber officinalis rhizomes are frequently used as seasonings for many foods and drinks. It has a long history of usage as medication and is useful in preventing CVD. Due to its significant antioxidant and anti-inflammatory characteristics, ginger has recently been recommended for treating illnesses including hypertension and palpitations. This plant does a good job of protecting against the toxicity of synthetic drugs.[74]

Phytosterols compete with dietary cholesterol by obstructing its absorption and increasing its evacuation from the body. They might potentially reduce CVD morbidity and death as a result. Although the seeds of green and yellow vegetables also contain significant levels of sterols, they are concentrated in the seeds.[75] Buckwheat proteins decrease blood cholesterol and hypertension. The majority of plant species generate phytosterols. Additionally, phytosterols, flavonoids, flavones, proteins, and thiamin-binding proteins are present in buckwheat seeds. Dietary fibre also lowers cholesterol, aiding in the treatment and prevention of diabetes and cardiovascular disease.[76] Fish contains omega-3 fatty acids (n-3 fatty acids), which are dietary components that affect arrhythmias, plasma lipids, and CVD. Whole grains, fruits, and the leaves of many plants contain octacosanol, a lipid-lowering substance that has no unfavourable side effects.[77]

Nutraceuticals in Alzheimer's Disease

Alzheimer's disease is a neurological condition that affects more than 26 million individuals globally. Dementia is the first stage, followed by Alzheimer's, and then death. There is presently no treatment for it, and it mostly affects older persons (over 60). The use of some nutraceutical products, such as lutein, curcumin, lycopene, and carotene, can be beneficial in the treatment of Alzheimer's disease. According to scientific sources, the reason why women are more susceptible to this disease than men may be related to their exposure to stressful situations.[78] According to certain research, Alzheimer's disease may be treated using plant extracts from Zizyphus jujube and Lavandula officinalis, which aid with memory.[79]

Diabetes and nutraceuticals

The most common kind of diabetes is type 2, which is almost often related to obesity. The overall number of people with the illness is increasing globally[80] despite the advent of several drugs for the prevention and treatment of diabetes. Diabetes has a major cost impact on society[81] in addition to placing a heavy financial burden on each patient and their family.[80] Few herbal dietary supplements and pharmaceuticals have been proven to be scientifically helpful in treating type 2 diabetes mellitus in well-conducted randomised clinical trials[82], but several have lately been proved to be so in preclinical research. Isoflavones are phytoestrogens that, in terms of both structure and function, are similar to oestrogen in humans. Most research on soy isoflavones has revealed a connection between soy intake and decreased risks of type II diabetes, heart disease, osteoporosis, and various cancers.[83] Omega-3 fatty acids may help those with diabetes who have decreased glucose

tolerance. Diabetes may increase the heart's susceptibility to their depletion since long-chain n-3 fatty acid synthesis depends on insulin. N-3 fatty acid ethyl esters may be helpful for diabetic patients.[84]

In Chinese traditional medicine, the isoquinoline alkaloid berberine is mostly used to treat gastrointestinal ailments. Berberine's hypoglycemic properties have led to more recent research into the idea of utilising it to treat diabetes. The Rutaceae (Evodia, Phellodendron, and Zanthoxyllum), the Ranunculaceae (Coptis, Hydrastis, and Xanthorhiza), and the Papaveraceae (Argemone, Bocconia, Chelidonium, Corydalis, Eschscholzia, Glaucium, Hunnemannia, Macleaya, Papaver, and Sanguinaria) plant families were included.

Antioxidant lipoic acid is used to treat diabetic neuropathy and looks to be beneficial as a long-term dietary supplement for safeguarding diabetics against issues. Psyllium-derived dietary fibres have been widely exploited as food additives, pharmaceutical supplements, and components in processed foods to help individuals lose weight, regulate their blood sugar levels when they have diabetes, and decrease their cholesterol levels when they have hyperlipidemia. Numerous plant extracts have been shown to either prevent or cure diabetes, such as cinnamon, bitter melon, and Toucrium polium.[86]

Nutraceuticals used in Cancer Therapy

The main reasons of today's difficult cancer therapies are the emergence of drug resistance and the negative effects of already accessible treatments. A global survey predicts that there will be 15 million more instances of cancer worldwide in 2020, nearly tripling the current number of cancer patients.[87] The bulk of cancer therapies used today include chemotherapy, radiation therapy, and surgery. However, a healthy lifestyle that includes a diet rich in antioxidants may be the best defence against cancer. Nutraceuticals may be the best option to fill the existing gap in cancer therapy because of their minimal risk of side effects and regular addition of chemicals and plant extracts that can overcome resistance.[88]

According to recent research[89], many nutraceuticals formulations contain lycopene, one of the carotenoids with claimed efficacy in treating various malignancies. Nutraceuticals made from plant extracts that are high in biochanin, isoflavones, tannins, and plant biologics including curcumin, gallic acid, and caffeic acid exhibit impressive efficacy against a variety of cancers.[90,91] Nutraceuticals including carotene and pectin have been demonstrated to be useful in treating prostate cancer because of their capacity to scavenge free radicals.[92]

Regular fruit consumption can give the body various nutraceuticals, including cysteine, Vitamin C, Vitamin E, and lycopene, as well as providing cancer protection. Using certain glucosinolate biotransformed products can help prevent cancers of the colon, lungs, breast, and liver. A large-scale clinical research purportedly testing active neutraceuticals for the treatment of prostate cancer includes lycopene, green tea, Vitamin D, and E.[93]

Nutraceuticals in Ophthalmic Disorder

Age-related macular degeneration (AMD) can be treated with vitamins and other nutrients including lutein, n-3 fatty acids, and zeaxanthin while also preventing its potentially fatal side effects like blindness. Along with these particular polyphenolic flavonoids[94], carotenoids are strong antioxidants that help prevent age-related macular degeneration. The carotenoid astaxanthin, which is found in marine critters like shrimp, salmon, and sea bream, is very useful in treating eye disorders. A marine is discovered. Lutein, a carotenoid that is also used to cure visual issues, is present in foods like sweet potatoes, carrots, mangoes, corn, etc.[96]

Market and growth of Neutraceuticals

In 2010, it was projected that the Indian nutraceutical industry was worth $2 billion, or around 1.5% of the global market. In India's literaceuticals industry, which generates $5 billion in annual sales, 60% of the market's revenue comes from dietary supplements and functional food and beverage sales. With a CAGR of 7.04% from 2016 to 2022, the nutraceutical industry is projected to grow from 1840 92 million in 2016 to 302206 million in 2020.

Table 1: Some marketed Neutraceuticals are as follows.

S.no	Disease Condition	Active Ingredients of Nutraceuticals
1.	Cardiovascular disease	n-3 PUFAs,Tannins,Anthocyanins Octacosanol[96]
2.	Eye disorder	Lycopene, β Carotene, Green tea, Vitamin C, Vitamin E, Astaxanthin[97]
3.	Alzheimer's	Curcumin, Lutein, lycopene, Turmerin[98]
4.	Diabetes	Isoflavones, Omega-3 fatty acid, Psyllium.[99]
5.	Cancer	Lycopene, Biochanin, Daidzein, β Carotene[100]
6.	Allergy	Quercetin[101]
7.	Immunity problems	Astragalus, Garlic, Echinacea angustfolia.[102]
8.	Inflammation	Glucosamine, Chondrointin, Vitamin C[103]
9.	Obesity	Capsaicin, Psyllium fiber, green tea, ma-huang guarana[104]
10.	Miscellaneous	Kaempherol, Moringa oleifera Lam,Saponins, Terpenes, Chitosan, Curcumin.[105]
11.	Toxicity	Most of the medicinal plant extracts.[106]

CONCLUSION

Numerous research have examined and reported on a variety of nutraceuticals, functional foods, and naturally occurring substances. These studies and publications have demonstrated that these products are very active, significantly affect cell metabolism, and typically have little side effects. It seems logical that individuals are focusing on proactive illness prevention in order to preserve their health. The study of nutrition has advanced internationally. Nutraceuticals usually provide an advantage when compared to the artificial pharmaceuticals being created by the pharmaceutical industry. Novel pharmacological activity is appealing due to the possibility of their practical application in the treatment and prevention of various diseases. The majority of pharmaceutical companies usually lack the motivation to pursue patent applications since they might be difficult to obtain.

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Conflict of Interest

The Authors declare no conflict of interest.

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