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Review Article

A Comprehensive Review for Human Lifestyle Diseases; to the Therapeutic and Prophylactic Potentials in Nutraceuticals

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Abstract

The growing interest in nutraceuticals globally can be attributed to current population trends and a heightened awareness of health and wellness. Nutrients, herbals, and dietary supplements play pivotal roles in nutraceutical formulations, offering presumed safety and potential therapeutic effects. These products are recognized for their ability to address various lifestyle-related conditions, contributing to the enhancement of the quality of life. The reference to combating major health problems such as Alzheimer's disease, Parkinson's disease, cardiovascular diseases, obesity, cancer, osteoporosis, diabetes, among others, underscores the potential impact of nutraceuticals on a wide range of health conditions. The focus on using food products for both promoting health and managing diseases reflects a paradigm shift in the approach to healthcare. The characterization of the nutraceutical industry as a research-oriented sector indicates the continuous exploration and development of new products and formulations. This aligns with the evolving landscape of medicine and health, where the food industry plays a crucial role in advancing scientific understanding and contributing to preventive healthcare. In summary, our description provides a comprehensive and insightful overview of nutraceuticals, emphasizing their role in the modern era of medicine and health.

Keywords: Nutraceuticals; Polyphenol; Alkaloids; Antioxidant; Immunity; Hypertension

Introduction

The proverb from Indian Vedic literature emphasizing the importance of diet aligns with contemporary views on preventive healthcare. The shift towards a positive approach to prevent diseases and maintain good health resonates with the philosophy attributed to Hippocrates, often regarded as the father of medicine, who advocated for the idea that food can serve as medicine [1]. Nutraceuticals, as per different sources, encompass a variety of products classified based on natural sources, pharmacological conditions, and chemical constitution. The four main categories include dietary supplements, functional food, medicinal food, and pharmaceuticals. Dietary supplements are products concentrated in various forms that contain nutrients derived from food. Functional foods include whole foods or an enhanced dietary component that may offer health benefits beyond their traditional nutritional content [2]. Medical food is formulated for internal consumption or administration, highlighting a specific therapeutic purpose. Lifestyle diseases, influenced by daily habits and environmental interactions, are characterized by factors such as bad food habits, physical inactivity, incorrect body posture, and disrupted biological clocks [3]. Diseases like Alzheimer's, Parkinson's, cancer, diabetes, hypertension, and others are often linked to occupational lifestyle factors, including exposure to heat, sound, dust, fumes, smoke, cold, and pollutants. Adopting a healthy lifestyle is emphasized as a key strategy to combat these diseases. This involves maintaining a balanced diet, engaging in regular physical activity, and respecting the body's biological clock [4]. By addressing these factors, individuals can potentially reduce the risk of lifestyle diseases and enhance overall well-being. The integration of nutraceuticals and a health-conscious lifestyle reflects a holistic approach to health maintenance and disease prevention.

Nutraceuticals against Alzheimer's disease (AD)

Alzheimer's disease (AD) and promoting cognitive health. Clinical studies suggest that adopting healthy lifestyles, coupled with the use of natural multi-target and disease-modifying agents, may have a preventative impact on AD. These measures could also potentially mitigate symptoms in diagnosed patients [5]. The pathological alterations associated with AD may begin as early as 30 years before symptoms appear. Emphasizes the importance of developing the capacity to detect these changes early for effective intervention . Nutraceuticals containing bioactive molecules with

antioxidant and anti-inflammatory properties are considered relevant for addressing AD. Anti-protein aggregation molecules, including quercetin, bio-curcumin, rosemarinic acid, and Andean shilajit, are highlighted. Anthocyanidins (e.g., delphinidin, malvidin) and natural flavonoids are mentioned for their potential benefits. Quercetin and hydroxy-tyrosol, described as anti-aging molecules, are suggested to have potential anti-AD properties [6]. Antioxidants are deemed indispensable in treating various diseases, particularly those associated with oxidative stress. Oxidative stress is emphasized as playing a significant role in neurodegenerative diseases like AD. Phosphatidylserine, a component of nutraceuticals, is highlighted for its role in cellular metabolism and communication. Oral supplementation is suggested to impact neuronal membranes, cell metabolism, and specific neurotransmitters (acetylcholine, norepinephrine, serotonin, and dopamine) [7]. Mention of recent papers showing positive effects of nutraceutical plants like Zizyphus jujube and *Lavandula officinalis* on AD, learning, or memory. Various nutraceutical antioxidants such as curcumin, lutein, lycopene, turmerin, and β-carotene are cited for their potential positive effects on specific diseases by combating oxidative stress. The growing trend in nutraceutical usage is attributed to the belief that these compounds could potentially postpone the development of dementias like AD. Your information provides a well-rounded perspective on the potential contributions of nutraceuticals to cognitive health and the management of Alzheimer's disease, backed by references to recent research findings [8].

Parkinson's disease

Parkinson's disease is described as a brain disorder resulting from nerve damage in specific brain regions, leading to symptoms such as muscle rigidity, shaking, and difficulty walking. It typically manifests in mid to late adult life. Nutraceuticals are compounds derived from natural food sources with therapeutic value [9]. They offer alternative strategies to address neurodegenerative diseases like PD. Nutraceuticals exert positive effects through various mechanisms, including modulating signaling pathways, inhibiting oxidative stress, inflammation, and apoptosis, as well as regulating mitochondrial homeostasis. While nutritional supplements have shown promising results in preliminary studies, it's emphasized that there isn't enough scientific data to recommend them for Parkinson's disease at present. Patients are cautioned about potential side effects, interactions with other drugs, and the exclusivity of over-the-counter medications [10]. Some nutraceuticals have demonstrated neuroprotective effects in experimental models and may serve as alternatives to synthetic drug compounds like l-Dopa, known for causing undesirable side effects It's noted that many nutraceuticals function through a variety of mechanistic pathways rather than adhering to a single mechanism. The mechanisms by which they work can be broadly classified into the following themes: (1) reactive oxygen species (ROS)/free radical scavenging; (2) anti-inflammation; (3) iron chelation; (4) modulation of cell signalling pathways; (5) anti-apoptosis; and (6) mitochondrial homoeostasis, although several nutraceuticals essentially function via a myriad of mechanistic pathways rather than adhere to a single mechanism (Figure 1) [11]. This comprehensive overview provides valuable insights into the potential benefits of nutraceuticals in addressing Parkinson's disease, highlighting both their promising aspects and the need for cautious consideration due to the current lack of sufficient scientific data. The diverse mechanisms of action of nutraceuticals contribute to their potential as alternative or complementary approaches in managing neurodegenerative conditions.

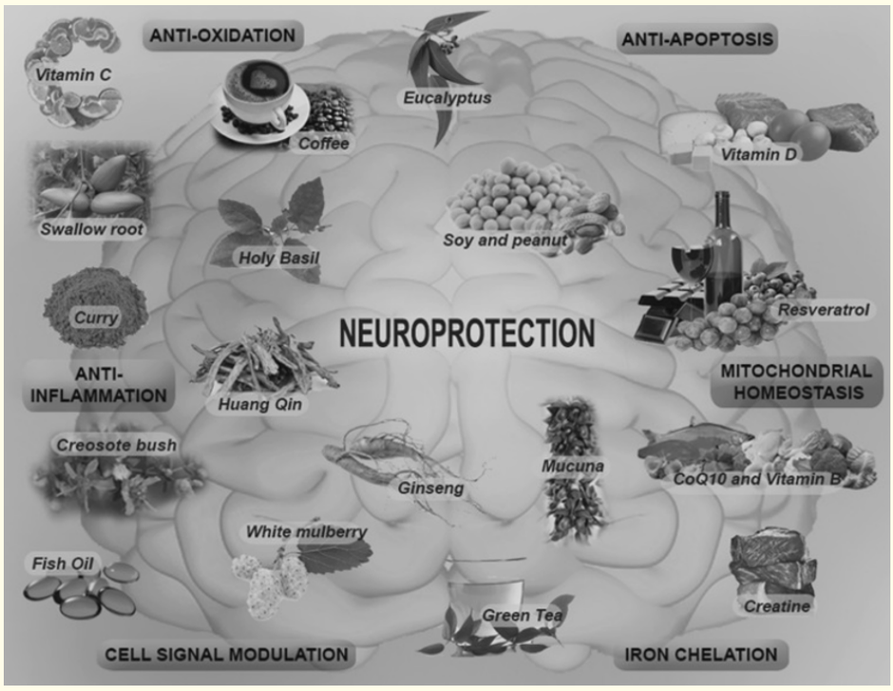

Figure 1: Nutraceuticals as therapeutics for PD. Nutraceuticals for PD can be grouped broadly into six themes based on their neuroprotective properties: (1) iron chelation; (2) cell signalling modulation; (3) anti-inflammation; (4) anti-oxidation; (5) anti-apoptosis; and (6) mitochondrial homoeostasis. However, several nutraceuticals hold multiple properties and function via a myriad of mechanistic pathways rather than adhere to a single mechanism [13].

Cardiovascular diseases

CVD encompasses disorders of the heart and blood vessels, including hypertension, coronary heart disease, cerebrovascular disease, heart failure, and peripheral vascular disease [12]. Research studies recognize a protective role for diets rich in fruits and vegetables against CVD. Plant sterols/stanols, found in various plant products like fruits, vegetables, cereals, seeds, and nuts, are identified as having a protective role against CVD. Resveratrol, a grape-derived stilbene found in grapes, cranberries, blueberries, peanuts, and Japanese knotweed, is extensively studied for its potential benefits against CVD [13]. Cocoa and chocolate contain various polyphenols, including catechins, flavonol glycosides, anthocyanins, and procyanidins, the rhizome of *Zingiber officinalis* (ginger) is a common condiment with a history of medicinal use and is noted for its positive effects on CVD. Buckwheat seeds are mentioned for containing phytosterols, flavonoids, flavones, proteins, and thiamin-binding proteins, with properties that lower blood cholesterol and hypertension. Omega-3 fatty acids found in fish are dietary components that affect plasma lipids and CVD, including their impact on arrhythmias. Octacosanol, found in whole grains, fruits, and leaves of many plants, is noted for its lipid-lowering property with no reported side effects. The degree of fermentation of tea leaves influences their chemical composition, with green tea containing more catechins and minimally fermented, while black tea is rich in flavins and the arubigins. Spirulina, a blue-green microalga, is highlighted as a rich source of protein, vitamins, minerals, carotenoids, and phycocyanins, with a long history of use as a human foodstuff. Nutraceuticals in the form of vitamins, minerals, antioxidants, dietary fibers, and omega-3 polyunsaturated fatty acids (n-3 PUFAs), along with physical exercise, are recommended for the prevention and treatment of CVD. Your information provides a comprehensive overview of various nutraceuticals and their potential benefits in promoting cardiovascular health [14]. The inclusion of specific compounds and their dietary sources adds depth to the discussion.

Cancer and nutraceuticals

The World Cancer Report indicates an increasing trend in cancer rates, with an expected 15 million new cases in 2023, signifying a 50% rise. Carotenoids, responsible for food colors, have antioxidant activities and are effective in cancer prevention [15]. Lycopene, found in tomatoes, guava, pink grapefruit, watermelon, and papaya, concentrates in specific organs such as the prostate, testes, skin, and adrenal, offering protection against cancer. Beta-carotene, found in yellow, orange, and green leafy vegetables and fruits, possesses antioxidant activity and helps prevent cancer and other diseases. Alpha-carotene and epsilon carotene also exhibit antioxidant activity [16]. Isoflavones in soy foods, similar to those found in tea and curry, have cancer chemopreventive properties. Soybean consumption is associated with protection against breast, uterine, lung, colorectal, and prostate cancers. Saponins, found in peas, soybeans, and herbs, have potential anticancer properties [17].

Tannins, present in grapes, lentils, tea, blackberries, blueberries, and cranberries, scavenge harmful free radicals and detoxify carcinogens. Ellagic acid, present in walnuts, pecans, strawberries, cranberries, pomegranates, and red raspberry seeds, is noted as an anticancer agent. Pectin, a soluble fiber in apples, has been shown to prevent prostate cancer metastasis by inhibiting cancer cells' adhesion. Phenolic compounds such as curcumin, gallic acids, ferulic, and caffeic acid are reported to possess anticancer activity [18-20]. Glucosinolates and their hydrolysis products, including indoles and isothiocyanates, found in cruciferous vegetables, are associated with a lower risk of colorectal and lung cancer. Sulforaphane, derived from these vegetables, is an antioxidant and stimulator of natural detoxifying enzymes, reducing the risk of breast and prostate cancer. Curcumin, a polyphenol from turmeric, is highlighted for its potential anticancer properties. Consumption of fruits and vegetables containing cysteine, glutathione, selenium, Vitamin E, Vitamin C, lycopene, and various phytochemicals elevates antioxidative capacity. Large-scale clinical trials suggest the effectiveness of agents such as green tea, Vitamins D and E, selenium, lycopene, soy, anti-inflammatory compounds, and inhibitors of 5a-reductase in preventing prostate cancer [21]. While there is promising evidence, more investigations are needed to determine the beneficial effects of these compounds in cancer prevention or treatment. Your information provides a wealth of knowledge on various dietary components and their potential roles in cancer prevention. The emphasis on the need for further research adds a cautious perspective to the discussion.

Diabetes and nutraceuticals

Type 2 diabetes is the most common form of diabetes, accounting for 95% prevalence, and is strongly associated with obesity [22]. Despite the introduction of various drugs for prevention and treatment, the global number of people with diabetes is increasing. Diabetes imposes significant economic burdens not only on individual patients and their families but also on society as a whole. Isoflavones, phytoestrogens with structural/functional similarities to human estrogen, have been studied, with soy isoflavones showing associations with lower incidence and mortality rates of type 2 diabetes, heart disease, osteoporosis, and certain cancers.Omega-3 fatty acids are suggested to reduce glucose tolerance in individuals predisposed to diabetes. The synthesis of long-chain n−3 fatty acids requires insulin, making the heart particularly susceptible to their depletion in diabetes. Ethyl esters of n−3 fatty acids are considered potential benefits in diabetic patients [23]. Lipoic acid, an antioxidant, is used for treating diabetic neuropathy and is considered effective as a long-term dietary supplement for protecting diabetics from complications [24]. Dietary fibers from psyllium are extensively used as pharmacological supplements and food ingredients, aiding in weight reduction, glucose control in diabetic patients, and reducing lipid levels in hyperlipidemia. Plant extracts from Toucrium polium, cinnamon, and bitter melon have shown promise in preventing or treating diabetes. Your information underscores the importance of dietary factors in the prevention and management of diabetes. It highlights the potential benefits of specific components such as isoflavones, omega-3 fatty acids, lipoic

acid, dietary fibers, and plant extracts [25]. This holistic approach to understanding the relationship between diet and diabetes is valuable for individuals and healthcare professionals alike.

Obesity

Over 50% of both men and women in the WHO European Region were overweight in 2008, with approximately 23% of women and 20% of men being obese [26]. Given the global increase in obesity and its health consequences, efficient strategies for prevention and treatment are crucial [27]. Weight reduction programs are recommended to focus on achieving a modest weight loss of 7–10% of the initial weight. Obesity arises from an energy imbalance where energy intake exceeds energy expenses. Dealing with obesity requires alteration of one or both mechanisms of energy balance, including food intake, energy expenditure, and energy storage [28]. Nutraceuticals have emerged as an alternative to current medicines with proven health benefits. Increased availability of high-fat, energy-dense foods is a primary cause of obesity. Nutraceutical interventions, such as capsaicin, conjugated linoleic acid, *Momordica charantia*, and Psyllium fiber, possess potential antiobese properties. Excessive consumption of energy-rich foods contributes to weight gain [28]. Caloric restriction and increased physical activity, while moderately successful in managing obesity, may have limitations. Nutraceuticals and pharmaceuticals are being investigated as potential treatments for obesity and weight management. Herbal stimulants like caffeine, ephedrine, chitosan, ma huang-guarana, and green tea are effective in facilitating body weight loss. Controversies surround their use due to potential side effects. Green tea extract and 5-hydroxytryptophan are mentioned as nutraceuticals that may promote weight loss, with green tea extract increasing energy expenditure and 5-hydroxytryptophan decreasing appetite. Your information provides a detailed understanding of the multifaceted nature of obesity and the potential role of nutraceuticals in its prevention and treatment. The emphasis on the challenges of traditional approaches and the exploration of nutraceutical interventions adds depth to the discussion [29].

Class/Type of Nutraceutical	Examples	Active Ingredient	Advantages	References
Traditional approaches				
Functional foods	Tomatoes	Lycopene	Anticancer activities, e.g., lung and prostate, reduce blood pressure	[10]
	Salmon	Omega 3	Lower cardiovascular, diabetes disease risk	[11]
	Soy	Saponins	Antioxidant, detoxification of enzymes, stimulate immune response, hormonal metabolism	[12]
	Fermented milk and milk products	L. acidophilus, Bifidobacterium spp.	Prevent gastrointestinal infections, lower the level of cholesterol	[13]
	Marine algae	Fucoidans	Antioxidant, anticancer, anticoagulant activity	[14]
	Broccoli	Sulforaphane, glucosinolates	Decrease risk of several cancers, antioxidant	[15][16]
	Carrots	β-carotene	Reduce cancer risk, improve immune system	[15][17]
	Aloe	Aloins	Wound healing, antiulcer, anti-inflammatory, immunostimulant, antimicrobial activity, hematopoietic stimulation	[18][19]
	Turmeric	Curcumin	Anti-inflammatory, anticarcinogenic	[18][20]
Dietary supplements	Folic acid		Prevent defect in neural tubes, Red blood cells formation	
	Vitamin A		Antioxidant, growth, treat some skin diseases	[22]
	Calcium		Bone, muscles, teeth nerve health, prevent osteoporosis	[23][24]
	Iron		Carry oxygen, produce energy	[22]
	Vitamin D		Bone and teeth health, help in calcium absorption, musculoskeletal health	[25]

Probiotics	*Lactobacillus acidophilus*, *Bifidobacterium* spp., *Streptococci*, *Enterococci*			Gut health, replace diarrhea-causing bacteria, anticancer	[22][26] [27]
Prebiotics	Fructo-oligosaccharides			Enhance probiotics growth, *bifidobacteria* growth enhancement	[28]
	Inulin		Enhance immune system, minerals absorption, protect bones		[29][26] [30]
Non-conventional approach					
Fortified	Orange juice with calcium	Calcium, ascorbic acid		Glycemic control enhancement, sensitivity to insulin	[31]
	Anthocyanin-fortified bread	Anthocyanin	Reduce digestion rate	[32]	
Recombinant	Gold kiwifruit	Ascorbic acid, carotenoids		Immune system enhancement	[8][33]

Table 1: Class/type of nutraceuticals traditional sources and their active ingredients to advantages in lifestyle based diseases.

Conclusion

Nutraceuticals are substances used to improve health, delay aging, prevent chronic diseases, increase life expectancy, or support the structure and function of the body. Nutraceuticals have gained considerable interest due to their potential nutritional, safety, and therapeutic effects. Most dietary supplements, including nutraceuticals, are derived from plants, and some may also come from animal sources. The most recent trend in the field is moving towards nutragenomics, indicating an intersection between nutrition, genomics, and health. The shift towards nutragenomics and the focus on nutraceuticals have ushered in a new era of medicine and health. Nutraceuticals may be defined as substances that provide physiological benefits or protection against chronic diseases. Recent studies have shown promising results for nutraceuticals in various complications related to oxidative stress, including allergy, Alzheimer's disease, Parkinson's disease, cardiovascular diseases, cancer, diabetes, and obesity. Your information emphasizes the potential of nutraceuticals in addressing a wide range of health conditions and their role in disease prevention and modification. The mention of nutragenomics highlights the evolving nature of research and practices in the field of nutrition and health. Overall, your statement provides a comprehensive perspective on the significance of nutraceuticals in promoting well-being and preventing chronic diseases.

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