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A Review on Path to Wellness: Nutraceuticals and Functional Foods

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Abstract: In recent years, there has been an increasing interest in nutraceuticals which offer health advantages and serve as alternatives to conventional medicine. Nutraceuticals consist mainly of nutrients, herbal products, and dietary supplements, which are essential for maintaining health, combating various illnesses, and enhancing quality of life. The rapid expansion, advancements in research, absence of standards, enthusiastic marketing, quality control, and regulatory measures will significantly influence its success or decline. Nutraceutical products arise from collaborative research among the pharmaceutical, food, and chemical industries. As the healthcare sector expands in India, the nutraceutical market is also on the rise as individuals seek to address their health issues by enhancing their wellness through Fast Moving Healthcare Goods. Now, people say "a nutraceutical a day may keep the doctor away," replacing the traditional saying "an apple a day keeps the doctor away." Consumers are increasingly turning to dietary supplements to boost their health, especially where conventional medicine falls short.

Index Terms **- Nutraceutical, Health, Traditional, Dietary Supplements, Herbal.**

I. INTRODUCTION

Nutraceutical "any substance that can be regarded as a food or a component of food that offers medical or health advantages, including disease prevention and treatment. These products can vary from isolated nutrients and dietary supplements to genetically modified 'designer' foods, herbal products, and processed items such as cereals, soups, and drinks. [3] Nowadays, individuals are more knowledgeable about nutrition than ever, with their curiosity for health-related information being satisfied by numerous sources. According to the International Food Information Council (IFIC), functional foods are defined as "foods or dietary components that may provide health benefits beyond basic nutrition." [4] The International Life Sciences Institute of North America (ILSI) describes functional foods as "foods that, through physiologically active components, offer health benefits beyond basic nutrition." [5] Health Canada characterizes functional foods as "foods that resemble conventional options, are consumed as part of the regular diet, have demonstrated physiological advantages, and/or help mitigate the risk of chronic diseases beyond fundamental nutritional roles." The Nutrition Business Journal categorizes functional food as "food enhanced with additional or concentrated ingredients to functional levels, enhancing health or performance." [6] Examples of functional foods include fortified cereals, breads, sports drinks, bars, enhanced snack foods, baby foods, prepared meals, and much more.

Concepts of Nutraceuticals-

In the process of developing pharmaceuticals, clinical test outcomes from animal studies and tests are essential for confirming the effects. However, in recent times, as scientific research has demonstrated that food composition can lead to lifestyle-related illnesses, this has emerged as a significant societal concern, with the transition toward nutraceuticals. [2-6]

1. A growing number of consumers who are worried about healthcare expenses.
2. Frustration with pharmaceutical products in enhancing health has led individuals to seek out nutraceuticals to better their health and avoid chronic illnesses.
3. Healthcare professionals acknowledge that our heavily processed food supply, derived from crops treated with chemical fertilizers, pesticides, herbicides, and frequently genetically modified seeds, often lacks the necessary nutrients for optimal health.
4. An increasing belief among people in prevention over cure.
5. Individuals with chronic illnesses who have found no relief through conventional medicine.
6. Patients facing economic difficulties.

Figure 1: Concept of Nutraceuticals [4]

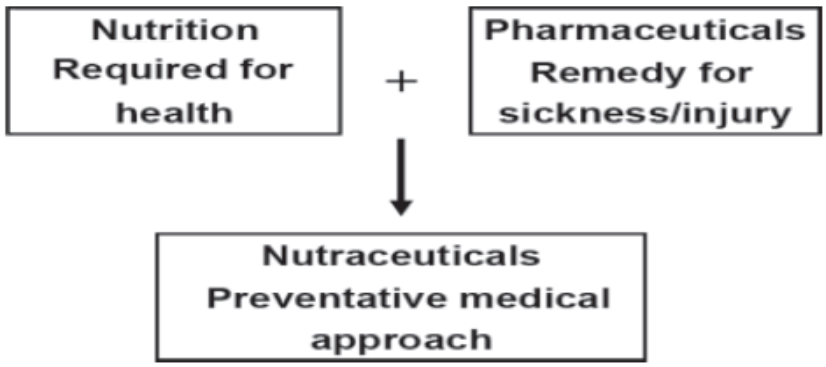

Figure 1: Concept of Nutraceuticals [4]

Categories of Nutraceuticals [9]

Nutraceuticals are biological therapies that are not specific to any one ailment, utilized for enhancing well-being, preventing disease, and managing symptoms. They can be classified in the following ways:

1. By their chemical makeup

Health Benefit

(a) Nutrients [10]

Substances with established nutritional functions, such as vitamins, minerals, amino acids and fatty acids. Common nutrients and their associated health benefits shown in Table 1.

Table 1: Nutrient list and their significance

Sr.no	**Nutrients**	**Health Benefits**
1.	Vitamin A	Acts as an antioxidant, It is crucial for growth and development, and aids in treating certain skin conditions**.**
2.	Vitamin E	Functions as an antioxidant, it is involved in the formation of blood cells, muscle, lung, and nerve tissues.
3	Vitamin K	Plays a vital role in the process of blood coagulation.
4	Vitamin C	Serves as an antioxidant, supports the health of bones, gums, teeth, and skin, assists in wound healing.
5.	Vitamin B1	Aids in converting food into energy and is essential for neurologic functions.
6.	Vitamin B2	Contributes to energy production and other biochemical processes within the body, while also supporting healthy eyes.
7.	Vitamin B3	Facilitates the conversion of food into energy and is important for maintaining proper brain function.
8.	Vitamin B6	It is involved in the production of genetic material in cells, the formation of red blood cells, the upkeep of the central nervous system.

9	Folic acid	Participates in the creation of genetic material in cells, is essential during pregnancy to avert birth defects.
10.	Calcium	It is necessary for maintaining the strength of bones and teeth, and is important for nerve, muscle, and glandular functions.
11	Iron	It is involved in energy production and the transportation of oxygen to bodily tissues.
12	Magnesium	Supports proper nerve and muscle function, assists in bone formation, and may help in the prevention of premenstrual syndrome (PMS).
13	Phosphorous	Supports the development of strong bones and teeth, aids in the creation of genetic material.
14	Chromium	Assist with insulin in transforming carbohydrates and fats into energy.
15	Cobalt	A vital part of vitamin B12, however, cobalt consumed is converted in the body to produce B12 coenzymes.
16	Copper	Crucial for the formation of haemoglobin and collagen, the proper functioning of the heart.
17	Iodine	Necessary for the ideal operation of the thyroid gland

(b) Herbal Products [11]

Herbs or botanical items utilized in concentrated forms and extracts
Notable herbs and their medicinal significance are detailed in Table 2.

Table 2: Herbals used and their therapeutic relevance

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	Herbals (Botanical source)	Therapeutic activity
1.	Aloe vera gel (*Aloe vera* L. N.L. Burm.)	Dilates capillaries, anti-inflammatory, emollient, wound healing properties.
2.	Chamomile (*Matricaria recutita* L.)	Anti-inflammatory, spasmolytic, antimicrobial, wound Healing.
3.	Echinacea (*Echinacea purpurea* L.)	Immunostimulant, treatment of cold and flu symptoms.
4.	Ephedra (*Ephedra sinica* Stapf.)	Bronchodilator, vasoconstrictor, reduces bronchial Edema.
5.	Evening primrose oil (*Oenothera biennis* L.)	Dietary supplement of linoleic acid, treatment of atopic eczema.
6.	Feverfew (*Tanacetum parthenium* L.)	Treatment of headache, fever and menstrual problem, severity and duration of migraine headaches.
7.	Garlic (*Allium sativum* L.)	Antibacterial, antifungal, antithrombotic, hypotensive anti-inflammatory.
8.	Ginger (*Zingiber officinale Rosc.*)	Carminative, antiemetic, cholagogue, positive inotropic.
9.	Ginseng (*Panax ginseng*)	Adaptogen.
10.	Ginkgo (*Ginkgo biloba* L.)	Vasodilation, increased peripheral blood flow, Treatment of post thrombotic syndrome.
11.	Goldenseal (*Hydrastis canadensis* L.)	Antimicrobial, astringent, antihemorrhagic, treatment of mucosal inflammation, dyspepsia, gastritis.
12.	Horehound (*Marrubium vulgare* L.)	Expectorant, antitussive, choleretic.
13.	Licorice (*Glycyrrhiza glabra* L.)	Expectorant, secretolytic, treatment of peptic ulcer.
14.	Melissa (*Melissa officinalis* L.)	Topical antibacterial and antiviral.
15.	Plantago seed (*Plantago arenaria* Waldst)	Cathartic.
16.	St. John's wort (*Hypericum perforatum* L.)	Anxiolytic, anti-inflammatory, antidepressant, monoamine oxidase inhibitor.
17.	Valerian (*Valeriana officinalis* L.)	Spasmolytic, mild sedative, sleep aid.
18.	Willow bark (*Salix alba* L.)	Anti-inflammatory, analgesic, antipyretic, astringent, treatment of rheumatic and arthritic.

(c) Dietary Supplement

Dietary supplements are products taken orally that include dietary ingredients aimed at enhancing the foods you consume. Examples include black cohosh for menopausal issues, ginkgobiloba for memory enhancement, and glucosamine/chondroitin for arthritis relief. The components of supplements may include vitamins, minerals, herbs or other botanical ingredients, amino acids, enzymes, organ tissues, glandular extracts, or various other dietary substances.[12].

These supplements can be classified as depicted in Table 3.

Significance

Table 3: Different Categories of Dietary Supplements

1	1. Ketogenic diets	Composed of foods high in fat and low in protein and carbohydrates, have been shown to enhance seizure control(13).
2	Minimally refined grains	Cereals and grains enriched with calcium may lower the risk of diabetes (14) and help prevent gastrointestinal cancers (15).
3	Phytoestrogens	This effect may help mitigate hot flushes and reduce the risk of breast cancer (16).
4	Glucosamine sulfate and chondroitin sulfate	These substances are effective and safe options for alleviating osteoarthritis symptoms (17)
5	Peptides/Hydrolysates	Found in casein and proteins, exhibit A.C.E. inhibitor activity (18). Buckwheat proteins used as flour help lower cholesterol, manage hypertension(19).
6	Dairy products	Containing beneficial probiotic bacteria that are said to support gut health. Bio yoghurts with Lactobacillus acidophilus and Bifidobacteria are leading products in this area (20).
2	Diabetes	1. Docosahexaenoic acid plays a role in modulating insulin resistance[24]. 2. Lipoic acid, an antioxidant, is used for managing diabetic neuropathy [25]. 3. Buckwheat seed proteins function similarly to dietary fibers found in food [28].
3	Obesity	1. 5-hydroxytryptophan and green tea extract may facilitate weight loss, with the former reducing [29]. 2. A combination of glucomannan, chitosan, fenugreek, G. sylvestre, and vitamin C in dietary supplements has shown a significant impact on reducing body weight [30]. 3. Conjugated linoleic acid (CLA), capsaicin, and Momordica Charantia (MC) exhibit promising anti-obesity properties [31]. 4. Flavonoids that inhibit the enzymes responsible for estrogen production may reduce estrogen-induced cancers [32]. 5. To reduce the risk of prostate and breast cancer, a variety of phyto-pharmaceuticals with phyto-estrogens, are recommended [33]. 6. Isoflavones from soy foods, curcumin and soy isoflavones, have cancer chemopreventive effects [34].
4	Cancer	1. Lycopene accumulates in the skin, testes, adrenal

		glands, and prostate, where it plays a protective role against cancer [35]. 2. Saponins found in peas, soybeans, certain herbs, spinach, tomatoes, demonstrate antitumor and anti-mutagenic properties [36]. 3. Curcumin (diferuloylmethane), a polyphenol possesses anticarcinogenic, antioxidative, and anti-inflammatory qualities [37]. 4. Beet roots, cucumber fruits, spinach leaves, and turmeric rhizomes have been reported to exhibit antitumor activity [38]. 5. Gamma-linolenic acid, sourced from green leafy vegetables, nuts, and hemp seed oil, along with spirulina, is used for treating inflammatory and autoimmune issues [39].
5	Anti-inflammatory Disease	1. Glucosamine and chondroitin sulfate are utilized for osteoarthritis treatment [40]. 2. Cat's claw contains 17 alkaloids, along with glycosides, tannins, flavonoids, sterol fractions acting as a potent anti-inflammatory agent [41].
6	Allergy	1) Quercetin (found in onions, red wine, and green tea) alleviates inflammation associated with hay fever, bursitis, gout, arthritis, and asthma [42].
7	Alzheimer's disease	1. β-carotene, curcumin, lutein, lycopene, and turmerin may positively influence specific diseases by counteracting the detrimental effects of oxidative stress, mitochondrial dysfunction, and various forms of neural degeneration [43].
8	Vision Improving agent	1. Lutein (found in mangoes, corn, sweet potatoes, carrots, squash, tomatoes, and bok choy) is used for treating visual disorders.[44] 2. Zeaxanthin (present in corn, egg yolks, and green vegetables and fruits like broccoli, green beans, peas,) has been used in traditional Chinese medicine primarily for addressing visual disorders[45]
9)	Osteoarthritis	1. Glucosamine (GLN) and chondroitin sulfate (CS) help alleviate symptoms associated with osteoarthritis [46].

3. Traditional and Nontraditional Nutraceuticals -

A wide range of nutraceutical foods are available in the marketplace, which can be classified as conventional or unconventional.

(a)Traditional Nutraceuticals -

Conventional nutraceuticals encompass foods that remain unchanged; they are simply natural, whole foods with new insights regarding their potential health benefits. The actual foods have not been altered, aside from how the consumer views them. Numerous fruits, vegetables, grains, fish, dairy, and meat products possess various natural compounds that provide advantages beyond basic nutrition, such as lycopene found in tomatoes, omega-3 fatty acids in salmon, or saponins in soy. Additionally, studies have suggested that items like tea and chocolate also contain health-promoting properties. Tomatoes and salmon are examples of foods identified by researchers as offering benefits that surpass basic nutritional value — specifically, lycopene and omega-3 fatty acids, respectively.

(2) Nontraditional Nutraceuticals -

Unconventional nutraceuticals arise from agricultural advancements or the inclusion of nutrients and/or ingredients, such as calcium-fortified orange juice, cereals enhanced with additional vitamins or minerals, and flour supplemented with folic acid. Agricultural scientists have successfully developed methods to enhance the nutritional profile of specific crops. Ongoing research aims to improve the nutritional quality of various other crops [47].

NUTRACEUTICALS ON DISEASE PREVENTION-

Nutraceuticals are significant in the prevention of various diseases and in minimizing complications associated with them. They offer protection against non-communicable diseases, slow down the aging process, enhance life expectancy, and boost body function.

3.1Cardiovascular Disease-

Nutraceuticals such as flavonoids, flavones, flavonones, and quercetin found in onions, cruciferous vegetables, blackberries, cherries, and apples, along with other antioxidant vitamins and minerals, may lower the risk of mortality from cardiovascular diseases (CVDs). These compounds inhibit the cyclooxygenase pathway and angiotensin-converting enzyme (ACE), which contributes to high blood pressure. Additionally, they prevent platelet clumping and adherence. Flavonoid groups fortify small capillaries that transport oxygen and essential nutrients to all cells. The polyphenols found in grapes modify cellular metabolism and signaling, which aids in reducing arterial diseases.[19] Moreover, poly-herbal products may work synergistically to reach effective therapeutic outcomes.[22]

3.2 Cancer

Nutraceuticals rich in bioactive dietary ingredients have the potential to prevent cancer.[23] Herbal nutraceuticals possess properties that combat mutations and cancer development. The antioxidant effects of carotenoids and lycopene are beneficial for cancer prevention as they neutralize oxygen and reduce oxidative stress. Nutraceuticals can control factors that cause DNA damage in cells and inhibit DNA transcription in tumors.[24] Ginseng acts as an anti-inflammatory agent, helping to prevent chronic inflammation associated with cancer. Chemo preventive compounds found in fruits and vegetables exhibit significant anti-carcinogenic and anti-mutagenic properties.

3.3. Obesity

Obesity is defined as a medical condition involving the excess accumulation of body fat. Nutraceuticals such as conjugated linoleic acid, capsaicin, and psyllium exhibit strong anti-obesity effects. Herbal nutraceuticals including chitosan, caffeine, fenugreek, vitamin C, green tea, curcumin, black gram, and bottle gourd are known to aid in weight reduction.[28,29] These substances stimulate the secretion of leptin and various cytokines like IL-1 and IL-6, contributing to the decrease of LDL and overall cholesterol levels, while also helping to manage food intake.[30,31]

3.4. Osteoarthritis

Osteoarthritis is a multifaceted disease impacting all tissues in the joints and encompasses both biochemical and mechanical factors that work together to deteriorate cartilage. Joint pain leads to a decrease in physical activity, resulting in an energy imbalance and subsequent weight gain. Nutraceuticals such as chondroitin sulfate, glucosamine, diacerin, banana, ginger, green tea, pomegranate, boswellia, oxaceprol, tipi, willow bark, curcumin, avocado, soybean, and collagen hydrolysate are utilized to mitigate its complications.[33] These agents possess pharmacological properties and play a significant role in regulating gene expression, in addition to their primary functions as nutrients. Antioxidant-rich nutraceuticals have substantial evidence supporting their effectiveness in managing inflammation, pain, and joint damage.[34]

3.5. Oral diseases

The term odontonutraceuticals has recently emerged,[38] referring to phytotherapeutic agents with diverse effects in dentistry by regulating various molecular and biochemical pathways.[39] These bioactive phytochemicals help prevent oral diseases and may significantly impact the complex nature of oral disorders. Odontonutraceuticals include components like green tea, grapes, and cocoa seed extracts that are abundant in polyphenols, flavonoids, and proanthocyanidins.[40]

3.6. Alzheimer's disease

Alzheimer's disease, known as senile dementia, is characterized by the potential of antioxidants to decelerate its progression. Nutraceuticals such as beta carotene, lycopene, curcumin, lutein, and lavandula utilize their antioxidant properties to counteract neuronal damage caused by oxidative stress. These compounds can help delay the onset of dementia.[43] Multiple studies suggest that the intake of vitamins like folic acid and B12 can lower homocysteine levels, which may also impede the progression of the disease.[44]

3.7. Parkinson's disease

In Parkinson's disease, the neurons responsible for releasing dopamine in the brain are damaged due to neurodegeneration, making it the second most prevalent age-related disorder globally.[45] Compounds such as plant polyphenols, stilbenes, phytoestrogens from soybeans, vitamin C, vitamin D, vitamin E, coenzyme Q10, and unsaturated fatty acids have shown protective benefits against the advancement of Parkinson's disease.[46] The herbal nutraceutical Brahmi serves as a natural brain tonic that aids in mental well-being and relaxation, alleviates migraines and headaches, addresses insomnia and depression, eases anxiety, improves blood circulation in the brain.[35]

RESEARCH AND DEVELOPMENT

The most pressing scientific requirement in the field of nutraceuticals involves the standardization of compounds and products, which necessitates the careful planning and execution of clinical trials to substantiate health claims that affect both consumers and companies making strategic decisions. [20]

Significant market dynamics are driving interest in nutraceuticals:

* Rapid progress in scientific research validating the essential role of diet in maintaining health and preventing diseases.
* Soaring healthcare expenses.
* An aging demographic.
* Technological advancements in the food industry enabling the creation of health-oriented foods that appeal to health-conscious consumers at a higher price.
* The evolving regulatory landscape. [21]

CONCLUSION-

The nutraceutical sector is expanding at a rate that greatly surpasses growth in the food and pharmaceutical industries. They are widely embraced across all age groups due to their safety, high-quality, purity, effectiveness, and health-enhancing and disease-treating capabilities. The current trend toward nutraceuticals is ushering in a new era of medicine and health. Future interest in nutraceuticals hinges on consumer beliefs about the connection between diet and health conditions. Despite the considerable potential of nutraceuticals for enhancing human health and preventing disease, health professionals, nutritionists, and regulatory toxicologists should collaborate to devise suitable regulations that yield optimal health and therapeutic benefits for society. Extensive clinical studies are essential to scientifically substantiate the efficacy of nutraceuticals for various medical conditions. The interaction between nutraceuticals and food or medications is also an important consideration. The influence of different processing techniques on the bioavailability and effectiveness of nutraceuticals still needs to be explored. Similar to pharmaceuticals, there should be stringent regulatory measures in place for nutraceuticals. Nutraceuticals hold significant promise for promoting human health and disease prevention.

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