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## A REVIEW ON NUTRACEUTICALS

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**Abstract:** Nutraceuticals are food product that provides health as well as medical benefits; including the prevention and treatment of disease. Few nutraceuticals are used as pharmaceuticals and a number of other being used and purchased by the general public as self-medication. Such products ranges from dietary supplements to genetically engineered foods, herbal products and processed foods. Clinical research on nutraceutical product is going on for integrating and assessing information. The main aim of this article is to explore and discuss that a number of nutraceuticals can actually treat or prevent underlying causes of disease. This article outlines the types and therapeutic applications of nutraceuticals.

**Keywords:** Nutraceuticals, functional food, dietary supplement, health promoters.



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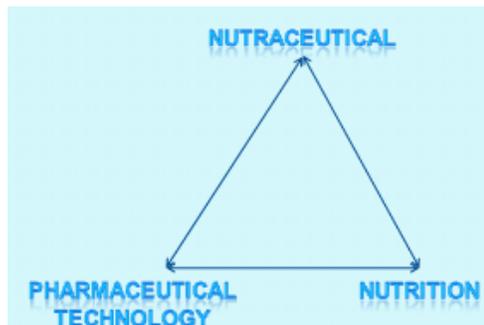
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## INTRODUCTION

Nutraceuticals are any products derived from food sources, and which offer extra health benefits besides the basic nutritional values other foods offer. The term “nutraceutical” was coined from the words “nutrition” and “pharmaceutical,” by Stephen Defelice, in 1989. Defelice was the founder and chairman of the Foundation for Innovation in Medicine, an American organization that encourages medical health discovery. A nutraceutical substance is any food, or part of a food, that provides medical or health benefits and helps in the prevention and treatment of disease.



Nutraceuticals are products that give extra nutritional value to food, and help in prevention and treatment of diseases. The nutraceuticals market can be classified into functional foods, dietary supplements, medicinal foods, and farmaceuticals. The market can also be segmented by its usage in body building, diabetes control, pain relief, and weight control. The nutritional requirement of a person varies according to the age of the individual and hence this industry offers various products according to demographics.

An increase in obese and diabetic patients on a global scale is the key driving force for the Nutraceuticals and Processing Technologies market. The market contributes less than 10% to the total food industry globally, but good growth opportunities are available if proper business partnership models are practiced, regulatory frameworks change, and consumer preferences are taken into consideration. The nutraceuticals market is growing at a fast pace as consumer awareness regarding health and fitness is increasing on a global scale. Some of the benefits associated with the use of nutraceuticals are delayed ageing process, prevention and treatment of chronic diseases, and improved life expectancy. Some factors like the changing lifestyle of the working population, affordability of medical services and good media penetration is expanding the nutraceuticals market in Asian countries.

The high price of nutraceuticals products is one of the major restraints to this industry due to the high cost of the raw material, higher manufacturing cost, and lower profit margins. The

absorption rate of nutrients from these products is a major concern. Other challenges to the industry are maintaining quality standards, safety, and effectiveness. Some of the key participants in the nutraceuticals market are BASF Group, Cadbury, Cargill, Bayer Healthcare, Clif Bar & Company, Johnson and Johnson group, Jordan Cereals, and Herbal Life International of America.

**Nutraceuticals include** COQ10, Probiotics/Prebiotics, Taurine, Omega-3, Green Tea, Antioxidants, Calcium, Lycopene, B-Complex, Dietary fiber, Collagen, Aloe vera and Zinc.

According to the report **IMARC** group, a major driver of the global nutraceuticals market is a continuously ageing global population. The report finds that a number of factors are catalysing this trend. The elderly people are increasingly addressing their health concerns with their dietary choices. Secondly, anti-ageing is a big issue for seniors and personalized foods and beverages claiming to slow the ageing process are easily able to get patronage. Thirdly, with the population getting older, more health problems are emerging and the need to keep them in control is increasing. With a continuous growth in the elderly population across both developed and emerging markets, the opportunity for nutraceuticals is expected to become more widespread in the coming years.

#### **Categories of nutraceuticals:**

Nutraceuticals are segmented into three major groups: Dietary Supplements, Functional Foods and Functional Beverages.

- 1. Dietary supplements:** Sub segmented into vitamin & mineral supplement, herbal supplements like ayurvedic extracts, plant extracts and protein supplements like protein powder & lifestyle products.
- 2. Functional Foods:** Sub segmented into omega fatty acid foods, probiotic foods and
- 3. Functional beverages:** Energy drinks, sports drinks and fortified juices.

Few commonly used nutraceuticals in India are Arjuna Sheerapka (for cardio protection), Shatavari Grihta (for women's health during various physiological states) and Brahma Rasayana (for protection from mental stress).

#### **Technologies used for nutraceuticals:**

Fortification, alteration, enhancement are few of the technologies used for nutraceuticals. To improve the bioavailability of nutraceuticals, patenting of new delivery systems is a new trend

like in nanotechnology which is a rapidly evolving interdisciplinary field based on the manipulation of matter on a submicron scale.

Recently it has been found that **Cactus plant**, which is used as anti-cancer, anti-viral, anti-diabetic plant, has a rich source of fibre and edible pulp. In cactus pear, taurine is a major contributor, which is fast becoming an active constituent of nutraceuticals.

WHO (World Health Organisation) has launched the first Global Strategy to address issues related to traditional medicine.

Assessing the various factors driving market growth, FMI analyst said, “*Advancements in product offering is fuelling the demand for nutraceuticals for application in a wide range of products such as medicines and food & beverages.*” The analyst added that increasing awareness among consumers in Middle East & North Africa (MENA) about the benefits of nutraceutical products over conventional medicines is expected to further fuel market growth, which in turn will prompt manufacturers to diversify their product offerings and introduce nutraceutical products to keep up with the demand.

### Currently available Dietary Supplements

- Vitamins/ Mineral supplements – eg: Revital, Evion, Seacod, Thirty plus, Becosules
- Dietetic supplements – Isoflavones, Prebiotic- Probiotic combinations
- Herbal supplements – eg. Chyawamprash, Mentat, Liv-52.



### Nutrients to Limit

Total Fat	≤ 35% of calories
Saturated Fat	< 10% of calories
Trans Fat	0 g (labelled)
Cholesterol	≤ 60 mg per serving

Added Sugars	≤ 25% of total calories
Sodium	≤ 480 mg per serving

### Potential health benefits

From many years nutraceuticals have considerable interest due to their potential nutritional, safety and therapeutic effects. They have a role in a plethora of biological processes, including antioxidant defenses, cell proliferation, gene expression, and safeguarding of mitochondrial integrity.

Therefore nutraceuticals are used to improve health, prevent chronic diseases, postpone the aging process (and in turn increase life expectancy), or just support functions and integrity of the body. They are considered to be healthy sources for prevention of life threatening diseases such as diabetes, renal and gastrointestinal disorders, as well as different infections.

A wide range of nutraceuticals have shown to impose crucial roles in immune status and susceptibility to certain disease states. They also exhibit diseases modifying indications related to oxidative stress including allergy, Alzheimer's disease, cardiovascular diseases, cancer, eye conditions, Parkinson's diseases and obesity.

### Research studies:

A number of phytopharmaceuticals and medicinal plants have demonstrated the efficacy of Huperzine A, berry anthocyanins, *trans*-resveratrol, *Ginkgo biloba*, *Bacopa monniera*, *Centenella asiatica*, ginseng, vitamin B12, alpha lipoic acid, vinpocetine, tocotrienols and palm oil, selenium, black pepper, acetyl choline, and gamma aminobutyric acid (GABA) in boosting brain health and physical well-being. Consumption of marine fishes and general seafood has been recommended for long-term nutritional intervention to preserve mental health, hinder neurodegenerative processes and sustain cognitive capacities in humans. Omega-3 (n-3) and omega-6 (n-6) polyunsaturated fatty acids (PUFAs), phosphatidylserine (PS) and marine antioxidants prevents the initiation and progression of many neurological disorders. Marine antioxidant carotenoid astaxanthin (present in salmon, shrimp and lobster) have shown promising results against free radical-promoted neurodegenerative processes and cognition loss.

Novel nutraceuticals including resveratrol, curcumin and green tea catechins have the potential to prevent Alzheimer's disease because of their anti-amyloidogenic, anti-oxidative and anti-inflammatory properties[1]. These novel nutraceuticals activate adaptive cellular stress

responses, called "neurohormesis," and suppress disease processes. Furthermore, amyloid-induced pathogenesis of Alzheimer's disease can also be partially protected or retarded by these novel dietary phytochemicals.

Medicinal herbs and structurally diverse botanicals have been widely used in Asia for more than 2,000 years. Botanical extracts with anti-amyloidogenic activity, including green tea catechins, turmeric, *Salvia miltiorrhiza*, berry anthocyanins, and Panax ginseng have demonstrated significant efficacy in Alzheimer's diseases[2,3,4]. Furthermore, Indian spices including cinnamon, ginger, rosemary, sage, salvia herbs, black pepper, as well as Chinese celery, singly and in combination, exhibited highly promising neuroprotective efficacy against Alzheimer's disease.

Vinpocetine is a vinca alkaloid that exhibits cerebral blood-flow enhancing and neuroprotective effects. Vinpocetine, a potent anti-inflammatory agent, has been demonstrated to treat cerebrovascular disorders including atherosclerosis and ischemic stroke. It improves neuronal plasticity and reduces the release of inflammatory cytokines and chemokines from endothelial cells, vascular smooth muscle cells, macrophages and microglia by inhibiting the inhibitor of the NF-kB pathway[5].

Huperzine A, a natural multifaceted pharmacological agent isolated from the Chinese folk medicine *Huperzia serrata* (Qian Ceng Ta), has demonstrated an ideal therapy for incurable degenerative brain diseases, as well as protecting the brain from free radical damage and maintaining or enhancing key neurotransmitter action and assisting the brain in functioning optimally. It is important to know that Huperzine A is a potent inhibitor of acetylcholinesterase (AChE), and thus helps to increase levels of acetylcholine in the brain. Huperzine A has also been demonstrated to protect the neurons against amyloid beta-induced free radical injury and mitochondrial dysfunction, as well as via the up-regulation of nerve growth factor and antagonizing N-methyl-d-aspartate receptors[6]. Huperzine A also exerts as a potential disease-modifying agent for Alzheimer's disease and other neurodegenerative disorders by significantly slowing down the course of neuronal death.

*Bacopa monniera* has been demonstrated as an Ayurvedic nerve tonic, indicating a potential role in helping prevent dementia and serving as a novel memory enhancer. Research studies demonstrated *Bacopa monniera* acts as a novel brain antioxidant, and favorably influences diverse neurotransmitters including serotonin, 5-hydroxytryptamine (5-HT), dopamine, acetylcholine and gamma-aminobutyric acid to execute the pharmacological effect to promote brain rejuvenation[7]. Especially, 5-HT has demonstrated to fine-tune the neural plasticity,

which is a substrate responsible for the key molecular restructuring associated with accelerated memory formation and functioning.

Curcumin, a novel polyphenolic antioxidant derived from the plant *Curcuma longa*, is widely used in India and Southeast Asia. Alzheimer's, Parkinson's and neurodegenerative malignancies have demonstrated chronic inflammatory responses mediating through increased accumulation of cellular free radicals, and oxidative damage to lipids, DNA and proteins. Curcumin has demonstrated significant efficacy against Alzheimer's, Parkinson's and diverse neurological malignancies. Curcumin protects against these structurally diverse neurodegenerative diseases via regulation of transcription factors, cytokines and NF- $\kappa$ B activity[8].

Parkinson's disease is another chronic and progressive movement disorder, affecting approximately 1 million people in the United States, with virtually no cure. Parkinson's involves the malfunction and death of vital nerve cells called neurons. Parkinson's primarily affects neurons in an area of the brain called the substantia nigra. These dying neurons produce dopamine, a neurotransmitter that controls movement and coordination. Ultimately, affected persons are unable to control movement normally. A number of nutraceutical antioxidants including epigallocatechin 3-gallate (EGCG) from green tea, apple quercetin, curcumin, resveratrol, rosemary-derived phenolic diterpenes such as rosmarinic acid or carnosic acid, broccoli-derived organosulfur compounds including isothiocyanate and L-sulforaphane, and garlic-derived allicin have demonstrated neuroprotective activity in Parkinson's disease[9]. In Parkinson's disease, these antioxidants provide protection by scavenging noxious free radicals via activation of Nrf2 transcription factor pathway and modulation of signal transduction cascade and gene expression.

A large body of evidence has indicated GABA has significant protective role in diverse neurological and psychiatric disorders including schizophrenia, neuropathic pain, as well as Alzheimer's and Parkinson's diseases[10].

Marine fishes and seafood including shrimp, crabs, lobster and salmon are excellent sources of the antioxidant carotenoid astaxanthin. Also, astaxanthin-rich algal biomass, fish oil including omega-3 fatty acids (PUFAs) and krill oil have demonstrated a potential role in preserving memory, sustaining cognitive functions and preventing neuro-inflammatory, neuro-motor and neurodegenerative disorders in humans and animals[11].

Researchers have demonstrated the beneficial effect of asiaticoside derived from *Centenella asiatica* in migraine and other neurological problems through 5-HT<sub>1A/1B</sub> mediated action[12].

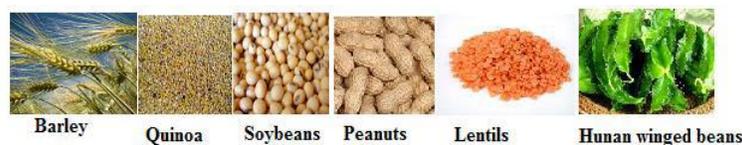
Overall, a number of nutraceutical and functional food supplements protect brain health and function against cognitive decline and boost its performance. Furthermore, selected nutraceutical and functional food supplements nourish the sub-cellular fractions of brain and enhance the activity of different neuronal receptors. Based on our extensive in-house research studies and peer-reviewed publications, we recommend selected optimal combination of ingredients which can attenuate and optimize the brain performance and function in a synergistic manner.

**Nutraceutical garden:** Plants offer a myriad of benefits and provide us with not only nutritional but also medicinal benefits. The Nutraceutical Garden is divided into six components each one focusing on these different plant types. These are Vegetables, Herbs, Herbaceous Plants, Grains and Legumes, Fruit and Common Weeds [13].

1. **Vegetable component** – Leek, Onion, Common Garlic, Shallot, Celery, Parcel, Beet, Swiss Chard, Mustard Green, Kale.



2. **Herb component** – Anise Hyssop, Chive, Angelica, Feverfew, Caraway, Lemon Grass, Lovage, German Chamomile, Basil, Oregano
3. **Herbaceous component** –Common Yarrow, Butterfly Weed, Black Cohosh, Foxglove, Meadowsweet, Sweet Potato Vine, English Lavender, Psyllium Indian
4. **Grain and Legume component** – Barley, Quinoa, Peanut, Soybeans, Lentils, Hunan Winged bean



5. **Perennial Fruit component** –Apple, Gooseberry, Hardy Arctic Kiwi, Lingonberry, Lowbush and Highbush Blueberry, Peach, Raspberry, Red Currant, Sour Cherry, Valencia Oranga, Wonderberry or Sunberry



6. **Weed component** - Burdock, Chicory, Horseweed, Ground Ivy, Creeping Charlie, Purslane, Plaintain, Sheep's Sorrel, Dandelion

### Nutraceuticals Market

With improved standard of living and changing lifestyle in Asia-Pacific, market has experienced a sea change in consumer's food habits and buying pattern. Irregular eating, junk food and hectic lifestyle has resulted in their ill health. Thus, giving rise to a number of diseases, mostly related to nutritional deficiencies. [Nutraceuticals](#) can play a vital role in curbing various health issues. They provide medicinal and health benefits for the treatment of diseases. The potential of this market is increasing particularly in Asia-Pacific due to the challenging lifestyle of the people who are looking for a modern and quick approach to fight for diseases or to prevent them.

Nutraceuticals promotes longevity and various health benefits. They are easily available and economically affordable. It claims to have a psychological benefits too in diseases like Chronic inflammatory disorder, degenerative diseases and antidiabetics. Few nutraceutical products like green tea, omega-3 fatty acids prevents obesity, helps in weight loss, improved glowing skin and cancers too. For example milk is a nutraceutical which is good for the heart and muscles.

### Role of Nutraceuticals in various diseases:

1. **Cancer therapy:** Nutraceuticals holds the promise that they are prominent active doctrines against cancer cells. The impact of different types of nutraceuticals derived from herbals like

- Phenolic Acids and Phytochemicals
- Dietary Fiber and Phytoestrogens
- Vitamin C and E as Nutraceuticals

- Resveratrol, Quercetin and Catechins
  - Lycopene, Genistein and Curcumin
  - Cruciferous Vegetables and Cancer Prevention
  - Combinatorial therapy
- 2. Cardiovascular Health:** Recent research innovations in Nutraceuticals allied with heart disease inhibition. In cardiac heart disease, atherosclerotic plaques form on the inner surface of arteries, which narrow the lumen and reduced the blood flow. There are many Nutraceuticals which are beneficial in the prevention or symptom reduction of CHD. Eg- soy protein, isoflavonoid and flax lignin.
- Marine derived components like Fish Omega 3 Fatty Acids- EPA and DHA
  - Fruit and Vegetables, Soy Proteins
  - Whole grains, Nuts and Legumes
  - Phytochemicals and Polyphenols
  - Sterols, Stanols, Phenols & Flavones
  - Dietary Patterns for cardiovascular health
- 3. Weight management:** An enduring approach to a healthy lifestyle and it comprises a balance of healthy eating and physical exercise to associate energy expenditure and energy intake. Sufferers would be delighted to find a relatively effortless way to handle this global public health issue through Nutraceuticals. There are different aspects in which weight issues can be managed from early stages of human life.
- Probiotic Supplementation
  - Marine bioactives and supplements
  - Herbal weight loss
  - Absorption Blockers
  - Thermogenic Ingredients
  - Capsaicins and Catechins
  - Soluble Dietary Fibers

#### 4. Joint diseases:

Joint diseases affect people of all ages mainly the elderly. Main joint diseases are:-

- a) **Osteoarthritis-** Degenerative damage and loss of the articular cartilage of the joint due to loss of protein substance between the bones of joints.

b) **Rheumatoid Arthritis**- Rheumatoid arthritis (RA) is a chronic, inflammatory disorder that may affect many an organs nd tissues but principally affect joints. In this condition inflamatory synovitis produced that causes distruction of articular cartilage.

#### **Nutraceutical use-**

##### **A-Glucosamine and Chondroitin-**

· **Glucosamine** is a precursor to a molecule called a glycosaminoglycan-this molecule is used in the formation and repair of cartilage[14].

· Source-bovine or calf cartilage

· Glucosamine sulphate in several European countries used as first line of treatment for arthritis. There side effects and contraindications are less but diabetics need to be careful as glucosamine might have an effect on insulin resistance. Glucosamine sulphate stimulates the production of hyaluronic acid in joint fluid. Hyaluronic acid relieves pain and improves mobility by repairing damaged cartilage. *In vitro* experiment of Glucosamine has shown a dose dependent increase in proteoglycan after administering it [15].

· It is marketed usually as hydrochloride or sulfate salt. Both compound have anti-inflammatory effects. Combination of Glucosamine and chondrotin are available [14].

· **Chondroitin** is the most abundant glycosaminoglycan in cartilage and is responsible for the resiliency of cartilage[14,15].

##### **β -Methylsulfonyl Methane (MSM) -**

It is a sold as nutritional and dietary supplement often used in combination with glucosamine and chondroitin[15]. MSM is the oxidized form of dimethyl sulfoxied; a natural organic form of sulfur and provides a source of sulfur for the formation of the cartilage matrix or the antioxidant system. Both this compound used for pain and inflammation.

**Recent Trends in Nutraceutical research:** Recent innovations in Nutraceuticals field are said to be the future upsurge in global public health issue.

- Nutricosmetics
- New generation skin supplements
- Food Polymers in Delivering Dietary Bio-actives

- Nutrigenetics and Nutrigenomics
- Safety and Efficacy of Nutraceuticals

**Nutraceutical bioactives:** Bioactives are specific compounds present in food, which help in stimulating health benefits. They are derived from marine's sources like Seaweed, Algae, Fishes, Shellfishes. Botanical and other natural ingredients like Fruits, Root crops, Cereals, Nuts and Seeds, Pulses, Edible Oils, etc; Foods that contain such bioactives are at times called Nutraceuticals. These bioactives show significant impact on human health.

- Tissue regeneration and disease prevention
- Regulation of stem cell function
- Prevention of chronic inflammation
- Skin penetration and oral absorption

#### CONCLUSION:

Nutraceuticals are growing at a rate far exceeding expansion in the food and pharmaceutical industry. Nutraceuticals are presenting excellent opportunities for research scholars and industry people to exploit their usefulness. A place for nutraceuticals in clinical research is emerging, but important pharmaceutical and clinical issues need to be addressed by further research. So, adopt nutraceuticals evidence based medicines and let food be our medicines

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