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REVIEW ARTICLE ON NUTRACEUTICAL

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ABSTRACT
Nutraceuticals are necessary food elements that have both nutritional and therapeutic properties. Nutraceuticals have been discovered to have a good impact on Cardiovascular and immune system health, as well as play a role in the prevention of infection and cancer. Nutraceuticals represent an emerging class of bioactive compounds derived from natural food sources that provide health benefits beyond basic nutritional value. The increasing prevalence of lifestyle-related disorders such as cardiovascular diseases, diabetes, obesity, and gastrointestinal disorders has intensified interest in nutraceuticals as preventive and adjunct therapeutic agents. Nutraceuticals are divided into classes based on their nature and mechanism of action. Various nutraceutical classifications and their potential therapeutic action in disease, such as anti-cancer, antioxidant, anti-inflammatory, and anti-lipid activity, will be discussed in this review. Furthermore, the various mechanisms of action, uses, and safety of these products on consumers, as well as current trends and future prospects of nutraceuticals, will be covered.

KEYWORDS: *Nutrients, Functional foods, Dietary supplements, Bioactive compounds and nutraceuticals .*

INTRODUCTION

Hippocrates, some 2000 years ago, properly stated, "Let food be your medicine, and medicine be your food." The recognition that "nutraceuticals" play a vital role in health enhancement has sparked a surge in global interest. The term “nutraceutical” was coined by Dr. Stephen DeFelice in 1989 by combining nutrition and pharmaceutical, to describe substances that have nutritional value and therapeutic potential beyond basic nutrition. However, there is no universally accepted regulatory definition, and the term often overlaps with functional foods and dietary supplements in literature [1]. In the past decade, despite the growing popularity of organic and natural foods, functional foods have significantly captured public interest. The food industry is keen to market these foods for their potential to promote health or maintain wellness. However, such claims are backed up by the lack of knowledge among the public, which is often linked to poor dietary choices [2]. The current state of the art on functional foods focuses significantly on the recovery, enhancement, and fortification of nutrients and bioactive compounds in foods to improve their health benefits. However, functional food design can only be applied when food side streams adopt a sustainable and health-oriented focus to develop new ingredients and formulations [3].

Because of their perceived safety and possible nutritional and therapeutic advantages,nutraceuticals and functional foods have attracted a lot of attention." The nutraceutical and functional food industries are in a good position to take advantage of consumer interest in these products. Whether it's a big pharmaceutical corporation, a nutritional company, a large food multinational, or a tiny vitamin-selling company, all are aware of changing patterns and the growing health-conscious customer trend. As a result, there is a proliferation of these value-added goods targeted at not only maintaining one's health but also the prevention and treatment of a variety of conditions ranging from heart disease to cancer [4].
Nutraceuticals have been claimed to provide physiological benefits or provide protection against the diseases listed below (and/or have been discovered to behave as) :-

- Cardiovascular agents
- Antiobese agents
- Antidiabetics
- Anticancer agents
- Immune boosters
- Chronic inflammatory disorders
- Degenerative diseases
- Rheumatoid Arthritis
- Cholesterol Lowering
- Blood pressure
- Digestive problems
- Osteoporosis

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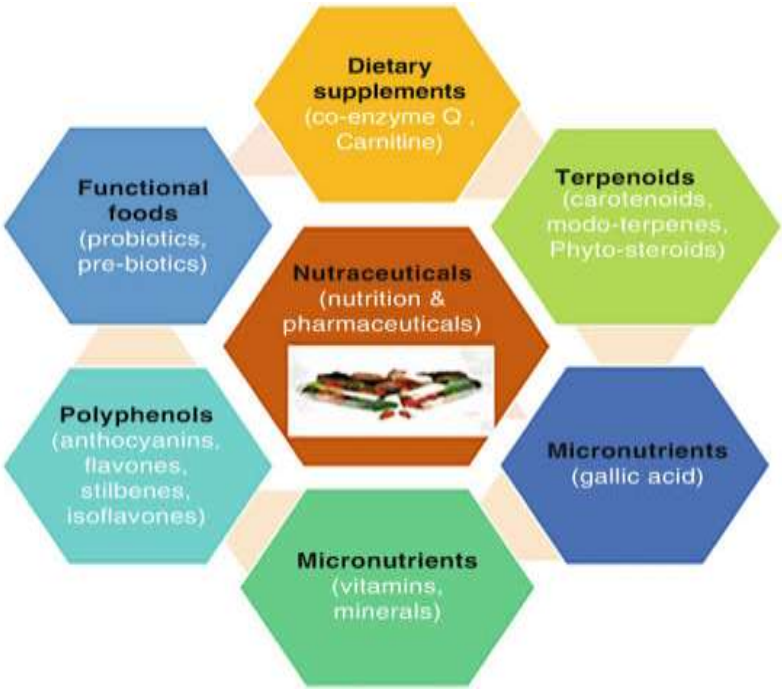


Figure 1: Nutraceuticals

Nutraceuticals are mainly consist of :-
1) Nutrients – Substances which have established Nutritional functions
e.g. Vitamins, Minerals, Amino acids, Fatty acids, etc.
2) Herbals/ Phytochemicals – Herbs or Botanical products.
3) Dietary supplements – Probioics, Prebiotics, Antioxidents, Enzymes, etc.

VARIOUS NUTRACEUTICALS USED AGAINST DIFFERENT DISEASE –

Sr. no.	Disease.	Examples
1	Alzheimer	Vitamin E and Vitamin C
2	Cardiovascular	Flavonoids (onion, black grapes)
3.	Parkinson.	Vitamin E
4.	Obesity.	Chitosan, Vitamin C
5	Diabetes.	Calcium, Vitamin D, Emblica
6	Osteoarithritis	Glucosamine, Chondroitin sulfate
7	Constipation	Buck wheat
8	Vision improving	Carrot, Mangoes, Spinach, Kiwi
9	Antioxidant.	Oats, Fruits, Carrots
10	Anti – inflammatory	Turmeric
11	Hypertension	Curry leaf, green tea
12	Hyperlipidemia.	Emblica officinalis

Uses of Nutraceuticals

Nutraceuticals provide energy and nutrients to body which are required for maintain optimal health.They used to prevent the onset of many life threating dieses like dibeatics, cancer neuro digernative disorder various consituents plants like catechins, caroteonids, lycopene, polyphenols, PUFA etc have been very effective in prevention and occurrence of various diseases like CVS arthritis,cancer,gasterointestional disorder etc [5].

Anti- Inflammatory
- In cardiac diseases
- Allergic condition
- Oxidative stress
- Cancer
- Gastrointestinal disease

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- Arthritis
  - Anti inflammatory
  - In cardiac disease
  - Allergic conditions
  - Oxidative stress
  - Cancer
  - Gastrointestinal disease

CATEGORIZING NUTRACEUTICALS

They can be classified on the basis of their natural sources, pharmacological conditions, as well as chemical constitution of the products. Most often they are grouped in the following categories: dietary supplements, functional food, medicinal food, pharmaceuticals.

A dietary supplement represents a product that contains nutrients derived from food products, and is often concentrated in liquid, capsule, powder or pill form.

Although dietary supplements are regulated by the FDA as foods, their regulation differs from drugs and other foods. The food sources used as nutraceuticals are all natural and can be categorized as

- Carbohydrates & Fiber
- Fat & Essential fatty acids
- Protein
- Vitamins
- Minerals like Macro minerals& Trace minerals
- Water and Other nutrients like Antioxidants

Phytochemicals & Intestinal bacterial flora Recombinant nutraceuticals [6,7].

Categories Based on Foods Available in Market

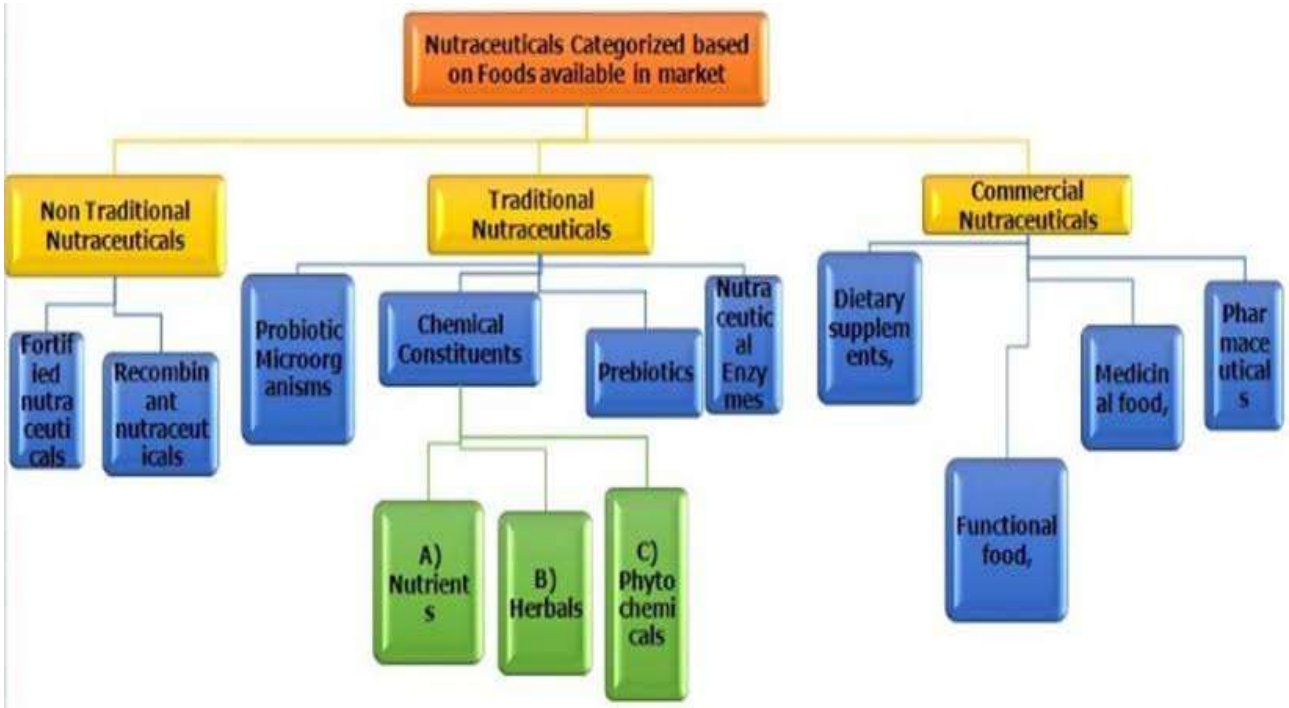


Figure 2: Categories based on foods available in market

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I. NON TRADITIONAL NUTRACEUTICALS

These Are artificial foods prepared with the help of biotechnology. Food samples contain bioactive components which are engineered to produce products for
human- wellness.
They are arranged into two types:

A. Fortified nutraceuticals.
B. Recombinant nutraceuticals.

A. Fortified nutraceuticals

They are enriched with vitamins, minerals, usually at a range up to 100 percent of the Dietary Reference Intake for that nutrient. Fortified nutraceuticals are the food with agricultural breeding or with added nutrients. Some of the examples of fortified nutraceuticals are Orange juice with calcium, cereals with added vitamins or minerals, flour with added folic acid, and milk with cholecalciferol.

B. Recombinant nutraceuticals

Production of probiotics and the extraction of bioactive components by enzyme/fermentation technologies as well as genetic engineering technology are achieved through biotechnology. Energy-providing foods, such as bread,
alcohol, fermented starch, yogurt, cheese, vinegar, and others are produced with the help of biotechnology [8].

II. TRADITIONAL NUTRACEUTICALS

Traditional nutraceuticals are simply natural with no changes to the food. Food contains several natural components that deliver benefits beyond basic nutrition, such as lycopene in tomatoes, omega-3 fatty acid in salmon or saponins in soy.
A. probiotic micro-organism
B. prebiotics
C. chemical constituents
D. nutraceutical enzymes

A. Probiotic Micro-organisms

They act to crowd out pathogens, such as yeasts, other bacteria and viruses that may otherwise cause disease and develop a mutually advantageous symbiosis with the human gastrointestinal tract. They have an antimicrobial effect through modifying the microflora, preventing adhesion of pathogens to the intestinal epithelium, competing for nutrients necessary for pathogen survival, producing an antitoxin effect and reversing some of the consequences of infection on the intestinal epithelium, such as secretory changes and neutrophil migration. Probiotics can cure lactose intolerance by the production of the specific enzyme (ß-galactosidase) that can hydrolyse the offending lactose into its component sugars. Examples are Yogurt is one of the best sources of probiotics, which are friendly bacteria that can improve your health. Kefir is a
fermented probiotic milk drink [9].

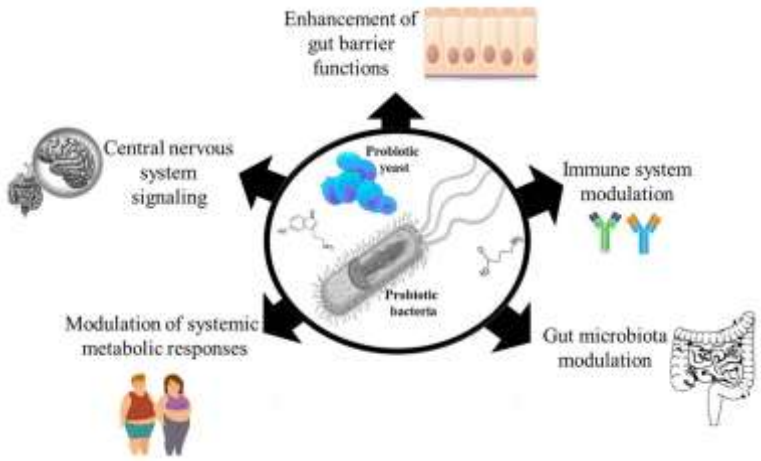


Figure 3 : Probiotic

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B. Prebiotics

"Prebiotics" are a more recent addition to our vocabulary and are substances which when consumed are not digested by us. Instead, they act as a nutrient source for the good probiotic bacteria. This encourages the probiotic bacteria to grow in a favourable environment, which in turn reduces the chances that harmful microorganisms may start to grow in our digestive tract.Example: Inulin is a prebiotic that has been widely used in processed foods [10].



Figure : 4

III. COMMERCIAL NUTRACEUTICALS

Finding a new chemical is more difficult, expensive, and risky than ever before. Many pharmaceutical companies are now attempting to create nutraceuticals due to the enormous and rapidly growing market. Anti- arthritic, cold and cough, sleeping difficulties, digestion, and the prevention of some malignancies, osteoporosis, blood pressure, cholesterol management, pain relievers, depression, and diabetes are just a few of the therapeutic areas covered by nutraceuticals. One of the most promising advances in human nutrition and disease prevention research in the last three decades is the recognition of health benefits from consumption of omega-3 rich sea foods.[11,12]

- Functional food,
- Dietary supplements,
- Medicinal food,
- Pharmaceuticals.

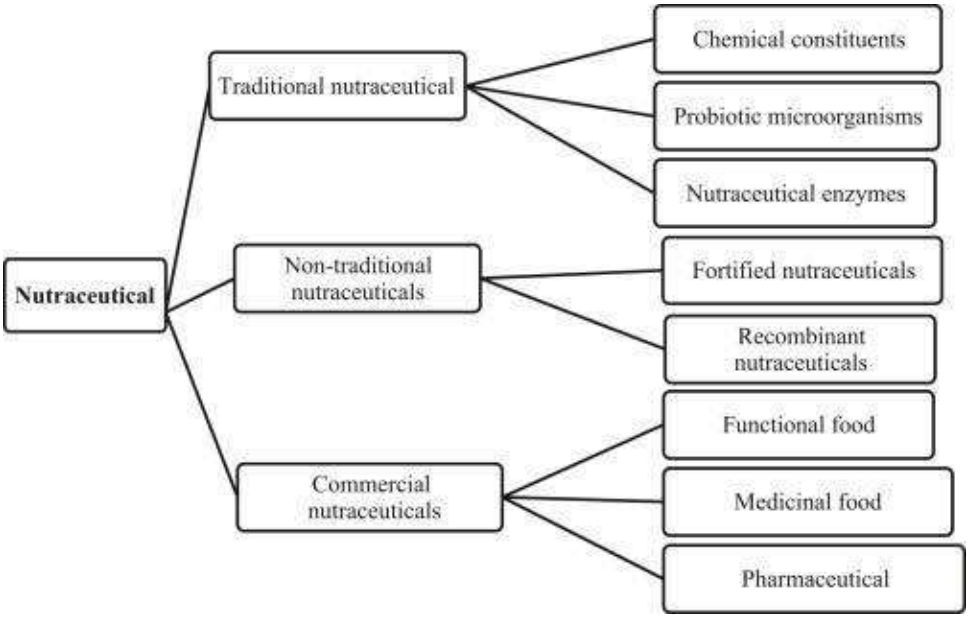


Figure : 5

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Benefits of Nutraceuticals

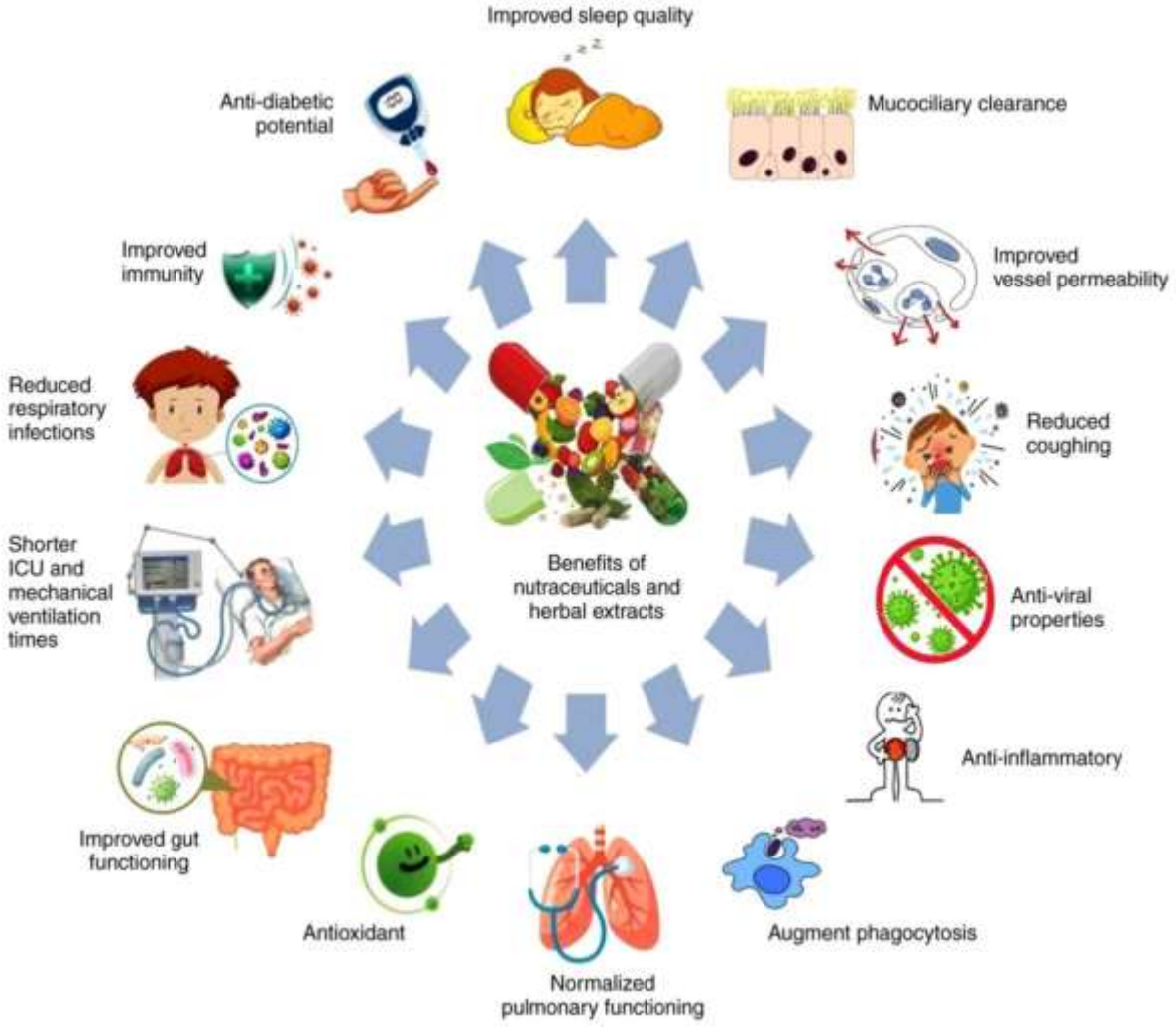


Figure 6. Benefits of nutraceutical

NUTRACEUTICALS AND DISEASES

Nutraceuticals have been claimed to have a physiological benefit or provide protection against the following diseases such as: Cardiovascular, Diabetes, Obesity, Parkinson's Alzheimer's, Cancer, Allergy, Osteoarthritis, Eye disorders,
Immune system and Inflammations.

Cardiovascular Disease

Cardiovascular diseases (CVD) is a chronic disease by means of disorders of the heart and blood vessels which generally include hypertension (high blood pressure), coronary heart disease (heart attack), cerebro-vascular disease (stroke), heart failure, peripheral vascular disease, etc. In cardiac heart disease, atherosclerotic plaques form on the inner surface of arteries, which narrow the lumen and reduced the blood flow. Further it would be the leading cause of death in developing countries. Majority of these diseases would be preventable and controllable. Nutraceuticals used in cardiovascular diseases are Anti-oxidants, Dietary fibres, Omega-3 poly unsaturated fatty acids, Vitamins, minerals for prevention and treatment of CVD. Milk and eggs having gamma linolenic acid (GLA) which has many benefits, including prevention and management of cardiovascular diseases. Polyphenols (in grape) prevent and control arterial diseases. Flavonoids (in onion, vegetables, grapes, red wine, apples, and cherries) block the ACE and strengthen the tiny capillaries that carry oxygen and
essential nutrients to all cells.[13,14]

Diabetes

Diabetes mellitus is characterised by abnormally high blood glucose levels, which can be caused by insufficient insulin synthesis or inefficient insulin.[15] Type 1 diabetes (5 percent), which is an autoimmune illness, and type 2diabetes (95 percent), which is linked to obesity, are the two most frequent types of diabetes[16]. Gestational diabetes is a kind of diabetes that develops during pregnancy.

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Diabetes, like most chronic health diseases, not only has a significant economic impact on society as a whole, but it also has a significant impact on individual patients and their families.[17]

Alzheimer's Disease

Alzheimer's disease (AD) is characterized by progressive dementia with memory loss as the major clinical manifestation. Women are more affected than men at a ratio of almost 2:1 due in part to the larger population of women who are over 70. Several lines of evidence strongly suggest that oxidative stress is etiologically related to a number of neurodegenerative disorders including Alzheimer's disease. [18]

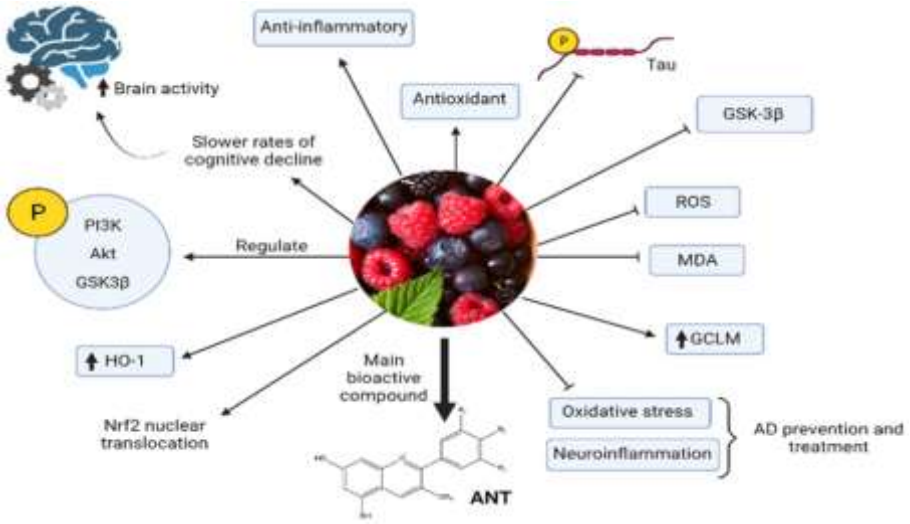


Figure 7 :Novel nutraceutical compound in Alzheimer disease

Nutraceuticals for Hypertension

Hypertension can be prevented, delayed, reduced in severity, treated, and controlled through optimal diet, nutraceuticals, vitamins, antioxidants, minerals, weight loss, exercise, quitting smoking, limiting alcohol and caffeine, and other lifestyle changes. - Lipoic acid, magnesium, Vitamin B6 (pyridoxine), Vitamin C, N-acetyl cysteine, Hawthorne, Celery, -3 fatty acids, and other nutrients and nutraceuticals have calcium channel blocking activity (therefore antihypertensive activity)[19].

Obesity

Obesity is now a global public health problem, defined as an unhealthy amount of body fat, which is responsible for many disorders like angina pectoris, congestive heart failure, hypertension, hyperlipidaemia, respiratory disorders, renal vein thrombosis, osteoarthritis, cancer, reduced fertility etc. The principal causes this rapid rise in obesity rates is the increased accessibility of high-fat, energy dense foods such as energy-rich foods (snacks, drinks, burger, pizzas etc) can encourage weight gain, which calls for a limit in the consumption of saturated and trans fats apart from sugars and salt in the diet about 315 million people are estimated to fall into the WHO-defined obesity categories. Nutraceutical interventions are currently being investigated on a large-scale basis as potential treatments for obesity and weight management. Nutraceuticals used in obesities are Buckwheat is a crop has special biological activities of cholesterol lowering effect, anti-hypertension effects and improving the constipation and obesity condition by acting similar as to dietary fibre present in food. 5-hydroxytryptophan and green tea extract may promote weight loss, while the former decreases appetite, the later increases the energy expenditure. Herbal stimulants, such as ephedrine, caffeine, ma huang-guarana, and green tea help in body weight loss. A blend of glucomannan, chitosan, fenugreek, G Silvestre, and vitamin C in the dietary supplement significantly reduced body weight. Conjugated linoleic acid (CLA), capsaicin, Momordica Charantia (MC) possesses potential anti obese properties. .[20,21]

Osteoarthritis

The most common form of arthritis in the United States is osteoarthritis (OA), a crippling joint illness that affects an estimated 21 million people. Joint discomfort caused by OA and other joint problems may cause people to become less active, resulting in an energy imbalance and weight gain. Weight gain might aggravate existing disorders by putting additional strain on joints. To treat osteoarthritis symptoms, glucosamine (GLN) and chondroitin sulphate (CS) are commonly utilised. These nutraceuticals have both nutrient and medicinal qualities and they appear to modulate gene expression and NO and PGE2 generation, which could explain their anti- inflammatory actions.[22]

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Parkinson's disease

Parkinson's disease is a brain ailment caused by nerve damage in certain areas of the brain, which causes muscle rigidity, shaking, and difficulty walking. It usually strikes people in their mid to late adolescent years.[23]

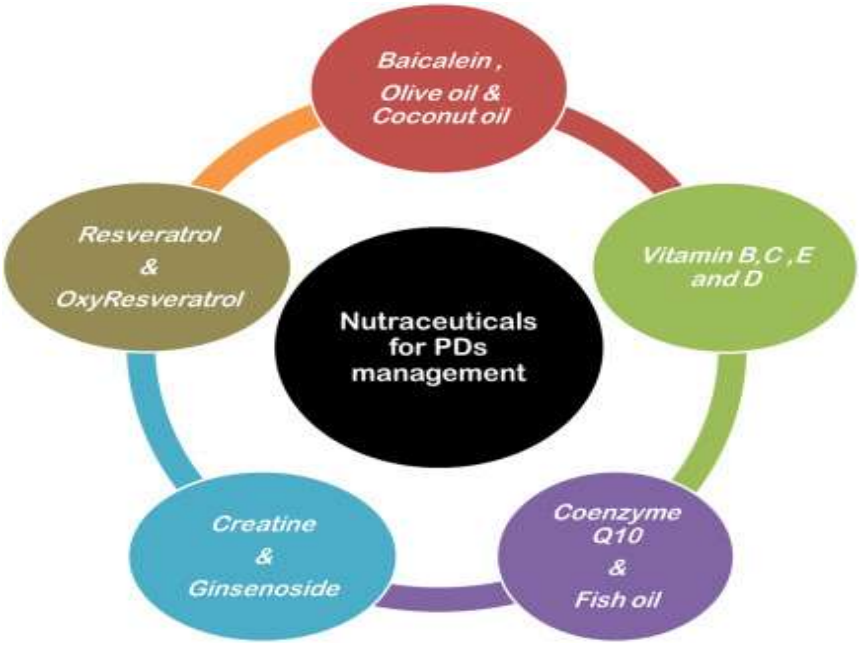


Figure 8: Nutraceuticals in parkinson's disease management

Immune Boosters

Various nutrients in the diet are important for maintaining a "optimal" immune response, as well as the organism's immunological status and susceptibility to a variety of diseases. Phyto-estrogens, a class of phytopharmaceuticals with purported hormonal activity, are advised for the prevention of a variety of disorders linked to a disrupted hormonal balance. In this regard, soy isoflavones (genistein, daidzein, and biochanin) are receiving fresh attention as potential superior alternatives to synthetic selective oestrogen receptor modulators (SERMs), which are currently Used in hormone replacement treatment.

Phytochemicals integrate hormonal ligand activities and interfere with signaling cascades; their therapeutic use may not be restricted to hormonalailments only, but may have applications in chemoprevention and/or certain inflammatory disorders as well as.

The effect of herbalmedicines and bacteria on the immune system and
intestinal epithelial cell function has led to new credence for the use of nutraceuticals and probiotics in clinical settings. Probiotics are effective in conditions such as infectious diarrhoea in children and recurrent Clostridium difficile induced infections. [24]



Figure 9 : Nutraceuticals for Immunity booster

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CONCLUSION

Nutraceuticals are widely used in the food and pharmaceutical industries. Most of the nutraceuticals are from either mineral origin, animal origin or vegetable origin like gamma terpenes, beta carotene, curcumins, limonene, eugenol, pinene, safranal, geraniol, aloine, caryophyllene, lycopene and silymarin. These constituents are prepared into dosage forms as topical, oral, etc. viz. creams, lotions, ointments, emulsions, unani formulations, aromatic oils, microemulsions, SMEDDS, beads, tablets, emulgels, herbal formulations etc. used in various categories as antidiabetic, antibiotic, antimicrobial, anti-inflammatory, anti-cancer, protective, etc. Nutraceuticals are quickly replacing pharmaceuticals in prevention and management of acute and chronic health problems. Nutraceuticals show an ample scope to flourish in future as therapeutic agents with preventive and curative properties. Although nutraceuticals show a promising approach for the promotion of health and prevention of various diseases, yet health professionals, nutritionists, toxicologists should strategically work in collaboration to explore them for their full potential. A ray of cure preference in the mind of common patients revolve around nutraceuticals because of their false perception "All natural medicines are good". Also, a high cost of prescription pharmaceuticals and reluctance of some insurance companies to cover the cost of drugs help the nutraceuticals to solidify their presence in the global market of therapies and therapeutic agents. Use of nutraceuticals as an attempt to explore their therapeutic potential with minimum side effects as compared to conventional pharmaceuticals has observed a great success and met with huge monetary benefits. The preference for exploration and production of nutraceuticals over pharmaceuticals is evident in various pharmaceutical and biotechnology companies. Nutraceuticals still need extensive scientific research to prove their preference over pharmaceuticals. It can be achieved by enactment of FIM Proposed Nutraceutical Research and Education Act (NREA). It includes creation of a Nutraceutical Commission (NUCOM) specifically for the review and approval of nutraceuticals as well as clinical research. As per FIM, NREA should look into exclusive rights over the research and development. Cost wise of nutraceuticals should be kept within the accessibility of common man. There is an imperative need to focus on the establishments of new horizons in nutraceutical development.[25]

FUTURE PROSPECTS

Nutraceuticals are products formed as a result of combined efforts of food, pharmaceutical and chemical industries. Botanical dietary supplement segment is anticipated to witness considerable growth over the forecast period of five years on account of increasing risk of various life style ailments like obesity, hypertension, diabetes etc. Rapidly expanding nutraceutical market is indicating the emergence of a new era in health and wellness industry. Inclination from Pharmaceuticals to nutraceuticals indicates the shifting trend in health care sector. Tremendous growth in nutraceutical industry has implications for food, pharmaceutical and agriculture sector. According to a latest research report by Grand View Research, nutraceutical market is projected to reach worth USD 578.23 Billion with CAGR of 8.8% by 2025.

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