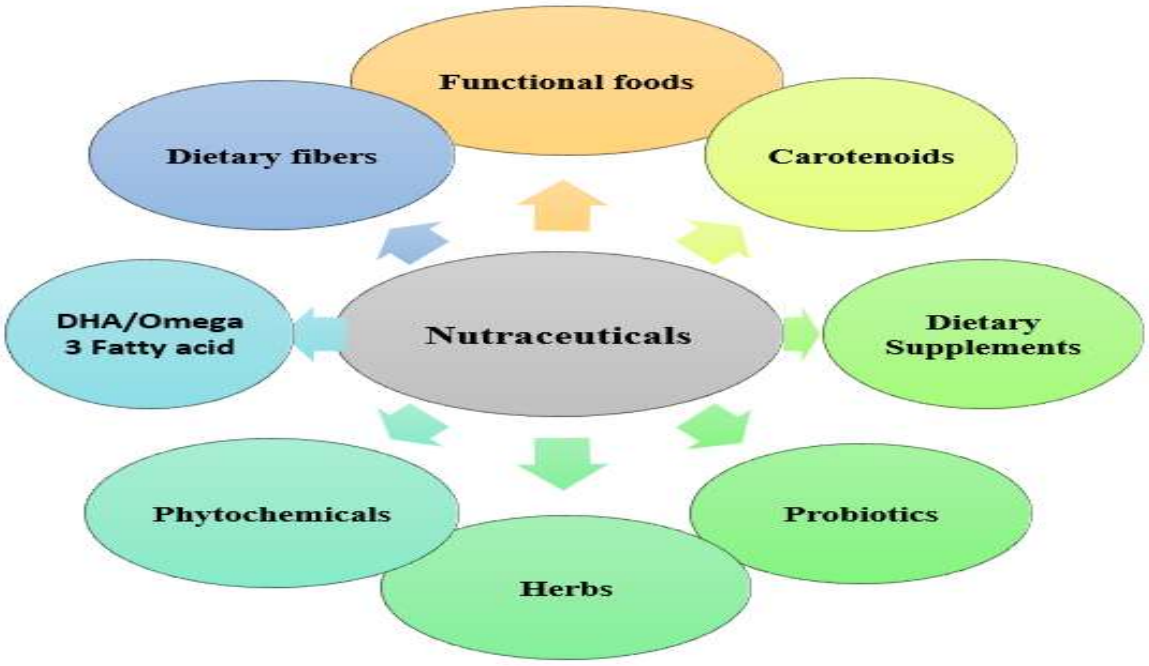
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Classification of Nutraceuticals based on chemical composition

Figure 1:Neutraceutical



Organizing Nutraceuticals

Nutraceuticals are divided into the following categories according to their food sources:

Nutrition Fibers

Dietary fibers are substances derived from plants that are present in foods and add bulk To the contents of the gastrointestinal tract without being reabsorbed by it. Eating foods high in fiber is linked to a lower risk of colon cancer, obesity, hypertension, cardiovascular diseases, and gastrointestinal disorders. Dietary fibers encompass items such as fruits, barley, oats, cellulose, pectin, and lignin, among others. A wide variety of materials classified as dietary fiber are resistant to breakdown by digestive enzymes in the small intestine of humans. The most important fibers found in plant-based foods include pectin, inulin, cellulose, hemicellulose, glucan, and resistant starch, among others. Moreover, several randomized, placebo-controlled studies on low-fiber supplements conducted in the elderly population have demonstrated positive effects on various CVD risk factors, such as blood pressure, triglycerides, metabolic syndrome, LDL, and triglycerides. However, no research has been conducted on the impact of dietary fiber supplements at doses higher than those achievable through diet in the older population concerning CVD risk factors.

Probiotics

Probiotics are dietary supplements that consist of live microorganisms which, when ingested in sufficient amounts, help restore the balance of gut microbes in the host. They reduce the likelihood of developing conditions such as allergies, asthma, cancer, and infections of the urinary tract and ears. Probiotics include organisms like Lactobacilli, among others. When consumed in appropriate quantities, these live bacteria provide health benefits to the host. Gram-positive bacteria that produce lactic acid are part of the genera Lactobacillus and Bifidobacterium, which are found in various foods and constitute a significant portion of the natural bacteria in the gut. Most probiotic microorganisms are utilized in nutraceutical applications. Additionally, probiotics include certain yeasts such as Saccharomyces cerevisiae and boulardii, which can be found in products like bread, wine, beer, and mangosteen fruit.

Prebiotics

Prebiotics are oligosaccharides based on fructose that can occur naturally or be supplied artificially, and they are indigestible by humans. Research has shown that they assist with issues such as constipation, detoxification, dyslipidemia, lactose intolerance, and certain types of tumors. Examples include beans, tomatoes, bananas, and chicory roots. These prebiotics are present in food substances that aid the host by specifically altering the composition or metabolic activity of gut bacteria. They are oligosaccharides based on fructose that can occur naturally or be supplied artificially, and they are indigestible by humans. Research has shown that they assist with issues such as

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constipation, detoxification, dyslipidemia, lactose intolerance, and certain types of tumors. Examples include beans, tomatoes, bananas, and chicory roots.

Polyunsaturated Fatty Acids

Among the omega-3 fatty acids are docosahexaenoic acid, eicosapentaenoic acid, and alpha-linolenic acid, which can be found in fatty fish, flaxseeds, soybeans, and other sources. These are examples of polyunsaturated fatty acids. Numerous large-scale randomized trials have been carried out on older adults to assess the effectiveness of omega-3 supplementation as a preventive or therapeutic approach for cardiovascular disease (CVD). Notably, a substantial number of participants in the JELIS and GISSI-Prevention trials were over the age of 60, including 11,323 individuals in primary prevention and 18,645 patients who had recently experienced a myocardial infarction (secondary prevention).

Antioxidant Vitamins

Many fruits and vegetables are rich in antioxidant vitamins, which possess the ability to inhibit lipid peroxidation and quench singlet oxygen. They also play a role in preventing various health issues. Carotenoids, Vitamin C, and Vitamin E are just a few examples. Antioxidants can be either endogenous or exogenous substances among the nutraceuticals recommended for older adults. Single or combined vitamin supplements (multivitamins) are the most frequently utilized. However, studies have shown that certain B-group vitamins, such as folic acid, may have a slight protective effect against age-related macular degeneration and cognitive decline, although conflicting results have been observed regarding cancer prevention and secondary cardiovascular disease prevention. Finally, numerous studies have highlighted the beneficial effects of vitamin D supplementation, whether on osteoporosis alone or in conjunction with calcium.

Polyphenols

Plants produce phytochemicals such as Anthocyanin, flavonoids, and various polyphenol phenolic acids to defend against reactive oxygen species and the stress of photosynthesis. These compounds can be found in foods like tea and legumes, exhibiting anti-inflammatory and antioxidant properties. The prevention of prostate and colon cancers (CRC) remains a significant area of research. BMC Cancer 2011; 11:360. In addition to studies focused on protection against cardiovascular diseases and cancer, the potential use of polyphenol nutraceuticals in older adults has been evaluated in several studies as a possible adjunct or alternative to anti-diabetic medications. Unfortunately, research involving polyphenols alone or extracts high in polyphenols as daily supplements has yielded inconsistent results for older adults. For example, daily supplementation with grape.

Insoluble Fiber

Nuts, Seeds.

Soluble fiber

Oats, Apple.

Spices

Spices are unique culinary enhancements that elevate the sensory experience of food. Their benefits encompass immunomodulatory, anti-inflammatory, anti-mutagenic, antioxidant, and chemopreventive properties. The majority of essential oils consist of terpenes and various other components found in spices. Examples include black pepper, ginger, and turmeric.

Dietary fibers

Dietary fibers are plant-derived sugars that your body cannot fully digest. They assist with various physiological functions and largely pass through the digestive system intact. These fibers are classified into two main categories.

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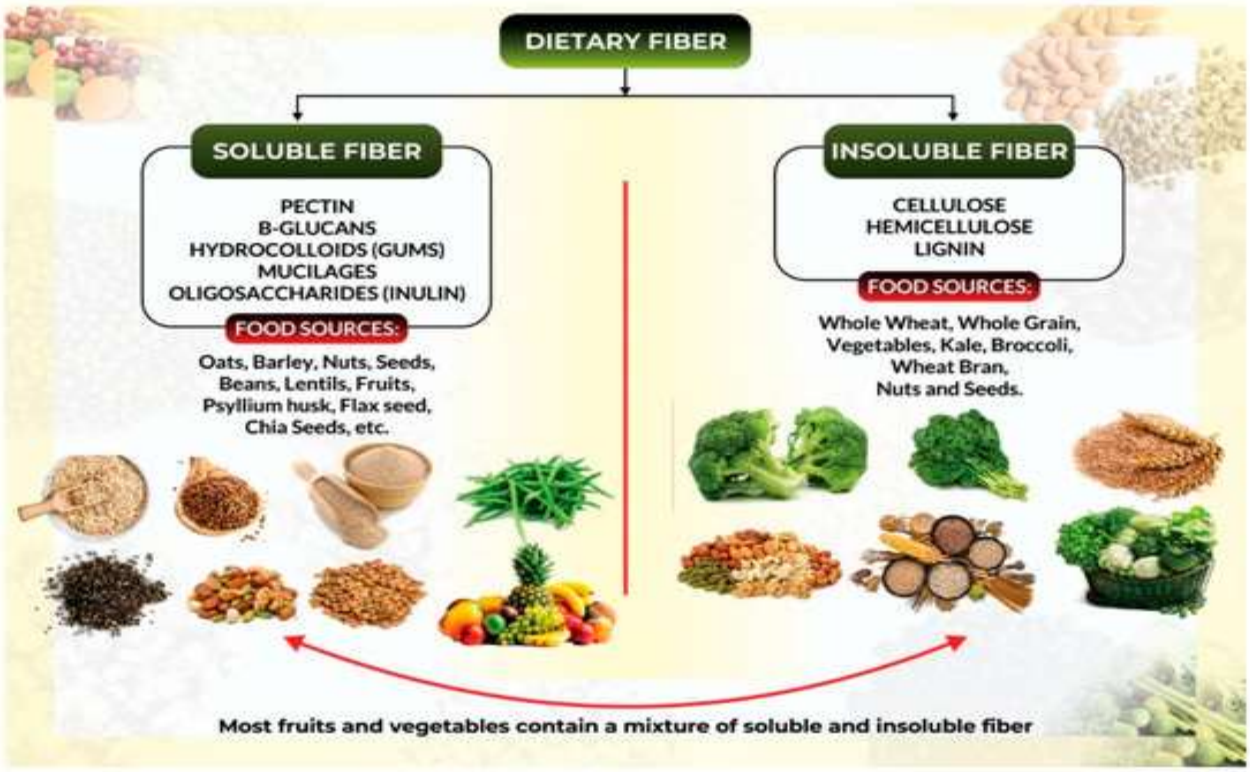


Figure 2: Dietary Fiberes

Our bodies cannot function correctly without enzymes, which are essential to life. An individual's symptoms of digestive problems, such as low blood sugar, irregular blood sugar, and obesity, may be alleviated by incorporating enzyme supplements sourced from plants, animals, and microorganisms into their diet. Our bodies could not operate properly without enzymes, which are vital components of life. Enzyme supplements derived from microbial, plant, and animal sources may assist anyone facing digestive issues like hypoglycemia, irregular blood sugar levels, or obesity.

Non-Traditional Nutraceuticals

These items, which consist of calcium-fortified orange juice, cereals enriched with vitamins and minerals, and flour enhanced with folic acid, originate from agricultural breeding through the addition of nutrients and/or additives. Agricultural experts have successfully developed techniques to enhance. Energy-providing foods, including vinegar, cheese, yogurt, bread, wine, fermented carbohydrates, and others, are made feasible through biotechnology. Probiotics can be generated through biotechnology, along with genetic engineering, utilizing enzyme/fermentation methods to extract bioactive components.

Nutraceuticals with added micronutrients (trace elements or vitamins)

Nutraceuticals enriched with additional micronutrients are developed by initially fortifying dietary elements. Fortification is the process of improving the efficacy and nutritional value of food by incorporating essential trace components and nutrients.

Examples of Specific Enzymes

Lipase The gut's lipase enzyme. Group aids in the breakdown of lipids.
Amylase Amylase aids in the conversion of carbohydrates into sugars in saliva.
Maltase This also occur in the saliva and splits the sugar maltose into glucose.
DNA polymerase These enzymes use deoxyribonucleotide to create DNA.
Trypsin These enzymes break proteins into amino acids in the small intestine.
Helicase DNA is unravelled by helicase enzymes.

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Classification of Nutraceutical based on their food sources Non-Traditional Nutraceutical
Recombinant Nutraceutical
Fortified Nutraceutical

Non-Traditional Nutraceuticals
These foods are artificially created through biotechnology. This type of food includes products that have had their nutritional value enhanced by incorporating specific nutrients or dietary elements. Additionally, there are two more types of nutraceuticals: recombinant and fortified**.**

Recombinant Nutraceutical
These products contain probiotics and various bioactive components, which are created through fermentation, enzyme technologies, genetic engineering, and other methods. Furthermore, energy-providing foods such as beer, cheese, yogurt, fermented grains, vinegar, bread, and others are produced using advanced biotechnology.

Fortified Nutraceutical
The act of incorporating specific micronutrients, such as vitamins and trace minerals, into food to enhance its nutritional quality and effectiveness is referred to as fortification. Probiotics can assist the microbiota in regaining its normal levels of abundance and diversity through the generation of SCFAs. There are assertions that nutraceuticals provide protection against various diseases or physiological advantages and/or have been identified to function as.
Agent for the heart
Agents of antibiotics
Insulin-producing agent
Agents anticancer Booster for the immune system Inflammation of chronic

Nutraceuticals Applied to Different Diseases

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 Officinalis
6.	Osteoarithritis	Glucosamine, Chondroitin Sulphate

Table 1: ***Many Nutraceuticals Applied to Different Disease***

Purpose of Nutraceuticals in Distinctive Disease Prevention
Diabetes
A high intake of isoflavones (20–100 mg/day) is associated with a reduced occurrence of certain cancers, osteoporosis, heart diseases, and type II diabetes. Omega-3 fatty acids have also been proposed as a means to enhance glucose sensitivity in individuals at risk for this condition. Patients with diabetes may find ethyl esters of n-3 fatty acids advantageous. These acids are not only crucial for neurovascular development but also play a role in insulin resistance. This is particularly significant for women with pregnancy-related diabetes mellitus, as they are more likely to gain from the essential fatty acid recommendations during pregnancy. Additionally, lipoic acid, a well-known antioxidant, is currently being used as a treatment for diabetic neuropathy in Germany**.**

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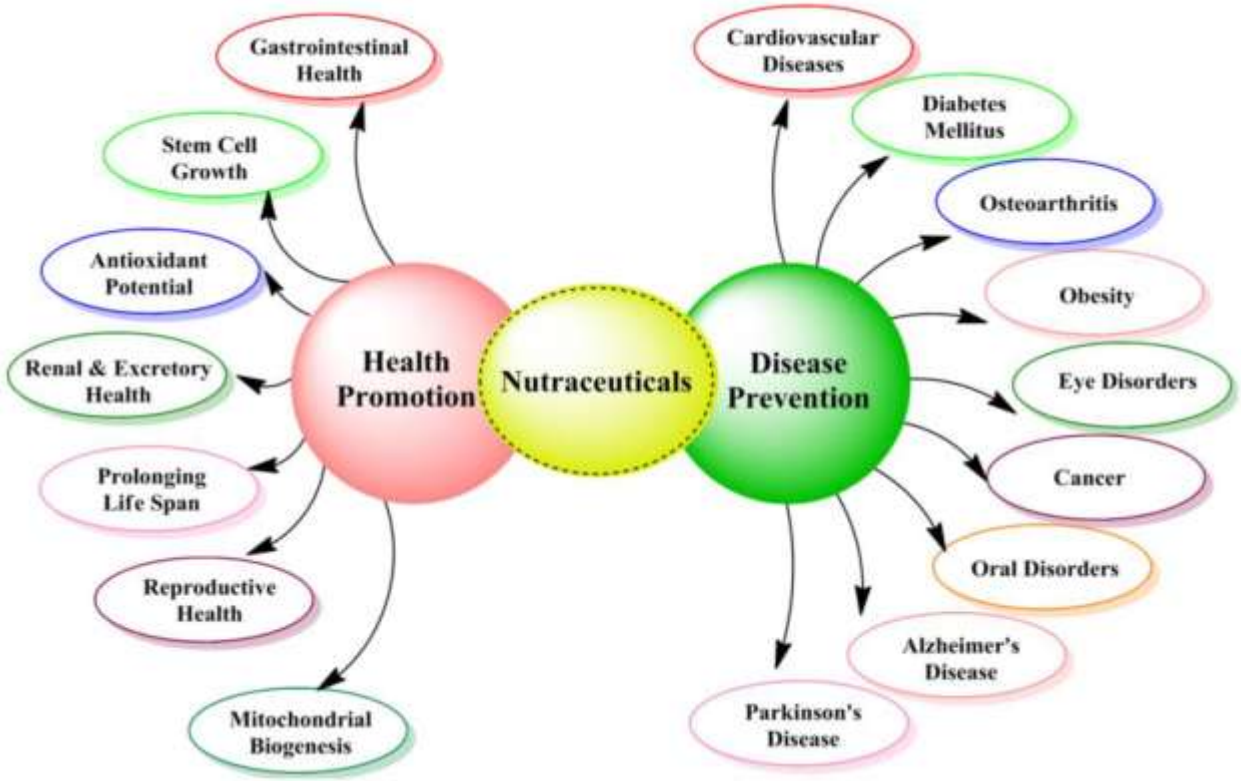


Figure 3: ***Nutraceuticals In Health Promotion and Disease Prevention***

Magnesium enhances insulin sensitivity and reduces the likelihood of diabetes. In some individuals with diabetes, Additionally, calcium and vitamin D enhance glycemic control and the management of insulin sensitivity. Ginger supports digestion and may alleviate digestive discomfort. The potent blend of turmeric, pomegranate, and ginger alleviates the symptoms associated with a cold or cough.

Blood Sugar Level

Stage	Fasting	After Eating	2-3 Hours After Eating
Normal	80-100	170-200	120-140
Pre-Diabetic	101-225	190-230	140-160
Diabetic	126+	220-223	200+

TABLE 2: ***Bood Sugar Level***

Cancer

Flavonoids reduce the occurrence of cancers linked to estrogen by inhibiting the enzymes responsible for estrogen production. It is recommended to consume phytoestrogens to help prevent breast and prostate cancer. Soy products are abundant in isoflavones; both curcumin found in curries and isoflavones from soy can aid in cancer prevention through chemotherapy. Lycopene levels in the skin, testicles, adrenal glands, and prostate may help in cancer prevention. Saponins exhibit antitumor and antimutagenic effects. The polyphenol curcumin (diferuloylmethane) found in turmeric possesses anti-inflammatory, anti-carcinogenic, and antioxidative properties. There have been observations of anti-tumor effects in spinach leaves, cucumber fruits, beet roots, and turmeric rhizomes.

Nutraceuticals As a Preventative Measure against Alzheimer disease

Alzheimer's disease (AD), commonly known as primary degenerative dementia of the Alzheimer's type (PDDAT), senile dementia of the Alzheimer type (SDAT), or simply Alzheimer's, is the most prevalent form of dementia. The various nutraceuticals utilized in the treatment of Alzheimer's disease are outlined below: Antioxidants Alpha-lipoic acid Phosphatidylserines The main clinical symptoms include memory loss and progressive dementia, which are characteristic of Alzheimer's disease (AD). Due in part to the larger population of women over 70, females are affected at a ratio of nearly 2:1 compared to males.

Use of Nutraceutical for treatment of AD

Golden root

Ginseng

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Lemon balm
Ursolic acid
Blueberry
Curcumin
Calabar bean
Moss
Rosemary

Parkinson disease

Parkinson's disease is a neurological disorder that typically manifests in middle to late life, resulting from the loss of nerve cells in a specific region of the brain. This condition leads to symptoms such as muscle stiffness, tremors, and challenges with walking. A reduction in the clinical symptoms associated with Parkinson's disease indicates that creatine may have modified its characteristics. It is important for individuals to understand that over-the-counter medications can be expensive, may have side effects, and can interact with other prescribed medications. Additionally, consuming a significant amount of vitamin E might help in preventing Parkinson's disease. Research has also been conducted on the effects of glutathione on nerve health and its role as an antioxidant. However, uncertainties remain regarding the long-term dosage, potential side effects, and the most effective method of administration.

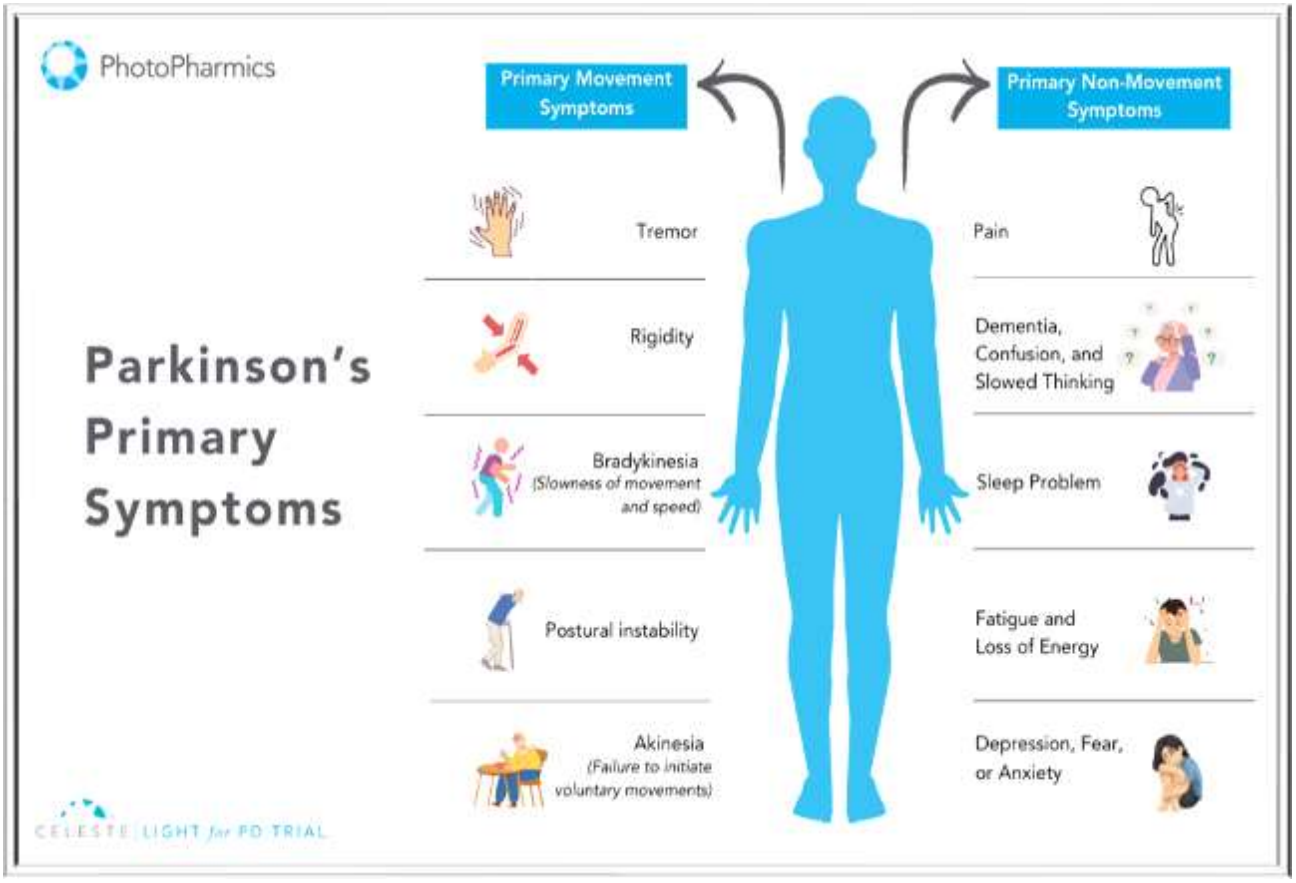


Figure 4: Sign and Symptoms of Parkinson Disease

Cardiovascular Disease

Garlic is beneficial in the treatment of heart disease. Allicin, a compound that is generated in significant amounts when garlic is chopped, macerated, or crushed, is believed to be the reason behind garlic's biological effects, according to recent studies. Therefore, the main chemical thought to contribute to the health advantages of consuming garlic is allicin. Vitamin D is another essential vitamin associated with cardiovascular diseases. This vitamin is primarily found in certain types of fish and is synthesized by the skin when exposed to sunlight. It can also be obtained through dietary sources. Vitamin D plays a traditional role in maintaining calcium-phosphate balance and also seems to have immunoregulatory and anti-inflammatory properties. It appears to involve the breakdown of the ATR1 disulfide bridge. While raw garlic contains other sulfur compounds, their concentration is lower than that of alliin. Garlic remains odorless until

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the alliinase enzyme interacts with the alliin molecule. Once alliin and alliinase are released, the process for producing allicin begins, as this component of whole garlic is stored in separate vesicles and vacuoles until activated.

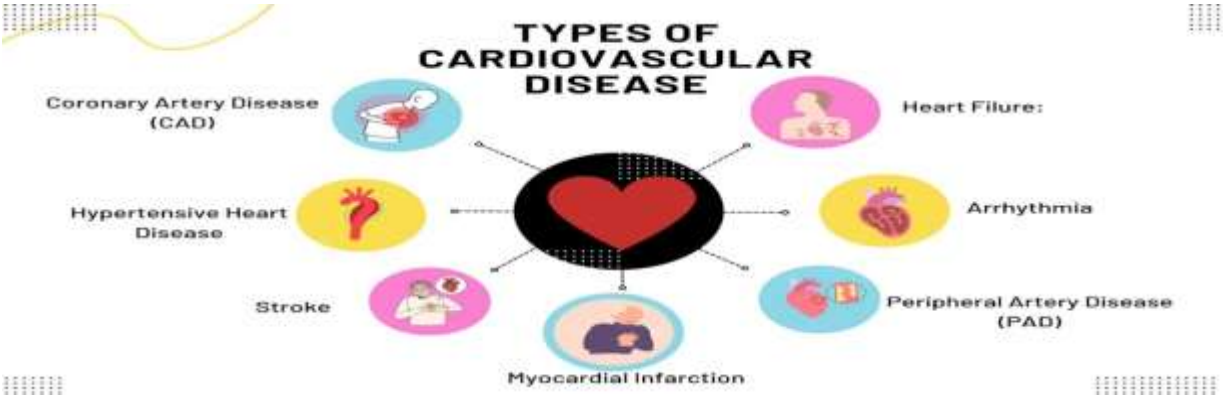


Figure 5*: Types of Cardiovascular Disease*

Treatment of Curcumin against Obesity

Individuals classified within the obesity categories established by the WHO are experiencing a significant rise in numbers. One of the primary reasons for this sharp increase is the greater availability of high-fat foods, which contributes to the prevalence of obesity and high-calorie meals. The accumulation of excess body fat leading to obesity is a chronic condition that heightens the risk of metabolic disorders and other health issues. Obesity, as defined by the World Health Organization, is characterized by a BMI exceeding 35 kg/m2 or a waist measurement of at least 102 cm for men and 88 cm for women. In East Asia, the threshold for BMI to be classified as obesity is set at 25 kg/m2. While BMI serves as a useful indicator of body fat, assessing the distribution of body fat provides a more accurate prediction of risk factors associated with cardiovascular diseases and metabolic syndrome.

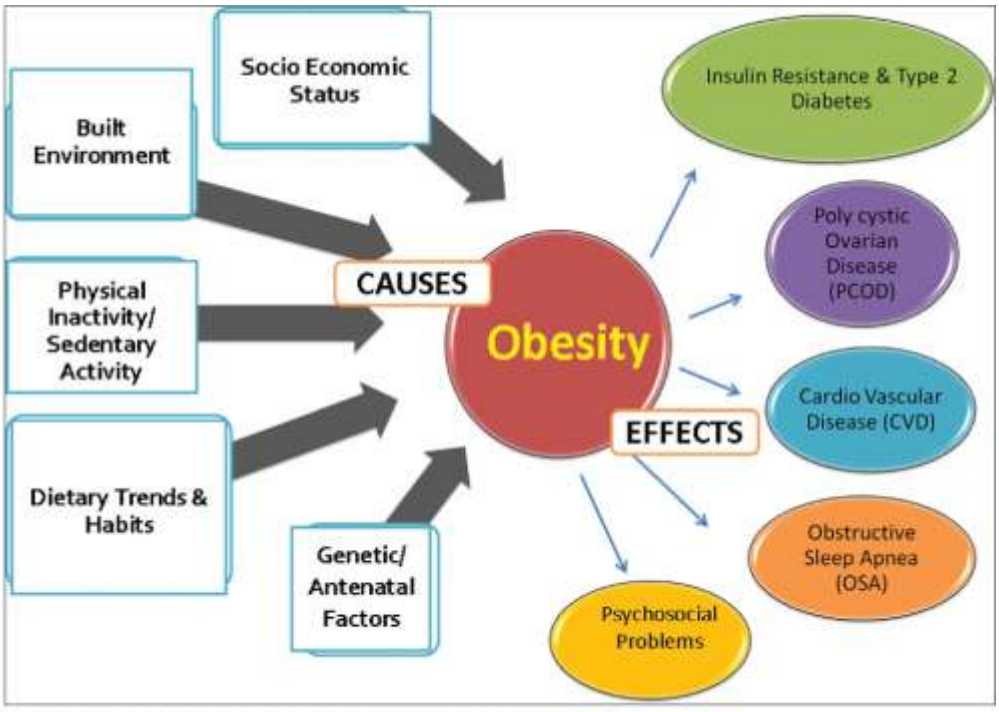


Figure 6: Causes of Obesity

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A variety of inflammatory conditions, such as obesity and other metabolic disorders, are managed using it. The main component of Turmeric Curcuminoid, a well-known Indian spice belonging to the Zingiberaceae family, is curcumin. Recent findings have shown that hydroxyl citric acid serves as an effective biochemical regulator for lipid disorders related to obesity in mammals. Ayurveda is the traditional medicine of India.

Other Nutraceuticals against treatment of obesity

Psyllium
Nigella Sativa
Spirulina
Chitosan
Nutraceutical

Extract formulations are frequently utilized; for instance, the rhizome of Zingiber officinale combined with the radix of Angelicae sinensis. Many studies have also shown that Z. officinale stimulates the AMPK signaling pathway.

Chronic Disease

There are three main types of tea: green, oolong, and black tea. Reports indicate that green tea can aid in the prevention of cancer, heart disease, and various neurological disorders, along with other chronic conditions. Chinese tradition holds that green tea may assist in weight management by reducing fat. This implies that green tea has properties that promote weight loss. Three key components present in green tea leaves impact individuals' health, which are:

Xanthine bases (Caffeine and theophylline)
Essential oil
Polyphenolic compound

Stress Management

Stress plays a crucial role in our mental well-being while also posing a threat to our survival. The naturally occurring bioactive compounds known as adaptogens help prevent cellular damage caused by stress. They provide a general enhancement in an organism's ability to withstand harmful effects and work towards restoring balance and normalcy for mental and stress health. Heat Shock Protein 70, which mitigates stress, is produced and activated by herbal nutraceuticals like Ashwagandha. These substances also stabilize physiological processes, promote balance, enhance resilience to external stressors, reduce moderate to severe anxiety, improve secondary memory, enhance sleep quality, and alleviate depression.

COVID-19

Research has shown that nutraceuticals like omega-3 fatty acids, zinc, and vitamins C, D, and E can enhance the immune system, which is crucial for fighting viral infections. It is widely recognized that COVID-19 induces a cytokine storm, a severe inflammatory response that can lead to significant lung complications and damage. Nutraceuticals such as curcumin, resveratrol, and quercetin possess antioxidant and anti-inflammatory properties that may help in modulating inflammatory pathways. These health-promoting bioactive compounds found in food have been studied for their ability to boost immunity and mitigate the impacts of COVID-19. Turmeric is known for its potent antioxidant effects and is beneficial for various health issues, including scabies, snake bites, asthma, cough, and dropsy. Vitamin C serves as an antioxidant and may help alleviate the severity of viral infections. Additionally, Vitamin D may reduce the likelihood of experiencing severe COVID-19 symptoms.

Range and Product Types of Nutraceuticals offered in the Market

Nutraceuticals, a term introduced in 1989 by Nutrition and Pharmaceutical, refer to the effects of food on human health that have therapeutic implications. This category includes medicinal foods aimed at preventing and treating illnesses, as well as probiotics, prebiotics, herbal products, and dietary supplements. Major nutraceuticals are characterized by minimal side effects and a variety of therapeutic benefits. Research has indicated that nutraceuticals can provide protection against chronic diseases or offer physiological advantages. Common examples of nutraceuticals include Omega-3 fatty acids (MUFA, PUFA), ginseng, Echinacea, glucosamine, folic acid, cod liver oil, calcium-fortified orange juice, green tea, plant phenols, among others. Depending on their understanding and application, nutraceuticals can be organized in various academic frameworks, such as clinical trial designs, educational programs, or functional food development in Europe or the United States, as well as dietary recommendations for India and Japan. The most frequently utilized classification systems for nutraceuticals are those based on their chemical composition, mechanisms of action, and sources of food.

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CONCLUSION

All age groups embrace nutraceuticals due to their exceptional quality, purity, safety, and effectiveness. They play a crucial role in combating various age-related and chronic diseases. Consumer perceptions regarding the link between diet and health will shape the future demand for nutraceuticals. The consumption of nutraceuticals can avert diseases and assist individuals in maintaining overall health, as they have been proven to offer health benefits. Their widespread acceptance across all age demographics is attributed to their superior quality, safety, efficacy, and their capacity to treat and enhance health issues. In today's self-medication landscape, nutraceuticals are vital for promoting health. They are increasingly recognized for their potential benefits in preventing osteoporosis, cancer, obesity, diabetes, heart disease, and other degenerative and chronic conditions, such as Parkinson's and Alzheimer's. The array of nutraceuticals being researched is continually evolving to meet new demands, consumer interests, and ongoing scientific studies.

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