



ROLE OF NUTRIENTS IN MANAGEMENT AND PREVENTION OF NEUROLOGICAL DISORDER

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Abstract

Neurological illnesses are a global health concern. Nutritional neuroscience studies how diet affects behaviour and cognition under the name neuronutrition. Neuronutrition uses various nutrients and diets to prevent and treat neurological problems, according to researchers. This narrative review examined neuronutrition as the key concept for brain health, its potential molecular targets, and its nutritional approach to preventing and treating Alzheimer's and Parkinson's diseases, multiple sclerosis, anxiety, depressive disorders, migraine, and chronic pain. Lifestyle changes raise the likelihood of chronic diseases, putting a huge financial and healthcare burden on society. Researchers seek effective, side-effect-free treatments for diseases. Functional meals with fewer side effects and higher therapeutic effectiveness have been studied in recent decades. Thus, numerous extraction methods have been explored to get bioactive molecules or phytochemicals from therapeutically active food products. Functional foods are sometimes confused with "pharmafoods," "medifoods," "vitafoods," and "medicinal foods." For neurological therapies, nutraceuticals are in high demand. Nutraceuticals may prevent neurological treatments by linking diet and lifestyle to neurodegeneration. This review covers key neurological illnesses and nutraceutical disease prevention.

Keywords: Nutrients, management, prevention, neurological disorder

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Introduction:

Numerous chronic disorders with extremely complex aetiologies are included in the category of neurological ailments. Central or peripheral nervous system abnormalities could result from a nutrient-poor diet. Annual neurological problems affect more than 10 million individuals worldwide, and this number is anticipated to increase. Because neurodegenerative processes contribute to the decline in brain function with age, cellular and molecular targets have been found that can be used to improve brain function [1]. Neurodegenerative illnesses are thought to be more likely to affect people in Western countries who are between the ages of 70 and

79 than those in India, where the prevalence is 0.7%. The variation is mostly caused by varied eating and living habits depending on the ingestion of various substances. Since the beginning of time, people have relied on natural remedies and spices to treat a variety of illnesses, with impressive results [2]. A renaissance in the study of nutrition and human health has resulted from the investigation and use of numerous phytochemicals with therapeutic properties from both plant and non-plant sources [3]. This has opened up opportunities for the development of novel dietary substances. With this development, a new term known as nutraceuticals—which combines the terms



nutrition and pharmaceutical—emerges. Dr. Stephen De Felice first used the phrase nutraceutical in 1989. Nutraceuticals are defined by the American Nutraceutical Association as a food or a food product with health-promoting qualities. They include dietary nutrient supplements, herbal goods, beverages, soups, vegetables, fruits, and processed foods, such as cereals, as well as genetically modified foods [4]. Vitamins, minerals, and amino acids make up the majority of nutritional supplements, but more than a thousand more probiotic substances have been discovered so far. Indians, Chinese, Egyptians, and Sumerians are among the most ancient civilizations to have provided proof of the usefulness of food products in medicine and the treatment of disease—a claim that has even been confirmed by Ayurveda for 5000 years. A nutraceutical is a functional food that has been proven to have health advantages independent of its nutritional value. Nutraceuticals are developing as a potential technique in the care of a number of chronic diseases, including neurological disorders, according to the available evidence. The exploration of molecules that are

extracted from conventional medicines and how they can be useful in disabling and degenerative illnesses is the main goal of ongoing research in the field of nutraceuticals [5]. Despite the potential advantages of nutraceuticals, they still have several drawbacks, such as poor bioavailability, poor brain permeability, metabolism, etc., which makes it difficult for them to have a positive impact. By enhancing numerous routes, such as improved re-uptake of blocked monoamines, nutritional supplements can boost the therapeutic effects of some pharmaceuticals when used in conjunction with them, producing extraordinary neurobiological effects. The possible contribution of dietary supplements to neurological illnesses and brain health is highlighted in the current review. Throughout the prehistoric period, plants were used as a source of medicine for many different diseases all across the planet. By establishing connections between alternative medical practises including herbalism, apothecary, ethnopharmacology, and phytotherapy, the historical development of nutraceuticals can be tracked [5, 6].



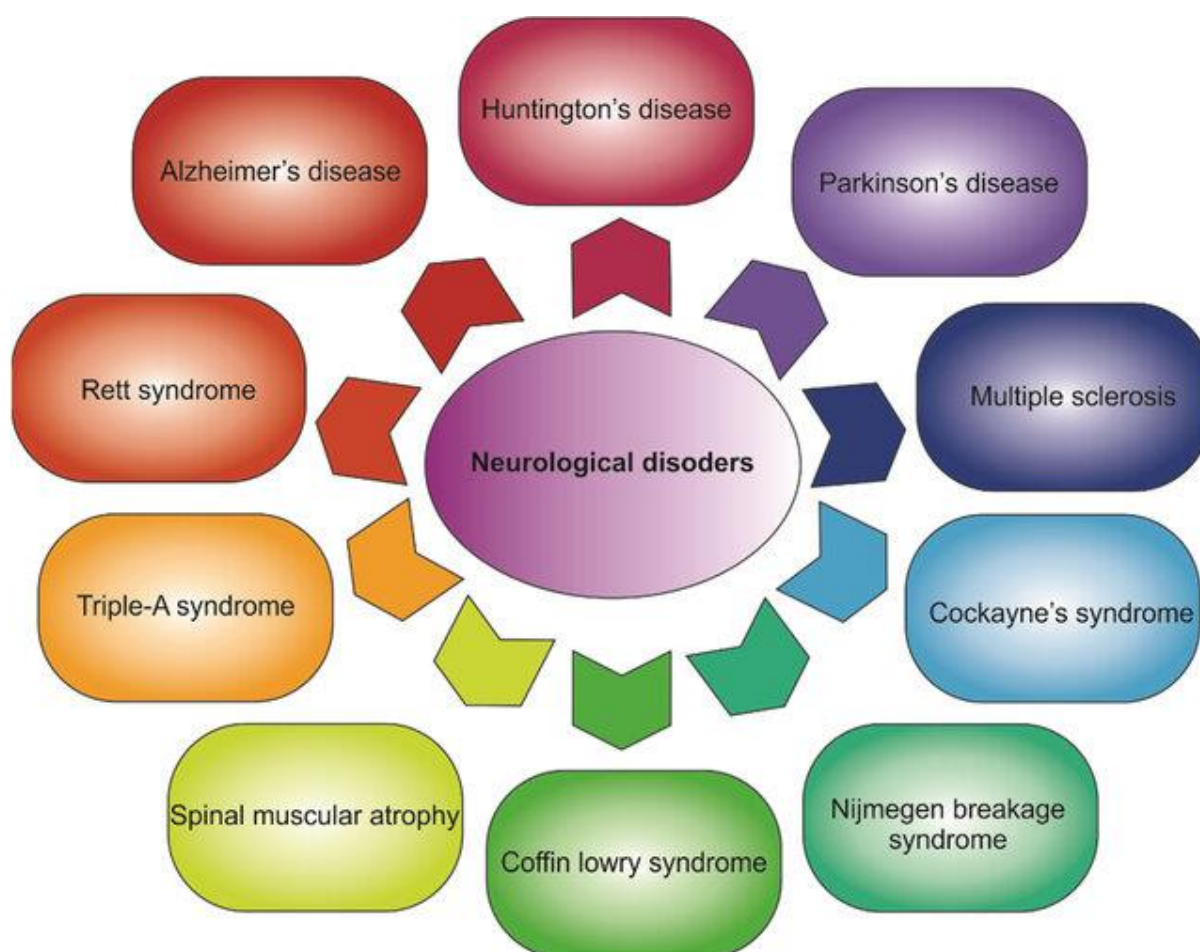


Figure 1. Type of Neurological disorder

Preventing ischemic stroke is another significant and well-discussed nutritional issue in neurology because it shares many risk variables with other cardiovascular diseases. This review will not cover this topic; you can read about it elsewhere. Although studies in nutrition science have shown that certain nutrients and diets may have positive effects on conditions like anxiety, depression, cognitive decline, and neurodevelopmental disorders, these findings frequently remain theoretical and have little practical application in clinical practise. Additionally, a need for study to establish useful guidelines on diet and the use of neuronutrients in the prevention and treatment of a variety of neurological illnesses has been discovered. Researchers also point out that nutrition in neurology has historically been seen only in the context of treating patients with neurological diseases brought on by malnutrition, dysphagia, or alcoholism. On the other hand, consuming too much of a

micronutrient like copper can cause Wilson's disease and other neurological conditions. The use of a ketogenic diet for the treatment of refractory epilepsy and Glucose Transporter Type 1 Deficiency Syndrome is another noteworthy area of clinical nutrition in neurology [7, 8].

Vegetables, animals, substances derived from minerals, and therapeutic plants—which included both magical and instinctual elements—were the ancestors of modern therapy. Philosophers had a strong belief in the importance of nutrition for both individual and societal health before the notion of nutraceuticals was developed. Since Hippocrates' day, or about 2000 years ago, until the present medical revolution, it has been understood that the types of foods that people eat affect how sick they are. To quickly advance research in the biomedical field, the New York Foundation for Innovation in Medicine, an educational foundation, coined the term "nutraceuticals" in 1989 [9]. The

majority of the benefits came from traditional knowledge that was gained by Europeans from Asian nations. The advent of contemporary drug development and clinical trials, along with the function of chemists, were all prompted by the sensible use of medications. Indian history is recognised for having the ability to perform healing processes, including the Unani, Ayurveda (including Sushruta, Samhita, and Charaka), Ashtavaidya, and Siddha systems of medicine. There are numerous undiscovered foods and substances with beneficial biological properties. The nutraceutical industry is currently the fastest-growing sector of the current food market, with a market of 30 billion US dollars that is expanding at a 5% yearly rate. Nutritionists, food technologists, doctors, and food chemists face a significant challenge as a result of the current state of nutraceuticals and the knowledge that has been acquired about it. Clinical testing on both humans and animals is necessary for pharmaceutical development, and the data collected confirm the therapeutic effects of the medicine. Although there were no well-established techniques for confirming the therapeutic effects of dietary items in the past, it has recently been demonstrated scientifically that food molecules can prevent illnesses related to lifestyle. Nutraceuticals have a number of benefits, including promoting a healthy diet and lengthening life. They are the most common methods for preventing neurological illness conditions because, in addition to its positive effects on physical disorders, it also helps with established psychological benefits [10]. More people, especially the elderly, gravitate towards nutrient-rich diets more for lifestyle-related problems because of the less noticeable negative effects. The purpose of the manuscript is to increase reader awareness of the use of nutraceuticals in the treatment of neurodegenerative and psychotic illnesses by utilising readily available substances that have been shown to have neuroprotective benefits. The possible contribution of dietary supplements to neurological illnesses and brain health is highlighted in the current review.

Nutrients in the diseases of the nervous system

Traditionally, nutrition has been seen as a source of energy for the body's essential processes as well as a provider of elements for the construction and maintenance of the human body. Research in PNEI (psycho neuro endocrino immunology) has expanded our understanding of the function of diet. According to the PNEI idea, eating habits and diverse nutrients have a complex impact on self-regulation, metabolism, the immune system, and brain function. Nutrition is a tool that the environment uses to meticulously shape the metabolome and epigenome. Nutritional neuroscience is a recent branch of science that examines how dietary elements like proteins, carbohydrates, fats, and phytonutrients affect the brain's central and peripheral nervous systems as well as neurochemistry, neurobiology, behaviour, and cognition. According to some academics, the word "neuronutrition" refers to the nutritional neuroscience of dietary influences on sustaining brain health and cognitive performance. According to some experts, neuronutrition is the utilisation of different nutrients in addition to diet in order to prevent and treat diseases of the central and peripheral nervous systems. The first mentions of neuronutrition were made in relation to food habits and the progression of Alzheimer's disease. Neuronutrition, in a larger sense, is an interdisciplinary field that investigates the impact of numerous nutritional factors on brain health as well as the prevention and treatment of neurological illnesses throughout the lifetime. Neuronutritional interventions will be used to prevent and treat brain disorders like migraine, chronic pain syndrome, epilepsy, amyotrophic lateral sclerosis, anxiety and depressive disorders, neurodegenerative diseases like Alzheimer's and Parkinson's, autoimmune conditions like multiple sclerosis, and others in the future as a part of personalised and preventive medicine [11, 12].

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Nutraceuticals and Their Classes

In non-specific biological therapies, nutritional supplements are utilised to treat everything from mild diseases to cancers that are extremely hazardous. They play a strong and widely recognised role in neuroprotection [12, 13].

Nutraceuticals derived from food or conventional nutraceuticals

This category includes food products obtained directly from nature without any change in their original constituent form. These include fruits, vegetables, grains, meat, fish, eggs, and dairy that provide several benefits beyond basic nutrition [14].

Nutrients

In the metabolic pathways, the principal metabolites of substances including minerals, fatty acids, vitamins, and amino acids have well-established nutritional characteristics. These nutrients offer various advantages in treating neurological problems when combined with animal and plant products. Nutrient planting can be utilised to stop brittle bones, increase haemoglobin, and improve muscle power and brain communication. The effects of fatty acids and their constituents, which tend to be hypolipidemic, include improved brain function and a reduction in artery-clogging cholesterol [15].

Herbal Medicines or Botanical Extracts and Concentrates

The combination of nutrition and herbal remedies has a great effect on problems linked to way of life, including mental health. Tannin-containing substances, like lavender, aid in reducing blood pressure and relieving tension. Based on their antioxidant capacity, flavonoids, which comprise substances like psoralen, which is produced from parsley and also has carminative and diuretic effects, have been clinically demonstrated to protect diabetes, cardiovascular problems, and kidney abnormalities. Compounds containing terpenoids, such menthol and peppermint, are used to treat respiratory ailments [16]. Aloe vera, for example, has anti-inflammatory and dilating characteristics, making it useful in

the healing of wounds, and ephedra has bronchodilator and vasoconstriction effects, making it useful in the treatment of bronchospasms. Garlic and ginger, two of the most often used dietary ingredients, are powerful immunity boosters with anti-inflammatory and chemotherapeutic capabilities. Nutraceuticals include not just herbal products but also the phytoconstituents they contain. For instance, vegetables include carotenoids, which support immunity, particularly killer cells, and have anti-carcinogenic qualities. Soybeans and chickpeas are examples of non-carotenoid foods that help remove cholesterol. One of the most widely used substances in cooking is turmeric, which contains curcumin, a phenolic acid with the highest antioxidant and anti-inflammatory activity. Dietary supplements, particularly those high in antioxidants like green tea, ginger, cumin, etc., have demonstrated potential results in weight loss. Additionally, their effectiveness in treating neurological disorders including depression has been researched. They come in a variety of dose forms, including capsule, powders, pills, and extracts from glands and enzymes [17, 18].

Beneficial Microorganisms

The eminent scientist Metchnikoff is credited with coining the term "probiotic." With regard to the physiology of the stomach and intestines, they are quite beneficial. They help remove harmful organisms from the intestines and have antibiotic effects. A balanced diet promotes both physical and mental wellness. Consuming probiotics has revolutionised the way gastrointestinal diseases are treated. Following these findings, probiotics have also been introduced for use as dietary supplements, including probiotic beverages and pills. Therefore, modern probiotics are contested for their therapeutic effects and claim to be useful in treating all medical disorders, from diarrhoea to neurological conditions like depression and Alzheimer's. Probiotics need to be thoroughly studied because there isn't enough public data on their safety. It is challenging to distinguish between probiotics' advantages

and disadvantages. The probiotics may be therapeutically somewhat effective in people with impaired immune systems who are at high risk of infection [18, 20].

Nutraceutical Enzymes

Cells produce protein structures called enzymes or biocatalysts. They accelerate metabolic processes and are particularly helpful for gastrointestinal disorders such as gastric reflux disease, constipation, diarrhoea, etc. The benefits of enzyme supplements for neurological health are the least, but recently, several therapies have been developed to treat uncommon diseases including Hunter syndrome and Gaucher disease. They are quite affordable because they may be found in both plant and animal sources [21]. The ingestion of food-based nutraceuticals offers a huge variety of benefits. Nutraceuticals made from food sources like dairy, carotenoids, ginger, garlic, and turmeric are considerably healthier and may give our bodies all the critical nutrients they need. They are readily available in food shops and stop the worsening of serious conditions associated to life, such as diabetes and even cancer. A nutritious diet may be the most alluring choice for neuroprotection, and having good mental health is important. They also have certain drawbacks, though. The safety of food-based nutraceuticals is the most emphasised disadvantage. Functional foods still need to be thoroughly investigated for their safety before being made available on the market for ingestion in raw forms. Unless a certain amount is consumed, all chemicals are poisonous. It is obvious that a diet that is extremely effective against cancer can also be cardiotoxic. So it is advised to administer the desired dose [22].

Non-Traditional Nutraceuticals

These are foods created by the breeding of agricultural goods and nutrients, such as calcium-fortified orange juice, cereals fortified with vitamins and minerals, etc. More study is being done to enhance the quality of nutrition in crops after cultural scientists successfully developed procedures and altered the nutritional content of crops [23, 24].

Fortified Nutrient Supplements

These are the type of nutraceuticals that are designed from breeding at the agricultural level by enhancing nutrients, such as minerals in cereals, increasing calcium, folic acid, iron in flour, making milk fortified with cholecalciferol for the treatment of vitamin D deficiency, etc [24, 25].

Recombinant Nutraceuticals

Recombinant nutraceuticals are those obtained by the incorporation of biotechnology in food items. These nutraceuticals are among the most widely utilised types of products; they include the process of removing nutrients from foods like dairy, cheese, and bread in order to obtain an enzyme that, when used at the right dosages, has therapeutic benefits. In order to increase the amount of nutrients in already existing food supplements and to increase the number of benefits in the same amount of food consumed, non-traditional nutraceuticals have arisen. In the age of sedentary lifestyles, it has many benefits and is a blessing, but it also poses some risks. The Food and Drug Administration (FDA) currently does not have any regulations governing the manufacture of nutraceuticals. Many businesses synthesise inferior non-traditional nutraceuticals in order to increase their profitability and margins. Additionally, the bioavailability of increased nutrients is often low in a variety of contexts and is not assessed. There are obviously no set regulations because the testing of nutraceuticals is not as tightly regulated as that of medicines [26, 27].

According to the Mechanism of Action

Nutraceuticals have been further categorised into antibacterial, antifungal, antioxidant, anti-inflammatory, and antiobesity categories based on the therapeutic properties they exhibit in order to distinguish their function and evaluate their usage. Many infection-related deaths are caused by food-borne illnesses. Carsonic acid (terpenoids), quercetin (polyphenols), and other bioactive chemicals have all been employed as effective antibacterial therapies in the treatment of

infectious diseases. They can be found in a variety of fruits and vegetables. Traditional foods have been used for many years as a form of treatment for diabetes, cancer, and other ailments [28]. The development of medicinal mushrooms as a promising candidate for antifungal therapy with the fewest adverse effects is the result of numerous investigations. All around Asia, these mushrooms are very well-liked. Due to their anti-inflammatory properties, nutraceuticals have been employed in a variety of inflammatory illnesses, including rheumatoid arthritis. Foods abundant in carotenoids, tocopherols, and antioxidants have stronger anti-inflammatory properties. The antioxidant and free radical-scavenging abilities of nutraceuticals are well known. Due to its antioxidant properties, it plays a part in the treatment of other linked illnesses like obesity. Anything consumed in excess has a poisonous effect, as was previously said. Based on their mode of action, nutraceuticals should definitely be consumed. Consuming a substance for its therapeutic effects tends to reduce the likelihood that it has obvious poisonous characteristics and benefits the person for the intended ill state. It also results in the careful delivery of nutraceuticals and guards against any hazardous side effects brought on by large amounts [29, 30].

Nutraceuticals in Neurodegeneration Improvement

Protein misfolding is the primary cause of neurodegenerative diseases. Transactive response d(eoxyribonucleic acid)-binding protein-43 (TDP-43) and A protein modifications can cause traumatic brain injury, and abnormal misfolding of the proteins au and amyloid-(A) (A) leads to the progression of Alzheimer's disease. Au and TDP-43 dysfunction can subsequently cause epilepsy and various other tauopathies. Protein A in Down syndrome and -synuclein in Parkinson's disease are the key factors that trigger the cytotoxic cascade of molecular and cellular events, which has negative effects and promotes further degeneration. These misfolded proteins also promote nuclear factor kappa-light-chain-enhancer of activated

B cells (NF-B) activation, which results in the release of reactive oxygen species (ROS) and glutamate-induced oxidative damage, activating destructive molecules like cyclooxygenase (COX-2) and inducible nitric oxide synthase, and producing inflammatory cytokines like tumour necrosis factor- and interleukin-1 [31]. Furthermore, the misfolded proteins further dysregulate the signalling of GSK3 with concurrently elicited inflammatory cytokines, resulting in the hyperphosphorylation of tau proteins and an increase in cholesterol synthesis. Additionally, it causes the creation of lipid rafts, which contain misprocessed and misfolded proteins as a result of the encouragement of enzymes, creating a vicious cycle. Furthermore, misfolded proteins alter the activity of several signalling pathways, including protein kinase A/B, cyclic adenosine monophosphate response-element binding signalling (CREB), and cholinergic functions, which impair cognitive abilities and cause synaptic degeneration. By focusing on proteins that are misfolded practically at all levels, nutritional supplements have the potential to alter the cellular and molecular cascade and prevent neurodegeneration. Nutraceuticals have been proven to have antioxidant, anti-hypercholesterolemia, and anti-inflammatory benefits, as well as the ability to boost the cholinergic system since acetylcholinesterase is inhibited. When used for their therapeutic potential, nutraceuticals can easily replace synthetic drug ingredients such as donepezil, tacrine, rivastigmine, and galantamine, which act by inhibiting the acetylcholinesterase enzyme; statins such as rosuvastatin and atorvastatin, which act by inhibiting 3-hydroxy-3-methylglutaryl coenzyme A reductase; alpha tocopherol or vitamin E; aspirin, the herb has been shown to be an antioxidant. It has been determined via numerous researches that the side chains of protein amino group combine with d-galactose to produce amadori products, which then result in advanced glycation end products (AEGs). Oxidative stress is ensured by the glycated products' 50-fold higher generation of free radicals than non-glycated products. In the cerebral cortex region of the



brain, the administration of phytoconstituents—primarily bacosides A and B and brahmine—significantly reduced the amount of AEGs, prevented aluminum-mediated neurotoxicity, and is beneficial in preventing neurodegeneration [31, 32].

Quercetin and Kaempferol

Free radical production in the brain prevents amyloid 1-42 proteins from aggregating and also causes fibril destabilisation. It has been demonstrated that kaempferol and quercetin significantly lower free radical levels. Additionally, they stop NF-kB from activating, which then stops proinflammatory cytokines, primarily interleukins, from activating. It is one of the most often researched phytoconstituents for the treatment and prevention of cognitive problems, mostly derived from *Ginkgo biloba* leaf extract. Additionally, they are quite effective at enhancing blood flow to the brain and delaying the onset of Alzheimer's disease [32, 33].

Withanine

Ashwagandha, commonly known as Indian ginseng, has been utilised for its memory- and neurocognition-enhancing qualities for over 2500 years, and its primary steroidal alkaloid is withanine. It has the ability to counteract the effects of oxidative stress on the nervous system. Ashwagandha root extract derived from methanol has been shown to improve memory and inhibit the enzyme acetylcholinesterase, which plays a crucial role in neurodegeneration by facilitating the transmission of cholinergic neurons. This makes it an excellent choice for the treatment and management of Alzheimer's disease. Antioxidant enzymes like glutathione and catalase are essential for cellular health, but they also play a role in increasing the levels of catecholamines like serotonin. Withanine's exceptional neuroprotective properties come from its ability to block the production of nitric oxide, therefore reversing oxidative stress. The ashwagandha extract somniferine is used for its memory-boosting and neuroprotective properties [33-35].

Asiatic Acid

Ayurvedic practitioners have long recognised the benefits of gotu kola for learning and memory. The neuroprotective effects are mostly attributable to asiatic acid, the main phytoconstituent. It works by boosting glutathione while lowering malondialdehyde. Malondialdehyde, a byproduct of lipid peroxidation, is a crucial marker for identifying the free radicals that cause neurodegeneration due to oxidative stress. Antioxidant medicine protection against neurodegeneration is enhanced by asiatic acid, which boosts levels of free radical-scavenging enzymes like glutathione [35, 36].

Nutraceuticals in Alzheimer's Disease

The most frequent cause of memory loss is Alzheimer's disease (AD), also known as senile dementia of the Alzheimer type or primary degenerative dementia of the Alzheimer type (PDDAT). Super important antioxidants, which can be used in the treatment of all chronic diseases owing to oxidative stress, which plays a significant role in neurological disorders like AD, are among the most prominent nutraceuticals that aid with its management. Ageing and a lack of dietary antioxidants both speed up oxidative stress, which in turn speeds up the development and stimulation of illness. Preventing disease is preferable to treating it, and several studies have found a correlation between consuming more dietary antioxidants and a lower risk of Alzheimer's disease. Further, studies have shown that avoiding AD may not be as difficult as first thought. meals high in polyunsaturated fatty acids, saturated fatty acids, and trans fatty acids have been shown to reduce the progression of neurodegeneration, while trans-fat-rich meals have been shown to hasten the process. Antioxidants as a form of treatment represents a promising strategy for halting the development and spread of disease [37, 38].

Flavonoids

Catechin, epicatechin, epigallocatechin, and epigallocatechin gallate are the most widely used flavonoids for treating



neurodegenerative diseases like Alzheimer's. These are a class of polyphenolic chemicals that are typically isolated from food sources. Fruits, vegetables, and beverages including wine, tea, and chocolate are the primary sources of flavonoids. Flavonoids and their metabolic products have been examined for their interactions with the neuronal-glia signalling system, which plays a major role in neuronal survival and function. Increased activity of antioxidant proteins and enzymes affects cerebral blood flow, leading to synaptic plasticity and the repair of neuronal functioning by halting the neuropathology process typically associated with Alzheimer's disease [39].

Carotenoids

There are over 700 different carotenoids known, with 40 of them being present in human tissues and blood. Lutein, zeaxanthin, lycopene, and -cryptoxanthin, as well as - and -carotenes, are some of the most abundant carotenoids in the human diet. Carotenoids' antioxidant activity can be determined from their molecular configuration. They are found in orange, deep yellow, and red produce and are extracted by the use of a fat solvent. It has been shown that astaxanthin, a carotenoid found in seafood, has powerful neuroprotective properties due to its anti-inflammatory and antioxidant properties, which have been studied extensively in in vivo and in vitro animal models. Major carotenoids including lutein and beta carotene are depleted in persons with moderate to severe AD, in contrast to mild AD patients [39, 40].

Crocin

Saffron (*Crocus sativus*) contains crocin, a major phytoconstituent. Antispasmodic, sedative to neurine, sedative to gingiva, expectorant, stimulant, and carminative are just a few of the ways it has been put to use over the years. Saffron's anti-epileptic, anti-depressant, and anti-inflammatory properties have all been scientifically established. Crocin is utilised in neurodegenerative conditions like Alzheimer's disease since it has been shown to help learning and memory and because ethanol blocks its long-term potential.

Crocin's effects on cognition in mild to moderate Alzheimer's disease are mediated by ADAS-Cog and CDR-SD mediated enzymes. Multiple studies have found that crocin can reverse chronic stress's negative effects on learning and memory by dramatically modifying oxidative marker levels in the hippocampus [41, 42].

Cyanidin

Among the other significant chemicals is cyanidin, which is typically extracted from berries like cranberries, strawberries, etc., and has been shown to have powerful anti-inflammatory and neuroprotective effects by preventing the activation of pro-inflammatory cytokines and, by extension, brain cell damage. Inhibiting the enzyme phospholipase A2, which plays a major role in the signalling of proinflammatory cytokines and oxidative stress parameters, has been shown to have extraordinary neuroprotective effects [43, 44].

Luteolin

Two flavones with impressive neuroprotective properties include luteolin and apigenin. Rosemary, parsley, and celery are rich in these flavone-containing chemicals. Anti-inflammatory and cell-protective effects against Alzheimer's-related inflammation and cell damage are just two of the many pharmacological benefits of these phytoconstituents [45].

Preventive measures

Food Culture

What we do, think, and feel as individuals and communities in relation to food in the context of modern social and environmental norms is our food culture. Aspects of neuronutrition that relate to the prevention and treatment of neurological illnesses include dietary habits, eating behaviour, and the food environment. A person's or a community's dietary habits consist of their repeated decisions about things like which foods to buy and prepare regularly. The brain's reward system, including the nucleus accumbens and other hypothalamic nuclei, are involved in the creation of dietary habits, which regulate



feelings of motivation, pleasure, appetite, and fullness in response to food intake. Risk factors for neurodegenerative diseases including Alzheimer's, Parkinson's, and depression include poor dietary habits such as eating too many refined carbs and not enough fibre. The timing of meals, the amount eaten, food preferences, and food choices are all influenced by a web of factors that includes biology, psychology, society, and genetics. Neurons in the hypothalamus are responsible for regulating hunger and fullness. Their messages are translated into actions that maintain a person's internal environment. Metabolic dysregulation, obesity, and the exacerbation of chronic pain and dementia are all linked to eating disorders. Migraine sufferers are more likely to have eating disorders, and skipping meals may actually be an indicator of an impending migraine rather than the cause of the condition. A person's nutrition choices are influenced by the availability of both nutritious and unhealthy foods in their urban and residential settings, which together make up the food environment. Food preferences are highly contextual, meaning they are shaped by the surrounding environment. A higher body mass index has been linked to living in close proximity to fast food businesses. Consumption of fresh fruits and vegetables, as well as lower intake of fast food and soda, and lower risk of being overweight and obese, have all been found to be independently associated with higher rates of grocery shopping and lower availability of fast food restaurants, as well as higher income and college education. Chrononutrition, a subfield of nutrition science, investigates the effects of food and meal timing on the circadian rhythm system and their relationship to health and disease. The timing of nutrient and food consumption has been shown to influence the functioning of circadian rhythms, and the desynchronization of circadian rhythms has been shown to negatively influence the timing and choice of food. There is a strong correlation between human personality, chrononutrition, and cardiometabolic health; eating at the wrong times can disturb circadian rhythm organisation and contribute

to metabolic dysregulation and the development of chronic disease. Chrononutrition has also been studied for its potential medical applications, with published data showing that intermittent fasting can reduce chronic pain [46, 74].

The Molecular Targets of Neuronutrition

It is still not well known how and why certain diets can affect neurological disorders. The synthesis of neurotrophic factors and neurotransmitters, neuroplasticity, myelination, and microglia activity have all been shown to be affected by dietary factors such as vitamin and mineral consumption. It is currently believed that individuals with neurological illnesses and brain health can benefit from neuronutritional therapies that can also affect neuroepigenetics changes, immunological regulation, metabolic control, and eating behaviour [48].

Immunological Regulation

Nutrition D Vitamin D has a significant impact on the immune system's control and can therefore influence a number of neurological diseases. Low vitamin D levels have been related to cognitive decline, Parkinson's disease, depression, Alzheimer's disease, and other neurological illnesses, according to research. Additionally important is the relationship between the microbiome and vitamin D. The microbiota and vitamin D deficiency have both been linked in studies to systemic and chronic inflammation, which has been linked to an increased risk of neurological disorders. These results suggest that vitamin D treatment may be able to delay cognitive deterioration in Alzheimer's disease, especially in the early stages. The ideal vitamin D dosage for preventing and treating neurological illnesses must yet be determined, as well as the vitamin's mechanisms of action. Additional patient variables that may alter vitamin D levels and its effects on the body include age, gender, the existence of certain medical diseases, and other factors [49, 50].

Conclusions

Herbal compounds can treat and prevent life-threatening diseases and lifestyle issues, including neurodegeneration. Studies show that phytonutrients reduce neurodegeneration and cognition. Nutraceuticals have neuroprotective, anti-inflammatory, antioxidant, hypolipidemic, and therapeutic capabilities that target diverse ligands and receptors to increase protein synthesis and neuroprotection. Inhibiting protein folding and breakdown promotes nervous system health. In this time of public health concerns, plant-based research has led to cheap neurodegenerative disease treatments. Changing lifestyles have suppressed antioxidants, causing oxidative stress. Antioxidants decrease with ageing, causing chronic diseases. Thus, for years, therapeutic nutraceuticals have been targeted. Vitamins naturally scavenge free radicals and boost antioxidant production in the body. This review discusses nutraceutical therapy's benefits and drawbacks in reducing neurological illness progression. Nutraceuticals offer exceptional properties, yet responses vary. They treat lifestyle-related mental disorders including depression by promoting brain health and preventing disease.

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Conflict of interest

None

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