Review Article

**Ethics of therapeutic foods consumption for neurodegenerative diseases and Hormesis-Based Anti-Aging Strategies**

**Abstract**

Food ethics allow individuals to make a right choice, determine the future consequences and outcomes. Neurodegenerative diseases such as Parkinson’s, Huntington’s, Multiple Sclerosis, moto neuron, human prion and Alzheimer’s at the moment are incurable illnesses characterized by waning/weakening in social behaviour, emotional control and social communication which are mainly caused by metabolic disorder. Various therapies have been targeted and developed for their treatment. Hormesis provides fundamental sustaining neuroprotective responses for improving the accuracy of the therapeutic treatments in reducing age-related diseases and assist healthy aging. The ethics of therapeutic diet must be based majorly on providing patients the nutrients needed to recover from diseases, considering food habits, food intolerances, allergy, occupation, meal timings among others. This review examined the influence of ethics on the level of application of therapeutic food in treatment of neurodegenerative diseases. It can be concluded that several foods play vital role in averting and lowering the risk of developing neurodegenerative diseases conditions. Flexibility in tolerance to therapeutic foods in alignment with food ethics considering religion, culture, belief, passion, education, social and economic perspective among others will help in maintaining or improving the nutritional status of patients and beneficial for the brain. Hence, channeling ethics of therapeutic diet towards improving lifestyle factors and healthy hormesis in aging are germane strategies to combat incidences of neurodegenerative diseases.

Keywords: Neurodegenerative diseases,Ethics**,** Responsible consumption, therapeutic foods, Hormesis, Anti-Aging

**INTRODUCTION**

Consumption of food is based on the preference, availability, economic and market value. Ethic of food consumption is referring to deliberate action which are influence by economic, social, climate and environmental factors which affect the purchasing power and consumption of food products. Sustainable value driven for supply chain and production have significantly improve over the last decade by prioritized the role of food ethics leading to basic reflection on our value and principles that determines the ethical position such as vegan, the use of plastics, deforestation. Food ethics allows individual to make a right choice, determines the future consequences and outcome. Growing public, policy, and academic interest has been drawn to the expansion of individual and group consumer mobilization around ethical concerns, and numerous facets of the ethical consumption phenomena have sparked discussion and debate among specialists in several sectors. In economics, geography, philosophy, psychology, sociology, marketing research, and advertising, the concept of the ethical consumer has grown to dominate theoretical and empirical investigations. According to current research, consumers who are "concerned” with the effects that a purchasing decision has, not only on themselves, but also on the external world around them" are often referred to as ethical consumers.[1]. Structurally, the developed countries have a notion that they have privileges to consume what they want at any given time and that is based on their private life which should not be interfered based on legal policy. The importance of eating healthy food is a must for life, but it can also cause problems when consumed inappropriately. Therefore it is important that the marketing of healthy food is promoted and encouraged at all levels. Nutrition becomes an issue when it is only used to boost product sales, this can make it harder for companies to understand the importance of healthy diet. There is a global challenge based on ethics of food consumption which deals with population growth, access to natural resources, global market, climate change and global health issues. To maintain a critical perspective on these claims, it is important that the food ethics are integrated into global development. Big data use and global development goals have been promoted by several well-known organizations, including the UN, WHO, and UNESCO, which is all very impressive [2]. Therapeutic diet is a type of meal plan that aims to control the intake of certain nutrients and food items to improve the quality of life for patients. It is usually prescribed by a doctor and is implemented by a dietician. In therapeutic diets, changes are made to the nutrients, texture, and food allergies in order to improve the effectiveness of the treatment [3].The therapeutic diet can change over time depending on the individual's response to the treatment and improvements in the patient health condition. It can be temporary, or it can become the permanent change needed to live a healthy life. The ethics of therapeutic diet is based on the purpose intending or channel it to which determines the type of food to prescribe. The various risk factors associated with neurodegenerative disease have been known to be the most important factors that contribute to its development. In addition, direct evidence suggests that the disease can be accelerated by aging. Most of the neuropathological changes that occur in the brains of older individuals are still observed in normal aging brains. In normal aging brains, the volume and weight of the ventricles and the dendrites are reduced [4]. This study review the influence of ethics on the application of therapeutic food in treatment of neurodegenerative diseases.

**NEURODEGENERATIVE DISEASE**

The brain and spinal cord are the building blocks of the nervous system. Neurons are not capable of reproducing or replacing themselves, therefore when they die or become injured, they cannot be replaced. Alzheimer's and Parkinson's disease are two disorders that can impair these structures. These are known as neurodegenerative illnesses, and they can result in the loss or degeneration of nerve cells. They can also impair mental performance and create mobility disorders [5]. Cell death is one of the causes of neurodegenerative diseases. It can be the direct result of damage induced by other processes or a combination of these. In the case of neurodegenerative illnesses, brain cell loss can be induced by a variety of reasons.

Molecular diseases that affect the development and maintenance of neurons are known to be associated with various factors such as protein aggregation, neurodegeneration, and neuroinflammation. These conditions can lead to the death of neurons and the clusters of neurons that are most vulnerable to these diseases are the original sites of the pathology. These conditions are known to affect the structural complexity of neurons. The large synaptic connections and long-range projections of these neurons make them vulnerable to these diseases. Their high metabolic demands are also known to make them more vulnerable [6].

A recent review revealed that several hazard factors have been recognized in connection with the growth of Alzheimer's disease (AD). These include the presence of rare forms of EO-FAD, as well as the effects of gene mutations [7]. A number of gene mutations are known to be associated with the development of Alzheimer's disease. On the other hand, LO-SAD is a multi-factorial disorder that can be caused by changes in the genetic hazard agents for Alzheimer's disease. These include the presence of allelic variation in the apolipoprotein E gene, as well as other factors such as exposure to metal, infections, and diet is difficult to explain how various risk factors can contribute to mental disorders such as schizophrenia and bipolar disorder [8]. Over 60 environmental risk factors have been identified, and these are categorized into six categories. Some of these include air quality, heavy metals, occupational exposure, and other elements. Although there are limited studies on the link between various risk factors and other disorders, such as Parkinson's disease, it is widely believed that drinking alcohol and having a low-income status are some of the factors that can increase the risk of developing this health condition [9].

The concept of Parkinson's disease (PD) has been around for almost two centuries. Although the exact details of the disease have been described in the past, the development of the disease is still yet to be fully explored. It is a neurodegenerative disorder that occurs when the central nervous system's dopaminergic neurons die [10]. The death of the dopaminergic neurons in the pars compacta region is the main cause of Parkinson's disease. In humans, the nerve cell bodies are colored black due to the neuromelanin pigment. The nerve cell bodies of the par’s compacta are made of pigment neuromelanin, which gives them a black color. As people get older, their pigment levels increase. The distinctive black stripe found in brain sections is the origin of a certain volume of the brain. The lack of dopamine within the basal ganglia can lead to a condition known as parkinsonian motor symptoms. This disorder, which lasts for over a decade, affects the ability to perform various tasks. These parkinsonian indicators include muscular rigidity, postural and gait impairment. rest tremor, and bradykinesia,

Alzheimer's disease is a type of brain disease that impairs the ability to think clearly and recall information. It can also kill off many nerve cells in the brain. Mild cognitive impairment (MCI) is a type of memory disorder that can be seen as an early warning sign of Alzheimer's disease. Although it can cause Alzheimer's disease, it does not always affect people who have the disease. People suffering from this condition can still function normally and care for themselves. This disorder's symptoms include forgetting to attend appointments or events, having difficulty coming up with words, and losing a lot of information [11].

'The disease of Alzheimer is a chronic neurodegenerative dysfunction that affects many different parts of the brain. A host of mechanisms can contribute to it. Age is notably the most common risk factors for Alzheimer's disease. The majority of people with this condition are over the age of 65. Alzheimer's disease affects about 5% of people between the ages of 65 and 74. The risk of developing this condition is much higher in people over the age of 85. Studies have shown that aging can have an impact on the body's self-repair mechanisms [12-13].

High blood pressure and cholesterol are some of the other risk factors that can increase one's chances of developing Alzheimer's disease. In sporadic Alzheimer's disease, the lack of a genetic pattern of inheritance does not cause the development of the disease. A link has been established between a gene known as ApoE and the development of Alzheimer's disease. This gene is involved in the production of a protein that is known to carry cholesterol. One form of the gene, known as ApoE4, has been shown to increase the risk of developing this health condition (Alzheimer's disease) [14]. It has been known that higher education is associated with a higher risk of getting Alzheimer's disease. This is because people with fewer years of education are more likely to be unaware of the various causes of this disease. It is not clear why this link is so, but it is theorized that a higher level of education can stimulate the development of synaptic connections in the brain (Bird 2018).

Therapeutic concept suggests that a higher level of education can stimulate the development of synaptic connections in the brain, which can help patients with Alzheimer's disease carry out their daily tasks. Alzheimer's disease is a type dysfunction of brain that progressively terminates the ability to think and perform various tasks. It has also been reported that having a strong connection between one's brain health and cardiovascular health can lead to the development of Alzheimer's disease. High blood pressure and cholesterol are some of the risk factors that can increase one's chances of developing this condition [15-16].

One defective gene on chromosome 4 causes Huntington's disease, a specific type of brain disorder. .This defect is referred to as dominant. Anyone who inherits this disorder from their parents will eventually develop it. The faulty protein gene codes known as huntingtin, although its standard function has not been recognized, scientists believe that this faulty form of protein is the cause of Huntington's ailment [17].The main symptom of Huntington's disease is its ability to uncontrollably move the head, arms, , , upper body and the legs. It also engenders a downturn in its ability to think critically and develop effective reasoning and memory skills. In addition, the changes caused by the disease can additionally affect a person's mood. A blood test can be performed to check if the huntingtin protein is the cause of the symptoms of people who are suspected of having the disease. It can also be used to identify individuals who are at risk of developing the disorder because their parents have it [18]. The metabolic disturbances that can expedite the growth and advancement of numerous neurodegenerative disorders like Alzheimer's ailment are known to be involved in the overall health of the patient. The human brain is responsible for about 20% of the body's energy expenditure, and it performs an important role in normal brain function [19]. The various metabolic conditions that can lead to the development and progression of neurodegenerative disorders are known to be involved in the overall health of the patient. These conditions include protein aggregation, neuroinflammation, and mitochondrial dysfunction [20]. The rapid emergence and evolution of aging-associated conditions has been linked to the increasing number of people globally.

Studies show that the primary cause of disability and early death is neurological [21].  Over 300 million people worldwide are affected by the second prevalent cause of death, years lived with disability.  Frailty has been recognized as another potential medical issue that may affect the elderly.  Also, a number of focused therapies have been created to treat a variety of neuropsychiatric disorders [22]. These include stem cell-based treatments, neurotropic substances, and neurotransmitters.  These have been demonstrated to have beneficial effects on patients' cognitive decline.  Likewise, creation of novel medications intended to promote the synthesis of particular messenger molecules has neuroprotective effects [23].

**ETHICS OF FOOD CONSUMPTION**

Ethics of food consumption strive on religion, culture, belief, passion, education, social and economic perspective. Influence of cultural belief affect the preparation, processing consumption and purchasing power of different food based on restriction that has been imposed from decades and strictly followed by individual [24]. Maintenance and nourishment occur through consumption of food which provide energy and vitality for the body through consumption of various food from simple to complex food component and all this are being derived based on personal preference. There are always decisions to be made regarding what to eat, how much to eat, when to eat, and how to eat it, which adds to the complexity and strength of the decision within the cultural, economic, preference, and social environment that acts as the driving force behind their choice. There are diverse aspects and perspectives on food that make them acceptable in various societies, but there is no dominant food theory [25].

Food is necessary for human survival, and ethical food intake is comprehensive and complicated in nature. It affects human psychological, emotional, and physical growth as well as the social life of the community. Numerous aspects of the concept of spirituality have been researched, including its connections to life purpose and spiritual coping. Examining the many aspects of spirituality, such as meaning, tranquility, and connection with something universal, makes it simple to gauge the capacity to engage in spiritual practice even though the expressions of spiritual experiences may vary [26].

The various aspects of eating behavior that can be addressed through mindfulness-based practices can be beneficial for people who are struggling with their eating problems. For instance, it can help them develop strategies to improve their body acceptance and reduce their stress levels. Studies on food intake regulation are used to inform eating-related practices [27]. These include the development of strategies that involve increasing awareness of the physiological and emotional triggers that can affect a person's food intake. For instance, by developing a sensory-specific satiety system, participants can improve their food intake awareness and signal the end of a meal. It helped participants focus on eating for the quality of their food instead of the quantity. This method allows them to shift their reward value from the food they eat to the experience of eating [26]

Studies have shown that identity is a recurring theme in consumers' narratives about their ethical practices [1-2, 25, 28]. It suggests that the importance of collective and individual commitments to this practice is acknowledged in the context of the various meanings that consumers attach to it. Another prominent notion that has been used in the analysis of ethical consumption is the idea of doing well [28]. Due to the increasing number of studies on the topic, many of these have focused on the idea of doing good or doing the right thing in response to consumers' narratives about their ethical practices. Some authors believe that this concept is a central part of the ethical consumer's identity, while others claim that it is not. However, by focusing on the individual's self-satisfying aspect of their behavior, researchers can attain a deeper cognizance of the essence of ethical consumer [29].

The link between consumers and producers has been severed for a long time. To gain a deeper cognizance of the relationship between consumption and food production, there is a need for that political scientists should use narrative to reconstruct the link between food consumption and production. This isn’t a simple task, and it requires a lot of work on the part of consumers. However, it is necessary to increase the value-based consumption of food [30].

Consumers that value ethical food are interested in learning more about the development of the food industry. The practices of the past can be understood using this idea. The trace can also be used to examine historical eating practices through the use of narrative and semiotics. Political scientists have reconstructed the connection between food consumption and production using storytelling to acquire a greater understanding of the connections between them. This idea is intriguing since it enables consumers to see the progression of their food's production [31]. However, the majority of people never consider the circumstances behind the food's production. Consumers can deeper comprehend the connection between food production and consumption by using the trace. This may enhance food quality and raise consumer knowledge of ethical food practices.

**ETHICS OF THERAPEUTIC FOODS**

A therapeutic diet is a type of diet that is designed to improve the health, prevent disease, manage illness, and promote healing. It includes whole-food diets that are low in fat and refined sugar, as well as fruits and vegetables that are high in nutrients. The principles of therapeutic diets are based on numerous factors, including giving patients the nutrients they require to recover from a variety of illnesses, including cancer, intestinal disorders, and malnutrition. Patients must also have a flexible tolerance to food in order to maintain or enhance their nutritional status and their body's capacity to absorb, break down, and excrete nutrients [32].

For optimal health, it's important to increase or decrease the amount of nutrients that consume, some of the most common changes that can be made include: reducing the amount of salt in diet, increasing the fibre diet, and developing a high potassium diet. For optimal energy efficiency, increase or decrease the amount of calories that is consume and diets that can be considered include low calorie diets and high calorie diets for burns. One of the most common changes that can be made to improve the quality of diet is by eliminating the use of spices and condiments. This can be done through the elimination of low fat diets and gluten free diets. The reason for this change is to increase the balance of fats, proteins, and carbohydrates in diet. It can be done through the development of various types of diets such as fever, ketogenic diet, the renal diet, and the diabetic diet, which are all derived from regular diet.

The kind, quantity, and frequency of meals are specified in the diet prescription depending on each patient's disease process and disease treatment objectives. A calorie limit or other restriction may be necessary due to the condition. Additionally, different dietary components like carbs, protein, fat, vitamins, minerals, fiber, phytonutrients, or water may be reduced or increased. Economic status, eating habits (such as vegetarian, ovo-vegetarian, or nonvegetarian), food intolerances (such as lactose intolerance, gluten-sensitive enteropathy), allergies (such as milk, eggs), the patient's occupation, and meal timings are additional factors that the dietetic prescription takes into account. [33].

**Relationship between Human Diet and Neurodegenerative diseases**

The record of experiences in the brain is referred to as memory. It can be used to describe the various steps involved in retrieving, storing, retaining, and communicating information from the outside world. It can also be used to describe the complex activities involved in conscious or unconscious learning. The human brain is a complex system that stores and processes information. It can be used to perform various tasks, such as remembering details [34]. There are multiple types of memory that can be acquired from the acquired information. Around 12 percent of all deaths worldwide are caused by neurological disease, and this condition affects over 30 million people globally. Due to the blood-brain barrier, most potential treatments for neurological disorders are not able to enter the brain in sufficient quantities. These disorders are categorized into two types [35] central nervous system dysfunctions and peripheral nervous system dysfunctions. The development of neuropsychiatric disorders (NDDs) can be caused by various factors. Some of these include the injury of the nervous system, inflammation, and viral or prion infections. The prevalence of these conditions has been shown to have a negative impact on the quality of life [36]. For instance, it can lead to the loss of years of productive life. The prevalent cause of death due to these conditions is stroke. One of the most important factors that can affect the development of cognitive decline is exposure to oxidative stress [37]. This condition is regarded as one of the most common causes of morbidity and mortality worldwide due to neurodegenerative diseases. One of the most common types of neurodegenerative diseases is Alzheimer's disease. This condition is caused by the degradation of the central nervous system's [35]. The aging population is contributing to the rise of these conditions, as well as their negative effects on the quality of life. Due to their irreversibility and lack of effective treatment, these conditions are becoming very important [38]. These conditions are characterized by the loss of the structure and function of neurons. The exact cause of these diseases remains unclear. These conditions can also trigger neuroinflammation, which is an inflammatory response that can be triggered by an energy crisis [39].

Some dietary supplements can also help improve the cognitive performance of the brain. These include natural compounds such as amino acids, polyphenols, and fatty acids. They can additionally prevent cognitive impairment and dementia [40]. Fish oil from deep sea sea can contain various nutrients that can improve the cognitive performance of the brain. These include omega-3 fatty acids, docosahexaenoic acid, and eicosapentaenoic acid. In animal models and cell models, these compounds exhibited neuroprotective effects at a dose of 55 mg/kg or 2 mM. In addition to fish oil, other natural compounds that can improve the cognitive performance of the brain can also be found in food. These include peptides that are produced through the fermentation or hydrolysis of proteins from plants, animals, and microorganisms. After being ingested, these neuroprotective peptides can either directly affect the body or serve as the precursors of other biological agents that can improve the brain's health [34]. One of the most important lifestyle factors that can affect the development and maintenance of brain health is diet. Although the use of natural products can offer various advantages to the treatment and prevention of neuropsychiatric disorders, there are still clinical concerns about their safety and efficacy [41]. Various natural agents have been suggested as potential treatments for various neurodegenerative disorders. Some of these include animal-based products that have anti-inflammatory and anti-cancer properties. Flavonoids and resveratrol are also dietary components. According to studies, a diet rich in nutrients can help protect the brain from various mental disorders [42]. In addition to being beneficial for the brain, a diet high in protein also helps lower the risk of developing other conditions. Antioxidant compounds found in fruits, vegetables, and beverages have been known to protect against neurodegenerative disorders. They can also help prevent these conditions from developing. These are the most common phytochemicals that have favorable biological roles. They help protect plants from harmful effects of photosynthesis and scavenge reactive oxygen species. These compounds are known to have various beneficial biological roles, such as protecting plants from harmful effects of photosynthesis. They can also be used to scavenge reactive oxygen species (ROS). Fruits and vegetables are known to have anti-inflammatory properties that can help prevent chronic diseases such as Alzheimer's and Parkinson's. Some of the nutritional protocols that have been proposed for treating these conditions include the use of plant-based compounds [43]. There is currently sufficient evidence supporting the efficacy of various interventions for the treatment and prevention of Alzheimer's disease and other neurodegenerative disorders, the results of these trials have been inconsistent. It has been known that adjunctive use of dietary supplements can improve the response of patients to antidepressants. This strategy can also be used to modulate various neurochemical pathways. It has been observed that the use of various nutrients can improve the response of patients to antidepressants. This is a potential augmentation strategy for treating inadequate response to drugs. Due to the increasing number of neurodegenerative disorders, it is difficult to identify effective treatment agents that can prevent the development of these conditions. The various pathways that are involved in the regulation of neurodegeneration have been shown to be effective in slowing down or halting the decline in loco motor and cognitive function [44].

A meta-analysis and review of the literature revealed that the use of various nutrients, such as S-adenosyl methionine, can improve the response of patients to antidepressants. However, there were mixed results for other nutrients, such as folic acid, vitamin C, and zinc. Due to the increasing number of studies showing the therapeutic potential of certain nutrients, the focus has been shifted toward the use of diet and eating habits that can provide adequate levels of these nutrients. Consuming 3 polyunsaturated fatty acids can help maintain cognitive function [39]. They promote neurogenesis and promote the development of neurons. Adequate nutrients, such as long-chain fatty acids, vitamin E, and mineral elements, can help decrease inflammation and improve antioxidative defense. It can also lower the risk of Alzheimer's disease and other age-related conditions [45].

It is crucial to take into account the various elements that influence the distribution and absorption of nutrients into the central nervous system while treating and preventing neuro-inflammation (CNS). One of these is how the patient's characteristics and the body's microbiota interact. The idea of a gut-brain axis implies that altering the gut microbiota may help in the development of novel treatment approaches for treating complicated neuro-inflammatory illnesses. The outlook for the treatment of Alzheimer's and other neurodegenerative disorders has improved significantly due to the development of new targeted therapy. In the last decade, the increasing understanding of the biological and therapeutic properties of polyphenols has led to the development of new strategies for treating these conditions. Unfortunately, the poor bioavailability of polyphenols is a major limitation of their therapeutic potential. Despite this, some polyphenols can still cross the blood-brain barrier [46].

**Natural and Medicinal Plants for treating Neurological diseases**

Natural compounds and medicinal plants, such as *Withania somnifera, Ginkgo biloba*, and resveratrol, have been used to treat and prevent neurological diseases. They have also been studied in clinical trials to treat various neurological symptoms. Naturally occurring substances can function in a similar manner to their native states, making them potent therapy options. Nanodrugs can also be used to deliver them to tissues and cells. Alzheimer's disease treatment is quite expensive. About $100 billion is thought to be spent annually on this illness. Many individuals are resorting to natural remedies as a result of the high cost of treating Alzheimer's illness. Compounds like Ginkgo biloba, Ashwagandha, and Baccopa monnieri are a few of these. Other plants like sesamol, flavonoids, and trehalose are also included [47]. Naturally occurring substances can function in a similar manner to their native states, making them potent therapy options. Nanodrugs can also be used to deliver them to tissues and cells [48]. Alzheimer's disease treatment is quite expensive. About $100 billion is thought to be spent annually on this illness. Many individuals are resorting to natural remedies as a result of the high cost of treating Alzheimer's illness. Compounds like Ginkgo biloba, Ashwagandha, and Baccopa monnieri are a few of these. Other plants like sesamol, flavonoids, and trehalose are also included. *Ashwagandha* is an Indian herbal medicine that has been used for various purposes, such as anti-inflammatory, neuroprotective, and immune boosting. It can also help boost memory power and improve the strength of muscles. Its Withanolides compounds have been known to suppress the growth of breast cancer cells. Numerous plant species have been used to treat various conditions in humans. The use of extract in either a semi-purified or crude form has been shown to work effectively [49].

Panax Ginseng is a type of medicinal herb that is native to China and Korea and is known for its ability to treat various conditions, such as neurodegenerative disorder, diabetes, and cancer. It is also believed that this herb can help boost the immune system. Compound K, which is a derivative of ginseng, has inhibitory properties that are more powerful than commercial anti-allergic drugs. Ginsenosides of gingko are known to have neuroprotective properties, which makes them an excellent treatment for Alzheimer's and other neurodegenerative diseases. Ginsenosides of gingko are known to have neuroprotective properties, which makes them an excellent treatment for Alzheimer's and other neurodegenerative diseases. Ginsenosides of gingko are known to have neuroprotective properties, which makes them an excellent treatment for Alzheimer's and other neurodegenerative diseases. They can block the elevation of nigral iron levels and decrease the expression of DMT1 [50].

In India, the popular spice known as cumcurum or turmeric has been used for its various medical and cosmetic properties for centuries. It is a storehouse of nutrients and dietary fiber. Some of its anti-inflammatory and antioxidant properties are also known to be beneficial. Curcumin is an anti-oxidant and has a high potential to boost the immune response. It can also help decrease the production of certain enzymes and cytokines. Curcumin can help boost the activity of macrophages, which are important in the fight against Alzheimer's disease. According to studies, this natural substance can help remove the toxic plaque from the brain. Cucurbit is useful in regulating the function of the cerebral microcirculation and hypertension. In a study, the effects of Curcumin on the regulation of hypertension and its potential mechanisms in the circulation was investigated. They found that the drug significantly reduced blood pressure in mice. It also improved the flow of blood through the capillaries and altered the functioning of the open capillaries [51].

A type of natural phenol known as Resveratrol is found in various fruits and vegetables, such as grapes, mulberries, and berries. It has anti-inflammatory and antioxidant properties and can help lower the risk of cardiovascular disease [52]. It has been proven that resveratrol can help in reducing inflammation. It can also stimulate the activation of AMPK, which can affect the homeostasis of neurons. Resveratrol is a derivative of Piceatonnol that can block the accumulation of reactive oxygen species (ROS) in the body. It has also been shown to have anti-inflammatory properties. The *Baccopa monnieri* is commonly used in Australia and India for its various medical properties. It can help improve memory power and stimulate nerve cells. There are two types of saponins in this plant: *Bacoside A* and *B. Bacoside* A is a type of saponin that can improve the memory power. Apart from its ability to boost memory, *B. monnieri* can also help lower stress levels and promote healthy muscle development [53].

In recent years, the effects of flavonoid-rich diets on various functions have been studied. These include modulation of the apoptotic and inflammatory signaling pathways. Numerous reports have been presented about the therapeutic benefits of anthocyanin. Unfortunately, the lack of effective therapeutic agents for Alzheimer's disease is largely due to the fact that current treatments only target a single aspect of the disease pathology. Instead, new strategies have been focused on identifying multiple factors that can contribute to the disease's progression. Due to their ability to modulate the effects of neurodegenerative processes, polyphenols have gained increasing attention in recent years. These compounds are known to be active in a wide variety of fruits, vegetables, spices, and herbs. Flavonoids are also known to have high levels of antioxidant activity. Anthocyanins are a class of compounds that have a unique structure that differ from one another. They are commonly found in fruits and vegetables and are responsible for the creation of various colors. These compounds are also known to be used in the production of multiple pigments such as blue, purple, and red [43].

Flavonoids known as anthocyanin are attractive as therapeutic agents due to their ability to be safely consumed in a regular diet. Because of this, they are commonly used as dietary supplements and food products. Their potential to treat various diseases, such as Alzheimer's and Parkinson's, has led to the development of a proposal to include them in the diet. The pleiotropic properties of these compounds could be used to develop new drug candidates for various diseases, such as Alzheimer's disease. This could be done through the development of multi-target-directed compounds, which are being studied as potential treatments for these conditions. Due to their ability to modulate various factors that affect the development and maintenance of cancer and cardiovascular disease, anthocyanin have been regarded as an ideal scaffold for further research [42].

There is promise for using flavonoid substances like isoflavones and flavones as a basis for creating new therapeutic approaches for Alzheimer's disease. The special qualities of anthocyanins make them a significant resource for upcoming drug discovery efforts. Anthocyanin, a naturally occurring component of their compounds, can alter several variables involved in the initiation and maintenance of cancer and cardiovascular disorders. They could act as a productive starting point for additional study into the development of fresh MTDLs. It is vital to keep in mind that anthocyanins' in vivo bioavailability is not as great as that of their stable metabolites, even though they have been demonstrated to be effective in treating a number of disorders, including cancer [45].

One of the main advantages of consuming anthocyanins is their ability to reduce the risk of developing Alzheimer's disease and other neurodegenerative conditions. Because of their high levels of bioactive compounds, it is very important that further studies are conducted on the use of these compounds in this field. The use of anthocyanins as therapeutic and neuroprotective agents is currently under study in the treatment of Alzheimer's disease and other cognitive disorders. Although the exact effects of these compounds are not known, their use in plant extract form is considered promising. There are also limited data regarding their effects on other neurodegeneration conditions. Although their effects are not known, several studies suggest that anthocyanins can help decrease the damaging effects of certain processes that are involved in the growth and care of Alzheimer's disease and other cognitive disorders. These include excitotoxicity, nitrosative stress, and protein aggregation. It has also been shown that these compounds can cross the blood-brain barrier, which suggests that they may mediate these effects in the central nervous system [52].

Fruits and vegetables have been shown to help prevent cognitive decline. Their high levels of nutrients and minerals and low energy density are known to be beneficial for maintaining a healthy brain. These compounds can help support the immune system and regulate cholesterol levels. They can also help lower the hazard of Alzheimer's disease and dementia [43]. Numerous studies have shown that an increased vegetable intake can help lower the cognitive decline rate in older adults. Consuming nuts can lower cholesterol and increase the risk of developing type 2 diabetes and cardiovascular disease. These factors could also improve cognitive function. There are currently no definitive studies supporting the link between coffee consumption and cognitive decline or dementia. However, recent meta-analyses suggest that drinking more coffee may reduce the risk of developing Alzheimer's disease (AD). These studies should be further analyzed in order to establish a well-designed and randomized clinical trial. Other studies also suggest that drinking green tea may help lower the risk of developing neurodegenerative diseases [54].

Flavonoids are a group of polyphenols that are commonly found in fruits, vegetables, and herbs. They are known to have anticarcinogenic and antimutagenic properties. They are also known to suppress the generation of free radicals and improve the protection against free radicals. Flavonoids found in citrus fruits, wine, and green tea have been known to improve the function of the brain. Their anti-inflammatory, antioxidant, and anti-apoptotic properties can be triggered by interactions with certain signaling pathways [43]. They can also increase the cerebral blood flow and improve cognition. Studies have shown that olive oil can reduce the production of arachidionic acid in animal macrophages by the G/H synthase pathway. A recent study by Moreno et al. [55] confirmed these findings and found that certain components of olive oil can also help reduce the free radicals in the body. The results of the study have helped to identify a potential therapeutic target for the treatment of non-diopathic diabetes (NDs). In addition, they found that the presence of certain compounds in olive oil can protect against the development of these conditions. Studies have shown that green tea can prevent various types of harmful substances from being released into the environment. It has also been shown that it can prevent the development of neurodegeneration in the dopaminergic neurons. In addition, a study conducted by Mandel et al. [56] has shown that green tea can play a role in the treatment of non-displaced neurodegeneration.

According to Weinreb et al. [57], the high levels of polyphenols found in green tea can help protect against the development of neurodegenerative diseases such as diabetes and Alzheimer's. It is believed that drinking green tea can also help protect the neurons from the effects of free radicals. Carotenoids help delay the progression of diseases by suppressing the effects of oxidative stress and pro-inflammatory cytokines. They also prevent the production of amyloid peptides and protect lipid-rich tissues from damage caused by free radicals. Beta-carotenes can help neutralize the effects of lipid peroxidation. The extract of crocin, which is commonly used for its anti-inflammatory and antioxidant properties, can protect neurons from various neurodegenerative processes. Some studies have shown that it can also reduce the damage caused by free radicals in the hippocampus [57].

Both clinical and epidemiological studies have shown that a low level of homocysteine and a sufficient supply of vitamins B6, B9, and B12 can help lower the risk of Alzheimer's disease. These studies also suggest that taking B-complex vitamins can help decrease the symptoms of Alzheimer's disease. It has been known that beta-carotene can help protect neurons from hydrogen peroxide, which is a major contributor to neurotoxicity. It has also been reported that a sufficient amount of beta-carotene in the diets can reduce the incidence of Alzheimer's disease and other related dementias. Moreover, studies have shown that the use of beta-carotene can improve the function of mitochondria, which could be used as a potential therapeutic target for these conditions.

A study found that high levels of homocysteine, which can increase the risk of Alzheimer's disease, were linked to a seven-year delay in the onset of symptoms. The study also noted that a higher level of vitamin B12 could help lower the risk of developing the disease. A plant-derived vitamin E compound can interact with cell membranes to help break down free radicals. It can also prevent the formation of harmful free radicals. One of the most widely-used antioxidant is vitamin C, which is regarded as the gold standard for expressing the beneficial effects of plant-derived compounds. It is also involved in a variety of other functions, such as the production of collagen and the stimulation of the immune system [58]. Numerous studies have shown that vitamin C can protect against the development of Alzheimer's disease and other cognitive disorders. It has also been shown that it can protect neurons from damage caused by the disease. It has been suggested that vitamin C could be used as a neuromodulator of certain brain cells. It is believed that this compound can help maintain the function of the neurotransmitters dopamine, glutamate, and cholinergic [43].

The development of vitamin D receptors in various parts of the brain has been linked to an increase in neurons. It has also been known that certain enzymes in the brain can stimulate the synthesis of a type of vitamin D3 called calcitriol. This could help prevent the development of Alzheimer's disease. B vitamins are essential nutrients that help in the activation of the antioxidant system. Almost half of all healthy elderly people have high levels of homocysteine. This amino acid is produced by the metabolism of protein. Studies have shown that high cholesterol can negatively affect brain cells. It has also been reported that people with Alzheimer's disease and vascular dementia are more prone to having high levels of homocysteine, which can increase the risk of developing these conditions [59]. Some studies suggest that taking certain nutrients, such as vitamin B6, vitamin B9, and vitamin B12, can reduce the risk of experiencing these conditions. Studies have shown that a high level of homocysteine in the blood can lead to the destruction of blood cells that are part of the endothelium, which can promote thrombosis and raise the level of LDL cholesterol. These factors can also lead to the development of cardiovascular diseases [58].

Unsaturated fatty acids, such as -3, are known to play a vital role in various brain functions. They are also known to have a significant effect on the development and maintenance of neuroplasticity and memory. The human brain is composed of 60% fatty acids, with around 20% coming from docosahexaenoic acid and 30% from omega-3.Docosahexaenoic acid (DHA) is also known to be incorporated into the cell membranes of the spinal cord and brain. It is mainly found in the plasma membranes and the cellular organelles of the nerve endings. This is because it plays a vital role in the development and maintenance of the central nervous system. Studies have shown that the composition of the fatty acids found in phospholipids can vary. For instance, the type of omega-3 or 6 that is found in a diet can affect the effects of the nutrients on the body. A negative correlation has been shown between the levels of -3 in the blood and the development of non-dysfunctional disorders (NDs) [60]. Some studies suggest that regular use of a -3 supplement can help decrease the incidence of AD in elderly patients [61-62]. Other studies also suggest that prolonged use of a -3 supplement can help slow down the progression of pathological conditions linked to the damaging effects of free radicals. These compounds, which are mainly found in vegetables such as garlic, onion, and Chinese chive, are known to fight the effects of age-related diseases. They can also help prevent inflammation and other harmful effects of free radicals [63-64].

**HORMESIS-BASED ANTI-AGING STRATEGIES**

Hormesis in aging is characterized by the stimulation of defense mechanisms in cells and organisms by mild stress, which has biologically advantageous benefits. Homeostasis, a notion that has dominated biology, physiology, and medicine since the 1930s, is the standard conceptual model used to define this feature. But there have been improvements in our comprehension of the biological processes of growth, development, maturity, reproduction, and ultimately of aging, senescence, and death [65].

The disturbance of homeodynamics, the mild overcompensation, the restoration of homeodynamics, and the adaptive nature of the process are the main conceptual features of hormesis. A wide range of physical, chemical, and biological substances, such as ionizing radiation, heavy metals, pesticides, antibiotics, chemotherapeutic drugs, ethanol, aldehydes, and chloroform, display hormetic dose-response. The well-documented positive effects of exercise, which at a biochemical level result in the generation of potentially detrimental chemicals such free radicals, acids, and aldehydes, serve as the model for thinking about the use of hormesis in aging intervention [40].

Therefore, it is predicted that if biological systems are purposefully subjected to little stress in order to test and stimulate inherent homeodynamic processes of repair and maintenance this should result in generating positive hormetic impacts, particularly effects that promote longevity and well-being. Thus, hormesis in aging is characterized as the beneficial effects that promote life that come from cellular responses to a single or numerous cycles of mild stress. Applying hormesis in aging research and therapy is a relatively recent area because the negative effects of extreme stress have long overshadowed the positive hormetic advantages of lower-level stress. Hormesis is a concept that offers mechanistic explanations for the seemingly contradictory and corresponding impact of possibly destructive agents, has resulted to new areas of research on anti-aging. Hormesis can be refer to for its health beneficial impact due to consumption foods and food components from garlic, vegetables, Gingko, fruits etc. Understanding the hormetic and interactive mode of action of either natural or processed foods is an interesting field of study with ample prospects in nutritional development as well as modifications of life style for antiaging intervention/therapies. For instance, it would be conceivable to create multi-hormetin compositions that work through hormetic channels through mild stress-induced activation of homeodynamic processes as anti-aging medications and nutraceuticals [66-67].

**Correlation between Caloric restriction as a therapeutic diet and hormesis**

Dietary calorie restriction (CR) has been demonstrated to increase longevity and delay the beginning of a variety of age-related changes. CR is the most widely practiced technique that has these effects. The universal applicability of CR as a lifespan-extension and anti-aging intervention, particularly in humans, is now a hotly contested topic, mostly based on evolutionary grounds [68]. However, CR has been found to have some positive and health-promoting benefits on people. For instance, it has been discovered that prolonged CR is quite beneficial in reducing the likelihood for atherosclerosis in human. By seeing CR as a low-intensity stressor, hormesis has been proposed as a primary explanation. The relationship between CR and the rise in plasma levels of the stress hormones glucocorticoid steroid serves as the primary argument in favor of the idea that CR is a low-intensity stressor [69]. According to the hormesis hypothesis, the effects of CR are caused by the employment of one or more pathways related to stress response, molecular damage prevention and turnover, and metabolic regulation. There is strong evidence that CR has hormetic effects by boosting pathways for repair and preservation. It has been demonstrated that a number of dietary components, including vitamins, antioxidants, trace elements, minerals, ethanol, and even herbicides and pesticides, have the normal hormetic dose-response. Hormetins are all such substances (natural or synthetic), which work through one or more pathways of maintenance and repair, and stress response, to provide biologically advantageous effects. The positive benefits of zinc are thought to be accomplished by stress response-induced changes in the gene expression of numerous maintenance and repair pathways, and their effects also exhibit a classic hormetic dose-response [70]. According to Corder et al. [71], flavonoid and non-flavonoid components of wine, such as resveratrol, which also has a hormetic dose-response, are thought to be responsible for the wine's cardio-protective, antioxidative, and other positive properties. Different antioxidants, such as those found in spices and other therapeutic plants, are potential additional hormetins. Nearly all anti-oxidants exhibit hormetic dosage response, and above a specific dose, they turn pro-oxidant. Additionally, in some instances, such as with alpha lipoic acid and coenzyme Q10, it is their pro-oxidant activity in creating hydrogen peroxide, which causes defensive responses, that serves as the foundation for their ultimately positive effects.

Toxicologists refer to a biphasic dose response to an environmental substance as hormesis, which is characterized by a small dose stimulatory or beneficial effect and a higher dosage inhibitive or poisonous effect. Hormesis is referred to as an adaptive reaction of cells and organisms to a moderate (often intermittent) stress in the domains of biology and medicine. Examples include exercise, dietary energy restriction, ischemia preconditioning, and exposure to low concentrations of certain phytochemicals. Herbal products' antioxidative properties are caused by phenolic chemicals, flavonoids, and proanthocyanidins from plants. Their chemical composition and capacity to give free electrons and hydrogen account for this. Green tea (*Camellia sinensis*) and the tropical Cabbage Palm Fern (*Polypodium leucotomos*) have potent antioxidant properties [72].

 Many plant extracts, such as Labisia pumila, can reduce UVB-induced photo damage by either enhancing the synthesis of tissue constituents or by inhibiting the activity of enzymes involved in tissue breakdown [73]. (Binic et al., 2013). Recent research has shown that dietary antioxidants, including polyphenols and L-carnitine/acetyl-L-carnitine, are neuroprotective via activating hormetic pathways, such as vitagenes. The fundamental mechanism underlying neuroprotective responses is hormesis, which also provides a framework for analyzing their dose response relationships' common quantitative features, their mechanistic underpinnings, and their connection to the idea of biological plasticity. Hormesis also provides a critical insight for increasing the therapeutic dose accuracy of pharmaceutical agents in the highly heterogeneous human population [66]. Reducing age-related morbidity and promoting healthy aging will be made possible by a comprehension of the mechanics of aging and the factors that influence life duration. As a result of medical advancements and environmental changes over the centuries, average lifetime has increased, but maximum life expectancy has not altered. The term aging is the unpredictable incidence and accumulation of molecular damage that results in functional degradation and a progressive rise in molecular heterogeneity. The rate of aging, the genesis of age-related disorders, and eventual death are all essentially determined by the success or failure of repair and maintenance channels. This idea can serve as the foundation for powerful anti-aging tactics that aim to prevent or at least delay maintenance failure [64].

Numerous anti-aging and longevity-extending hormetic effects are produced by single or repeated exposure to low concentrations of otherwise damaging substances, including radiation, dietary restriction, excessive heat, hypergravity, oxygen radicals, and other free radicals.The consequences of a failed homeostasis or homeodynamics are aging, senescence, and death. The characteristic of aging and the root of age-related disorders is a steady contraction of the homeodynamic space. Reactive oxygen species (ROS), which are continuously formed during oxidative cell metabolism, contribute to aging-related alterations. There is strong evidence to suggest that ageing is a result of free radical damage caused by numerous endogenous ROS, however this is more likely [50].

Globally, age-related illnesses like cancer, cardiovascular disease, and neurological diseases are the main killers and sources of health problems. Because a significant portion of older people are suffering a variety of age-related disorders, a greater emphasis has been made on maintaining better mental and physical well-being as we age. This has an impact not only on the elderly but also on the family members who provide care for them. The world's aging population is growing as a result of better nutrition, powerful medicines for infectious diseases, and improved healthcare, making the prevention of age-related disorders all the more crucial. By 2060, there will be 98 million individuals over the age of 65 in the United States, up from the present 46 million. This will bring the overall population's share of those over 65 down to 25%. Consequently, it would be extremely valuable to improve quality of life by developing interventions that slow down the rate of aging and decrease or delay the occurrence of incapacitating age-related disorders [74].

Additionally contributing to neurodegeneration is dysfunctional autophagy. Because autophagy makes it easier to get rid of harmful protein forms, including the α-synuclein linked to Parkinson's disease, autophagy has a neuroprotective impact on neurons. Polyphenol-rich foods, which have anti-inflammatory and antioxidant properties, hold promise as "anti-senescence foods" in a nutraceutical strategy for better aging [75].

**Role of Ethics: application of Therapeutic Foods in Neurodegenerative Diseases and Aging**

Ethics is a subdivision of philosophy aimed at conducting an intellectual investigation of the moral human component in all of its diversity. Ethics supports principles that assist individual/humans to decide what is right and wrong. It represents evaluation of behaviors, whether they are good or negative. The goal of ethics is to identify our duties through an intellectual and logical assessment of principles and value conflicts. Duties always integrate the values in question within every specific context, constantly supporting them. Identifying an ethical problem or dilemma is the first phase in ethical reflection. This means when a medical or other healthcare practitioner encounters an ethical challenge, the reason is that they are aware of the principle or moral standard that should be upheld. A "conflict of values" exists here when the health care provider has an ethical difficulty if there is a value demanding attention but there is a conflict between opposing values [76]. There is an ethical concept that recognizes that individuals are free agents with their own beliefs and goals who are capable of taking intentional actions in accordance with these beliefs. Failing to consider how one's culture genuinely influences their beliefs, ambitions, and daily life, implies denying them a certain amount of cultural freedom. The same applies for overlooking the foods that are significant to one's culture [77]. A medical intervention like nutrition therapy involves both the knowledgeable patient's valid consent and a rationale for achieving a therapeutic target. In certain circumstances (terminally ill, hospice care, dementia, senior citizens), prolonging and withholding dietary therapies and artificial hydration must always be reviewed [78]. This must always be done on a specific instance in accordance with the clients' cultural and philosophical values. One of the most significant lifestyle aspects that affects mental health is food. “Eating is an ethical act as well. We are more than just customers through the act of eating. In the contexts of cultures, beliefs, and societal factors with a global impact on people's diet and health consequences, eating frequently incorporates ethical decision. There has been debate on whether food is considered “exceptionalism" in communities or countries. Food is a fundamental feature of human function, way of life, experience, and mental health. If not carefully planned, can result in a variety of unusual social difficulties [79]. The ethical implications of evaluating food security in a way that limit to a nutritional perception offers an erroneous picture. Our food choices are frequently connected with our ideas and values, to the source of the food, and our increased connectedness to a more globally interconnected world. "You are what you eat" has some validity. Nutrition has consequences for a variety of sectoral approaches that must be implemented. Food is crucial to patient care. Prior to nutrition education, it is important to address the restrictions of food access and propose solutions for patients [80]. Food is essential to human survival. It is necessary for survival, health, and well-being; it has profound spiritual-symbolic value (such as Buddhist vegetarianism), and it supports in the formation and maintenance of social bonds. As a result, it is not unexpected that food is inextricably linked with ethics, the study of rules, principles, or values that should guide human activity. Food ethics is confronted with a slew of new issues that have arisen only since the introduction of modern farming methods and biotechnologies [81].

Food is at the heart of human sociability, as it is crucial in family life and other forms of social connection." "Drinks are for strangers, acquaintances, workers. Meals are only for family, close friends, and honored guests". Meals, especially at home, are an expression of personal friendships. Common meals serve as gathering areas for family and friends. The social bonding role of food may be eroding because of individualist eating, whether it takes the form of functional foods or foods adapted to a person's genetic makeup. Due to their individualizing nature, such meals may have a negative impact on these social dimensions: what is healthy for one person may not be for another due to variations in the genome, age, lifestyle, and expectations. As a result, the shared meal—which is prized in maintaining relationships at least in European and Asian eating customs—might eventually disappear [82]. “Let food be thy medicine and medicine be thy food.” Consumers in the modern West hardly practice in agrarian production, and they have a limited degree of knowledge about in the processes. Though, consumers still regard food as inherent, they usually complain about the constraints that hinder them from making morally conscientious food choices. Consumers need to decide their diet as one's consumption preferences are an element of one's autonomy; as a result, the markets reflected these preferences. Hence, the question of choice of food, and why, is at first instance (prima facie) open to the decision of the individual. There is an ethical concept that recognizes that individuals are free agents with their own beliefs and goals who are capable of taking intentional actions in accordance with these beliefs. Failing to consider how one's culture genuinely influences their beliefs, ambitions, and daily life, implies denying them a certain amount of cultural freedom. The same applies for overlooking the foods that are significant to one's culture [79]. Only in preventive medicine, of which diet is a key component, allows for healthy aging. This only implies that food as well as its byproducts can play a significant role in medicine. In addition to conventional therapy, therapeutic diets are a form of disease-specific treatment. These diets have been created to treat one or more disorders and are composed of nutrients that may be useful in doing so. They frequently use fixed-formulation diets and better foods, which increases the cost [41].

Patient safety and quality is an integral aspect of health care. In the contexts of cultures, beliefs, and societal factors with a global impact on people's diet and health consequences, eating frequently incorporates ethical decision. A multi-sectoral approach to good nutrition is necessary; different institutions have a role to play in making sure that all people are properly nourished. Governments, multinational and domestic enterprises, farmer/producer, donors, the private sector, non-governmental organizations (NGOs), civil society and the United Nations (UN) organizations are just a few examples of these institutional stakeholders. The core purpose of these institutions is to protect people's rights and interests as consumers and producers. There are many different stakeholders who have made nutrition, food, and hunger a central goal of their work, affecting the relationships between national and international agencies that combat to tackle malnutrition. With its inclusion in G8 meetings and the United Nations secretary General's Call to End Hunger, nutrition has also gained more political recognition. The Copenhagen Consensus identified nutrition as one of the best-valued interventions to improve global development in both 2008 and 2012 [75].

Multiple sclerosis, Parkinson's disease, and Alzheimer's disease are the most prevalent neurodegenerative diseases. In the progression of these disorders, neuroinflammation, oxidative stress, and mitochondrial dysfunction were all reported. Despite the reality that there is currently no permanent treatment for these illnesses, clinical therapies for AD, PD, and MS symptoms may include drugs, way of lifestyle changes, as well as several alternative approaches. Dietary programs, specialized foods, and nutritional supplements could all be used as lifestyle therapeutics. Individualized nutrition techniques have been proposed as preventative measures, and adopting a nutritional strategy for relieving the symptoms of these disorders has already shown to be therapeutic for some clients. Natural chemicals included in vegetarian food, that is, fruits (particularly berries), have been shown to have anti-inflammatory neuroprotective potential, and nutritional programs aimed at slowing the advancement of chronic diseases have been anticipated. Interest has also centered on dietary patterns, such as feeding time and circadian rhythms, in order to boost the availability of bioactive substances capable of acting as both anti-inflammatory and antioxidant agents. The study of the association between dietary variables and mental health disorders is known as "nutritional psychiatry" [83]. The neuroprotective effects of several foods and lifestyle choices have been studied. In recent cross-sectional research, it was discovered that improved cognition was linked to improved food quality and compliance to dietary recommendations that place an emphasis on eating fruits, veggies, fishes, and fibres [84].

According to Oboh and Ogunruku [85], pepper fruits were able to restore the antioxidant status of the brain, which had previously been damaged by the intraperitoneal dose of cyclophosphamide. The neurological effects of capsaicin in peppers account for most of the recent interest in them. By increasing membrane permeability to cations like calcium and sodium, capsaicin acts as a chemical signal to activate the peripheral terminals of sensory neurons. Didyrocapsaicin, capsaicin, quercetin, isoquercetin, rutin, kaempferol, gallic acid, and chlorogenic acid were all present in the bell pepper extracts. The phytochemicals in the extracts were thought to be responsible for their neuroprotective properties. Around the world, green leafy vegetables play a significant role in many cuisines and dishes. According to numerous reports, some green leafy vegetables that are popular in Nigeria had useful characteristics for treating neurological illnesses. For instance, it has been suggested that the leaves of cabbage, cucumber, atama, afang, editan, and utazi are useful in treating dementia and cognitive dysfunction [86].

The leaves of C. crepidioides, often known as fireweed, have reportedly been shown to have the ability to enhance cognitive functioning in vitro, according to Adedayo et al [87]. The activities of acetylcholinesterase, butyrylcholinesterase, and monoamine oxidase might be inhibited by the various extracts of these vegetables. However, their bioactive phenolic components have been associated with these properties. Grochowska and Przeliorz [88] reported that the availability of ketone bodies in Parkinson's patients can minimize muscle stiffness and tremor while also enhancing cognitive performance. According to the study's findings, utilizing a low-carb diet, such as a ketogenic diet (KD), can improve brain function in conditions that result in neuronal damage. Hersant and Grossberg [89] also compared the influence newly FDA-approved symptomatic therapies using ketogenic diet and exogenous ketone supplementation as therapy for Alzheimer's disease as a combined approach. It was concluded that combining the two approaches could prove as more beneficial in averting/deferring Alzheimer's disease as well stabilizing in reducing disease progression in patients with Mild cognitive impairment. Recent research on neurodegenerative diseases has revealed adequate nutrition, such as omega-3 fatty acids and vitamin D, and special diets, such as the Mediterranean and keto diets, offer potential benefits for preventive, lowering disease progression, and enhancing patient quality of life [90].Walnuts have been investigated for their possible anti-inflammatory advantages on brain health due to their high source of antioxidants and omega-3 fatty acids. According to a review from 2020, adding walnuts to a patient's diet may enhance cognition and lower risk of neurodegenerative disorders including AD and PD. This is based on findings from a combination of animal and human studies [91]. In a 2015 randomized clinical research, extra virgin olive oil or mixed nuts (including fifteen grams of walnuts) were used as supplements to the anti-inflammatory Mediterranean diet. There were Four hundred and forty-seven cognitively healthy participants. The walnut-supplemented diet was the only one to show a significant improvement in cognitive tests compared to the control group, even though the results showed that both supplemented diets improved overall cognitive function [92].

Resveratrol is a polyphenol that can be found in a wide range of foods, including as dark chocolate, grapes and blueberries. It is well known for its anti-inflammatory, antioxidant, and neuroprotective properties. Resveratrol may also be used to treat a host of disease disorders, including neurodegenerative illnesses, according to animal and in-vitro research. The findings of human clinical trials have been optimistic and it reported a considerable improvement in verbal memory and general cognitive function [93]. It has been reported that gingko biloba leaf extract can enhance cognitive performance and help AD patients. With the precise dosage and continuous administration, gingko biloba leaf extract may enhance cognitive performance in individuals who have mild dementia [94]. Numerous foods that have antioxidant and anti-inflammatory properties may have an impact on the mechanisms underlying the pathology of AD, the most prevalent form of dementia. These include isothiocyanates (present in cruciferous vegetables), phenolic compounds (turmeric, olive oil, berries, etc.), omega-3 fatty acids (fishes, walnuts, etc.), fat-soluble vitamins (vitamins A, D, E, and K), and carotenoids (the yellow, red and orange plant colors)[95]. Taking a daily supplement of carotenoids and fish oil (10 mg meso-zeaxanthin, 10 mg lutein, and 2 mg of zeaxanthin in addition to 90 mg EPA,1 g of fish oil,and 430 mg DHA ) may help AD patients slow the progression of their disease and improve their quality of life, according to a small clinical trial of 12 participants conducted in 2018 [96].Low serum vitamin D levels can increase the chance of developing MS in addition to other risk factors like age. A 2018 randomized controlled clinical trial with fifty three participants combined the two treatments and evaluated the effects of a daily dose of omega-3 fatty acids (two capsules containing 500 mg DHA and 106 mg EPA) and vitamin D3 supplementation (50,000 IU cholecalciferol twice a week) on MS symptoms. Compared to the placebo group, the therapy group experienced a substantial improvement in metabolic status and disability status scores after 12 weeks [97]. A 2019 evaluation of human trials found that omega-3 fatty acids and fish oil may lower risk of recurrence and inflammatory markers as well boost the general quality of life for MS patients. These supplements have also been examined for delaying the course of MS in adults [98]. A 2020 review emphasized the potential advantages of vitamin D therapy as a treatment for MS patients, including a potential decrease in clinical symptoms and degree. After the initial deficiency has been treated, continuous, high levels of vitamin D therapy may pose some risks, according to the review [95].

Aging, which occurs at varying rates in various tissues, is linked to the physical decline that increases the likelihood of disease. Aging is the single risk factor for neurodegeneration that has the greatest effect. It is uncommon to find a brain free of neurodegenerative problems in the aged population, especially in extremely old people [64]. Neurodegenerative illnesses are largely caused by the irreversible process of brain aging. Patients' propensity for neurodegeneration increases with age, while their capacity for self-healing declines [50]. The most common age-related disease, neurodegeneration, shows a connection to age-related changes in the microenvironment of the brain, including epigenetic modification, genomic impairment, and the loss of proteostasis [69]. Although aging is a significant contributor to neurodegeneration, the precise processes by which aging is connected have not yet been established. The emergence of dementia is a global problem that is becoming more prevalent due to an increase in lifespan. The most prevalent type of dementia is AD, which is marked by memory loss and cognitive impairment. Age is the main cause of AD.PD is a different age-related neurodegenerative condition that involves protein denaturing. Lewy bodies are created as a result of -synuclein misfolding, which begins in the olfactory and inferior brain stem areas and subsequently spreads to the cortex and midbrain [75]. The main risk factor that affects the development and occurrence of Parkinson's disease is age. Aging, increased oxidative stress, neuroinflammation, and environmental factors can all lead to neurodegenerative disorders [69]. Proper understanding of hormesis in aging and interactive method of action in consumption of food natural or processed form is a dynamic prospect for nutritional development and adjustments of lifestyle for antiaging intervention/therapies. Therefore, constant right choice to make about what to eat, quantity, when and how to eat the food in line with cultural, economic, preference and social context will help protecting the brain from neurodegeneration and it consequences while lowering the risk of developing other conditions.

A diverse range of conditions known as neurodegenerative diseases are characterized by the slow degeneration and death of particular neuronal populations, which results in the disease's clinical symptoms. Consumption of food is based on the preference, availability, economic and market value. Food ethics allows individual to make a right choice, determines the future consequences and outcome. There are various perspectives on the consequences of food ethics that have affected policies, behavior, and responsibility in the field of medicinal foods in nutrition. Numerous ethics have caused consumers, particularly the weak, to develop a fear of healthy food. As a response, it is necessary to ask concerns about the weight of duties and responsibilities to public and corporate actors participating in nutrition and international food systems.

**CONCLUSION**

Food consumption have been inextricably linked with ethics. Food ethics is challenged with arising issues in realization and conservation of social bonds while recommending therapeutic/functional foods or foods adapted to a person's genetic makeup in averting/ reducing neurodegenerative diseases. The social bonding role of food in an individualist eating can improve healthy ageing which is of great importance in medicine. Proper understanding and application of hormesis advances in regulating aging and senescence using dietary energy restriction, introductions of quantified dosages of phytochemicals, ischemic preconditioning, keeping fit (exercise) are germane in ameliorating/ combating the neurodegenerative diseases. Therapeutic diets containing a specially designed food component for treating/ alleviating neurodegenerative diseases need to be developed to bridge the barriers preventing them from realizing ethically conscious food choices by consumer/ patients. Therefore, overlooking one’s cultural practices while designing a dietary intervention can deny persons of their opinions, cultural autonomy as well as impede the meaningful success that the goals of the therapeutic diet is geared towards; which entails lifestyle changes and adopting anti-aging strategies.

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