

## Nutraceuticals for Prevention and Treatment of Neurodegenerative Diseases

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Due to their health benefits, foods and substances derived from them have been in use for centuries. Recent rise in the use of nutraceuticals is mainly because of their safety profile [1]. Nutritional psychiatry is based on the use of nutraceuticals for treatment, prevention and cure of psychiatric disorders [2]. Several evidences suggest a potential role of several food derived substances in the management of neuropsychiatric and neurodegenerative diseases [3,4]. Clinical studies also show promising therapeutic efficacy of nutraceuticals in these diseases [5]. Therefore, many researches imply that these natural substances can play a significant role in the pharmacotherapy of neurodegenerative diseases [6].

### Neurodegenerative disease, a compromise in neuronal structure and function

Neurodegenerative disease is a universal vocabulary for varied and often irregular disorders that are categorized by dynamic nervous system diseases emerging from neural degradation [7]. Besides neuronal loss, these diseases are characterized by deposition of proteins [8]. This results in impaired neuro-chemical and electro-physiological properties in the effected brain regions and thus, influences the associated functions [9]. Alzheimer's disease, Parkinson's disease, Huntington's disease, prion disease and motor neuron diseases are the examples of neurodegenerative diseases. Alzheimer's and Parkinson's disease are the most common among the elderly [10]. Alzheimer's disease is characterized by loss of cognitive function, memory damage, language impairment and visual-spatial disorders, as well as complications with organization, analysis or judgment [11]. Patients of Parkinson's disease suffer from uncontrollable tremors and a variety of non-motor symptoms that worsens in the later stages of disease [12]. Symptoms may include depression, anxiety, dementia, excessive daytime sleepiness and optical delusion [13].

Lifestyle, physical activity, environment and diet are known to influence brain functions [14]. The effects of diet on brain activity are due to the interaction of therapeutically active constituents present in food with the underlying neurochemical processes. For example, tryptophan, an essential amino acid that is to be provided through diet only, is the natural precursor for serotonin [4, 15]. Serotonin is a monoamine neurotransmitter and hormone present in CNS, blood, GI tract, liver, spleen, lungs and skin [16]. It is synthesized in a cluster of neurons present in brain stem. Tryptophan, absorbed into blood mainly from small intestine, enters the brain by the help of carrier proteins [17]. Amount of serotonin synthesized depends upon the concentration of tryptophan in blood [18]. Several studies associate the dietary deficiency of tryptophan with declined brain serotonergic metabolism [19-21]. Studies show that altered serotonin neurotransmission in brain regions is associated with several neuropsychiatric and neurodegenerative diseases [22]. Dopamine, another catechol

amine neurotransmitter, is synthesized in dopaminergic neurons from amino acid tyrosine. Although, tyrosine can be synthesized within body, but is also synthesized from phenylalanine, an essential amino acid. Dopamine is used as a precursor in the synthesis of epinephrine and nor-epinephrine. Both, dopamine and epinephrine, are known to regulate several physiological processes [23]. Altered dopaminergic neurotransmission is associated with several mood disorders and neuro-degenerative diseases [24]. Levodopa, a precursor for dopamine is approved by FDA for the treatment of Parkinson's disease [25]. Several studies suggest a potential role of tyrosine and phenylalanine supplementation in the pharmacotherapy of Parkinson's disease [26].

### Nutraceuticals promise a better neuronal health

Substantial evidences suggest a neuroprotective effect of several food derived substances [27]. Antioxidants and polyunsaturated fatty acids enrich diets such as fish, fruits and vegetables are helpful in reducing the incidence of Alzheimer's disease [28]. Piperine, an alkaloid from *Piper nigrum* fruits, has shown to improve impaired memory and neurodegeneration [29]. Flavonoids such as rutin and carotenoids manifest neuroprotective effects [30]. Ascorbic acid and carotenes are known to depress lipid peroxidation and thus lowers the possibility of Alzheimer's disease [7]. Caffeine is also capable of protecting against oxidative stress in Alzheimer's disease [31].

For the prevention and treatment of Parkinson's disease several nutraceuticals have been reported with neuroprotective effect [7]. Dietary supplementations can help improve the altered motor function observed with age [32]. Studies suggest that capsaicin, an alkaloid found in the fruit of the Capsicum genus, provide protection against loss of dopamine neurons and encourages behavioral recovery by inhibiting oxidative stress in Parkinson's disease model [33]. Sesamin from sesame oil also exhibits a neuroprotective effect on dopaminergic neurons and also increases the levels of dopamine [34]. Resveratrol and pinostilbene are antioxidant found in many foods, such as grapes and blueberries, exhibit a neuroprotective effect. Epigallocatechin-3-gallate, anti-oxidant from green tea, also show similar neuroprotective effect [7]. Fructose, a rich constituent of honey, sugar cane and sugar beet produced anxiolytic and memory enhancing effects in rat models after six-weeks treatment [35]. The consumption of olive oil as the primary source of monounsaturated fat can reduce the incidence of neurodegenerative disease [36]. A plant from ginger family Curcumin which has been reported to have wide range of biological activities, also exhibit neuroprotective effect [7]. Studies also revealed that *Nigella sativa* (black cumin) enhance learning and memory in rats [37,38]. An active compound thymoquinone (TQ) from *Nigella sativa* can possibly exhibits its antioxidant properties and can also protect from early pathological impacts of common neurodegenerative disease [39,40].

### Conclusion

In conclusion, understanding how multiple inputs from nutrition affect the brain should help in the development of novel preventive and therapeutic approaches to various mood and neurodegenerative disorders such as cognitive decline, dementia, Alzheimer's disease, etc. It is necessary to discover more natural remedial choices that could reduce the symptoms and development of these diseases [41-43]. Therefore, new studies should look for new classes of natural compounds that should provide novel approaches to the prevention of various mood and neurodegenerative disorders.

### Conflict of Interest

No potential conflict of interest was reported by the authors.

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