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211

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Role of Allium Species in Neuroprotection: A Review

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Abstract

Neurodegenerative disorders such as Parkinson's disease, Alzheimer's disease, dementia, Epilepsy, Genetic Brain Disorders, Head and Brain Malformations, Hydrocephalus, Stroke etc. cause progressive loss of neurons and thus, are associated with high mortality and morbidity. Clinically available therapies for the management of such disorders are limited by numerous side effects. Thus, there is a need to explore the safer drugs which may be beneficial to treat brain disorders. Plants are considered safe and have always been a potential source of drug discovery. The present review summarizes the neuroprotective ability commonly used species of Allium genus. i.e. Allium cepa and Allium sativum. Scientific information was collected by visiting various online databases such as Google scholar, Pubmed, Science direct, Scifinder etc. Allium cepa and Allium sativum are consumed as vegetables, in the form of juice and salads worldwide. Scientific reports from our laboratory have shown the beneficial effects of both Allium species against neuropathic pain, diabetic neuropathy, ischemic stroke, convulsions, depression and Alzheimer's disease. Both the species are documented to be a rich source of sulphur compounds along with appreciable amounts of flavonoids, phenols and volatile oils. The reported neuroprotective effects of selected Allium species were attributed to the presence of phenols, flavonoids and sulphur compounds. The neuroprotective and antioxidant effect of Allium species owing to the presence of the alanyl group and the absence of the oxo group in organosulfur compounds was effective in protecting cell death induced by both oxygen glucose deprivation and cerebral ischemia and effective in inhibition of oxidative stress caused by increased accumulation of reactive oxygen species (ROS) in cells has been implicated in several neurodegenerative diseases. The present review emphasizes that, Allium species such as Allium cepa and Allium sativum could be a source for drug discovery of neuroprotective drugs.

Keywords: Neurodegenerative diseases; Flavonoids; *Allium* species; Sulphur componds

Introduction

Allium cepa (AC) and Allium sativum (AS), commonly known as onion and garlic respectively are the member of family Amaryllidaceae. Previously the genus belonged to the family Alliaceae, but now it has been positioned in the Amaryllidaceae family according to classification of Angiosperm Phylogeny Group III in 2017 [1-3]. Both plants are indigenous to western Asia, but these are cultivated worldwide particularly in regions of moderate ambiance for commercial value. AC and AS are well growing plants at the temperature range of 6-30°C with dry conditions and can be cultivated in both seasons in different type of soils i.e. clay loamy, sandy loamy, red soil, black soils etc. with standard irrigation. Both plants are of various types like white, red, dark red and yellow [4]. According to different verities the outer scales also varies in colour from white to dark red color and amount of chemical constituents present in plants also altered. Both plants are used since the old times for culinary as well as therapeutic purposes because of their great nutritional value [5].

In Ayurvedic and Siddha system of medicines, garlic and onion were used in the form of juices, paste, extract to relieve earache, deafness, fever and to alleviate sinus problems i.e. cold, cough, asthma etc. According to the ancient literature of Charaka Chikitsa the juice of onion and garlic was used to cures all skin diseases and microbial and fungal infections. Literature shows that AC & AS have immense therapeutic value and both plants are most consumable plants worldwide due to their different pharmacological activities. Extracts prepared from onion and garlic bulbs or outer scales are used for treatment of aneamia, cold, cough, cholera, bronchitis, influenza, eczema, skin infections, urinary infections, tuberculosis etc [6,7].

Scientific reports have shown the beneficial effects of both Allium species against neuropathic pain, diabetic neuropathy, ischemic stroke, convulsions, depression and Alzheimer's disease. Both the species are documented to be a rich source of sulphur compounds along with appreciable amounts of flavonoids, phenols and volatile oils. The reported neuroprotective effects of selected Allium species were attributed to the presence of phenols, flavonoids and sulphur compounds. The present review we study about the phytochemical & pharmacological attributes of Allium species. The review emphasizes that, Allium species such as Allium cepa and Allium sativum could be a source for new drug discovery [8].

Vol.8 No.2:120

Literature Review

Review of literature was prepared by visiting various online databases such as Google scholar, Pubmed, Science direct, Scifinder etc. Number of articles and abstracts were found using different keywords and all collected data was screened to assess the suitability of the study and duplication removed. After assessment of the quality of the data, the data was extracted in uniform manner.

Phytochemical Attributes

Onion and Garlic are still being used in folk medicine worldwide for the treatment of various diseases due to their valuable phytoconstituents. Data from a number of investigations suggests that the biological and medical activities of garlic and onions are attributed to high organo- sulphur compounds in Allium species, i.e. AC and AS. The most abundant chemical constituents present in onion are the alkaloids, flavonoids, anthocyanins, tannins, proteins, sterols, glycosides, saponins and carbohydrates etc. AC is recognized for being a good natural source of flavonoids i.e. quercetin and kaempferol, and these are present in glycosides form in it. Moreover, this plant is great source of minerals i.e. Calcium, Copper, Iron, Magnesium, Manganese, Potassium, Sodium, Phosphorus and vitamins i.e. Folic acid, Biotin, Pantothenic acid, Riboflavin, Thiamine, Vitamin A, B6, C and E. Similarly AS shows extensive range of therapeutic effects owing to its different sulfurcontaining compounds i.e. Diallylthiosulfinate (Allicin), Sallylcysteine sulfoxide (Alliin), S-methylcysteine sulfoxide, S-Diallyl propylcysteine sulfoxide, tetrasulfide, Allylmethanesulfinate, Dipropyldisulfide, Dimethylsulfide, Methylallyltrisulfide, Diallyldisulfide, Dimethyldisulfide, Methylmethanesulfinate, Dipropylsulfide, 3-vinyl-4H-1, 2-dithiin, 3vinyl-6H-1, 2-dithiin, 3-vinyl-6H-1, 3-dithiin, Diallytrisulfide, Allylmethyl thiosulfinate, Methylpropyldisulfide thiosulfates, volatile sulfur compounds etc. and other vitamins, saponins, flavonoids and moderate levels of carotenoids too [9]. Role of compounds derived from Allium species in management of



Role of Allium Species in Neuroprotection

Onion and garlic are enriched in flavonoids and are well renowned that these phytoconstituents are potent antioxidants. It is reported that both plants are functional for reduction of oxidative stress owing to their strong antioxidant ability. The neuroprotective actions of Allium species involve a various effects within the brain, counting a potential to protect neurons against injury induced by neurotoxins, an capacity to suppress neuro-inflammation and to enhance memory, learning and cognitive function. There are two common processes which involved for these all effects. Foremost, they interact with important neuronal signaling cascades in the brain leading to an inhibition of apoptosis triggered by neurotoxins. Moreover these active constituents participates in promotion of neuronal survival and differentiation [10,11]. Apart from the neuroprotection activity, these plants also have numerous pharmacological activities i.e. Antihypertensive, cardioprotective, antihyperlipidemic, anti-inflammatory, antibacterial, antifungal, anti-parasitic, anti-thrombic, hepatoprotective, wound healing etc. There is relevant evidences that flavanoids present in AC and AS are helpful to reduce the risk of Alzheimer's disease, Huntington's disease, Parkinson's Disease [12,13]. It has been reported that quercetin is able to undo several effects produced by ischemia-reperfusion in rat, possibly by scavenging superoxide ion and thus preventing the consumption of nitric oxide thought the formation of peroxynitrite. Since, several studies indicate that quercetin reduced the brain matrix metalloproteinase-9 activation, GSH depletion, p53 induction and incidence of apoptosis after ischemia and quercetin and quercetin-3rutinoside (rutin) are considered strong neuroprotective agents as compare to other flavonoids [14].

Conclusion

In view of the aspects discussed above it is ostensible that number of experimental studies demonstrating a wide range of neuroprotective effects of Allium species i.e. AC and AS, largely obtained with model experimental animals and neuronal cell cultures, have been published during the earlier period. Both plants have strong potential to cure various neurodegenerative diseases i.e. Parkinson's disease, Alzheimer's disease, Ischemia, stroke, Epilepsy, Anxiety, Depression Memory/cognitive enhancement and other mental disorders. Moreover, the allopathic medicines available in the market are responsible for various side effects and doesn't pledge for proper cure of neurodegenerative disorders. So, in these situations herbal remedies can be a boon for pharmaceutical industries. Plants of Allium species has such potential, that these can be recommended for discovery of new neuroprotective formulations with great safety efficacy.

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Conflict of Interest

There is no conflict of interest to declare.

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