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P Sudhakar
Assistant Professor,
Department of Pharmacology,
Swamy Vivekanandha College of Pharmacy, Tiruchengode,
Tamil Nadu, India

C Kirubha Hari
Final B.Pharm, Swamy Vivekanandha College of Pharmacy, Tiruchengode,
Tamil Nadu, India

R Divya
Final B.Pharm, Swamy Vivekanandha College of Pharmacy, Tiruchengode,
Tamil Nadu, India

Corresponding Author:
P Sudhakar
Assistant Professor,
Department of Pharmacology,
Swamy Vivekanandha College of Pharmacy, Tiruchengode,
Tamil Nadu, India

Role of Indian spices in CNS disorders: A review

P Sudhakar, C Kirubha Hari and R Divya

Abstract
Ayurveda the Indian traditional medicinal system evidences that the utilization of spices provides better human health and cures various diseases. Some of the scientific reports also have been proven the beneficial effects of spices in humans. Many Indian spices primarily used for the culinary purpose and have been found to have reported specific activity against CNS disorders. This review focuses on the Indian spices black cumin, cardamom, coriander, fennel, garlic, saffron, and turmeric therapeutic applications and it's till date scientific findings in CNS disorders. The review findings of this study suggest that these Indian spices possess therapeutic potential in disorders associated with neuroinflammation, neurotransmitter deficiency, and depression. It might be due to their phytoconstituents and potent antioxidant properties.

Keywords: Indian spices, neuroprotection, CNS disorders, antioxidant

Introduction
The spices are herbal preparations obtained from different plant parts like leaves, buds, flowers, seeds, barks, roots, rhizomes, and secretory products such as resins, gums, and volatile oils. Spices are a common food additive used to imparting characteristic flavor and color, augment the taste and act as a preservative in some foods [1]. In addition to that, it also possesses certain medicinal properties that provide sound health to the human and can cure the diseases in the form of traditional medicine which is known as Ayurveda in India [2]. Indian spices shares half of the world trade in spices and ranked third [3]. Several previous studies reported that most of the commonly used Indian spices contain flavonoids, terpenoids, lignans, sulfides, polyphenolics, carotenoids, coumarins, saponins, plant sterols, and phthalides [4]. Moreover, pharmacological screenings have also shown that these molecules possess antioxidant, anti-inflammatory, anti-microbial, immune stimulant, and anti-cancer effects, also protect against heart diseases, central nervous system disorders and other chronic diseases [5]. The spices are gaining increased considerations in this modern era due to their beneficial effects which are getting reported day by day against various diseases [6]. Hence this review aims to explore the CNS disorder protection properties of some commonly used spices, such as black cumin, cardamom, coriander, fennel, garlic, saffron, and turmeric.

Spices and their role in CNS disorders
Crocus sativus (Saffron)
Crocus sativus L. (Iridaceae) is one of the most expensive Indian species. The stigmas of it are used as an additive to give flavor, color, and aroma to food. It also used as the main foodstuff in preparing some other traditional desserts and confections [7]. Traditionally saffron is used as antispasmodic, anticatarrhal, aphrodisiac, antidepressant, eupeptic, expectorants, and emmenagogue [8, 9]. The reported pharmacological studies established that the saffron has effective against the CNS disorders like Alzheimer disease (AD), Parkinson's disease (PD) and other neurodegenerative diseases, as well as neuroprotective action against the cerebral ischemic injury, anti-convulsant, anti-depressant [10, 11] and also improves some disorders related to memory and learning [12]. These beneficial effects have been widely ascribed to the potential antioxidant properties of saffron and its constituent crocetin and safranal, which in turn mitigate downstream consequences such as oxidative stress and apoptosis [13]. It also contains the antioxidant carotenoids, lycopene, zeaxanthin, and vitamin B_2 [14].

Elettaria cardamomum (Cardamom)
Elettaria cardamomum (L.) Maton var. (Zingiberaceae) is popularly known as the Queen of spices in Indian spices [15, 16].

The dried fruit of it is used as a food additive and flavoring agent.

In Ayurveda and Unani system of medicine cardamom used against various gastrointestinal disorders like dyspepsia, anorexia, debility, asthma, bronchitis and halitosis, cardiac disorders, renal and vesicular calculi [17]. The pharmacological studies of cardamom reported that it works efficiently against neurodegenerative diseases like convulsions and Alzheimer's disease [18, 19]. It also shows promising activity towards the enhancement of neurotransmitters like dopamine and serotonin and also has a positive effect on enhancing memory and other behavioral attitudes [20]. It is a natural memory booster in scopolamine-induced amnesia, has anxiolytic and muscle-relaxing effects [21, 22]. These beneficial effects of cardamom are mainly due to its strong antioxidant property and it phytoconstituents. Alpha-terpinyl acetate in cardamom demonstrated that anti-cholinesterase, anti-oxidative, anti-amyloidogenic, and neuroprotective effect [19].

***Coriandrum sativum* (Coriander)**

Coriandrum sativum L. (Umbelliferae) rich in vitamin A, B_2 (riboflavin), C and dietary fiber, fresh leaves and dried seeds of this plant are extensively used as pleasantly aromatic spice [23]. In Iranian traditional medicine, the juice of fresh leaves and the powder fruits tea are recommended to relieve anxiety and insomnia [24]. Apart from that, it is used to relives pain, flatulence, loss of appetite [25], used as carminative, spasmolytic, digestive, and galactagogue [26], used in the disorders of digestive, respiratory and urinary systems. The pharmacological studies have been reported that the coriander on CNS acts as anti-convulsants, sedative, and hypnotics. The extracts and the essential oil of coriander seeds produce central nervous depression [27]. Coriander shows a promising neuroprotective effect because of its strong antioxidant property which can prevent dark neuron and apoptotic cell production in the hippocampal region [28]. The coriander also has anxiolytic properties and proved to have a good effect on memory [29].

***Foeniculum vulgare* (Fennel)**

Foeniculum vulgare Mill. (Umbelliferaceae) is one of the most commonly using spices in Indian subcontinents, and a key ingredient in Kashmiri Pandit and Gujarati cooking [30]. Fennel seeds are anise-like in aroma and are used as flavorings in baked goods, meat and fish dishes, ice cream, alcoholic beverages, and herb mixtures [31]. Fennel is traditionally used as a curative drug for the epileptic disease, seizures carminative, digestive, lactogogue, treating respiratory, kidney, and gastrointestinal disorders [32, 33]. The reported pharmacological studies established that fennel effective against neurodegenerative diseases especially Alzheimer's disease because of its anticholinesterase potential, memory-enhancing effect, anti-stress activities and shows neuroprotective activity [34]. Also, it has been reported to exhibiting anxiolytic and antidepressant effects [35, 36]. It is mainly due to its potent antioxidant capacity and it phytoconstituents like essential oils.

***Curcuma longa* (Turmeric)**

Turmeric is a product of *Curcuma longa* L. (Zingiberaceae) rhizomes known as "Indian saffron" [37]. Also known as Golden Spice of India, It has been used in traditional medicine as a household remedy for various diseases like biliary disorders, anorexia, coryza, cough, diabetic wounds, hepatic disorder, rheumatism and sinusitis [38, 39]. It is also has a major role in the treatment of various central nervous system disorders. It demonstrates neuroprotective action in Alzheimer's disease, dyskinesia, major depression, epilepsy, and other related neurodegenerative and neuropsychiatric disorders, Parkinson's, Huntingtin's, Head trauma, aging and stroke [40, 41]. The neuroprotective effect of turmeric is mainly due to its polyphenolic compounds particularly curcumin. It has potent antioxidant and anti-inflammatory effects as well as effects on reducing beta-amyloid aggregation [42].

***Allium sativum* (Garlic)**

Allium sativum L. (Amaryllidaceae) is a bulbous herb, has been widely recognized as a valuable spice in the Indian kitchen [43]. In the traditional system of medicine, garlic has widespread of therapeutic applications like curing infections, cancer, heart diseases, hemorrhoids, rheumatism, dermatitis, abdominal pain, menstrual pain, high blood pressure, coughs, gastrointestinal problems, atherosclerosis, bronchitis, cough, loss of appetite and loss of weight [44, 45]. Garlic possesses excellent neuroprotection action because of its broad range of anti-atherogenic, antioxidant, and anti-apoptotic protection effect. Hence garlic helping to reduce the risk of dementia, including vascular dementia and Alzheimer's disease [46, 47].

***Nigella sativa* (Black Cumin)**

Nigella sativa L. (Ranunculaceae) its seeds are named as 'Black Seed' or 'Black Cumin'. The roasted dry seeds are used to flavor curries, vegetables, and pulses in Indian dishes, one of the ingredients in spice mixture (Panchu phoron) and many recipes of Bengali cuisine. Black seed also used as a flavoring additive in bread, pickle, sauces, and salads of Persian foods [48, 49]**.** Black seeds are traditionally for the treatment of asthma, cough, bronchitis, headache, rheumatism, fever, and influenza [50]. Moreover other reported Pharmacological activities are immune stimulation, anti-inflammatory, hypoglycemic, antihypertensive, spasmolytic, bronchodilator, gastroprotective, hepatoprotective, renal protective, antimicrobial, antiparasitic, antioxidant, and anticancer [51, 52]. The Pharmacological action and therapeutic potential of Black seeds on CNS include anti-alzheimer, antiepileptic, antiparkinson, antidepressant, anti-anxiety, Neuroprotective effects, as well as improvement of learning and memory, alertness, the elevation of mood and feeling of good health [51, 53]. These beneficial actions are mainly through the inhibition of acetylcholinesterase enzyme and particularly due to its antioxidative effects to improve nervous system diseases. It is also suggested that black seed has interactions with the GABA, opioid, and NO system [50]. Numerous studies reviled that the thymoquinone (TQ) which is a major bioactive component of *Nigella sativa* recognized as neuroprotective agents [54].

Table 1: Spices and their reported CNS related activities

Name of the Spices	Common Name	Parts used	Reported CNS related activities	References
Crocus sativus L. (Iridaceae)	Saffron	 Stigmas	Effective inAlzheimer disease, Parkinson's disease and other neurodegenerative diseases, neuroprotective action against cerebral ischemic injury, anti-convulsant, anti-depressant and improves memory and learning [13].	[10-12]
Elettaria cardamomum L. (Zingiberaceae)	Cardamom	 Dried fruits	Anti-convulsant, anxiolytic, muscle-relaxant, and effective in Alzheimer's disease, also natural memory booster in scopolamine-induced amnesia.	[18-22]
Coriandrum sativum L. (Umbelliferae)	Coriander	 Dried seeds	Anti-convulsants, sedative, and hypnotics produce central nervous depression, neuroprotective effect, anxiolytic, and have a good effect on memory.	[28-30]
Foeniculum vulgare Mill. (Umbelliferaceae)	Fennel	 Seeds	Effective in Alzheimer's disease, memory-enhancing effect, anti-stress activities and shows neuroprotective activity. Also, exhibit the anxiolytic and antidepressant effect.	[34-36]
Curcuma longa L. (Zingiberaceae)	Turmeric	 Rhizomes	Effective in Alzheimer's disease, Parkinson's, Huntingtin's, dyskinesia, major depression, epilepsy, and other related neurodegenerative and neuropsychiatric disorders, Head trauma, aging, and stroke.	[40, 41]
Allium sativum L. (Amaryllidaceae)	Garlic	 Bulbs	Neuroprotection action. Reduce the risk of dementia, including vascular dementia and Alzheimers Disease.	[46, 47]
Nigella sativa L. (Ranunculaceae)	Black Cumin	 Seeds	Anti-alzheimer, antiepileptic, anti-parkinson, antidepressant, anti-anxiety, Neuroprotective effects, improves learning and memory, alertness, the elevation of mood, and feeling of good health, *a* recognized neuroprotective agent.	[51, 53, 55]

Conclusion

In this study, we intensely reviewed the reported preclinical and clinical neuroprotective effects of some of the commonly used spices on CNS disorder. We selected 7 common Indian spices such as black cumin, cardamom, coriander, fennel, garlic, saffron, and turmeric based on their traditional evidence. These spices are possessed definite neuroprotection effects, antidepressant, anxiolytic, and effective against neurodegenerative disorder. They are well tolerated with fewer side effects on CNS disorder. These therapeutic properties are due to their potential phytoconstituents and the majority of its antioxidant properties. So this review

concludes that rational inclusion of these spices in foodstuff may possess the beneficial neuroprotection against the day to day stress/oxidative stress-induced CNS disorders.

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