

Pharmaceutical Uses of Coriander (*Coriandrum sativum*) for Neuropsychological Disorders

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ABSTRACT

Coriander (*Coriandrum sativum*) in addition to its wide applications in the food, perfumery and cosmetics industries, has significant medicinal properties. Based on various studies in the field of pharmacognosy, different effects have been reported for coriander. In this review study, the medicinal uses of coriander in the field of neurological and psychological disorders are discussed and the use of coriander essential oil, syrup and its seeds for disorders such as Alzheimer's, anxiety, migraine, and seizures are reviewed.

Keywords: Coriander, Neuropsychological diseases, Alzheimer's disease, anti-anxiety

INTRODUCTION

One of the aromatic and edible plant of Umbelliferae (Apiaceae) family is coriander (*Coriandrum sativum* L.). Its fresh leaves and dried seeds (as a spice) are traditionally used in cooking but the other parts of this plant are edible and widely used in folk medicine (Mandal and Mandal, 2015). The taste of the leaves of coriander is perceived sour, like the taste of lemon, but sometimes its taste is reports as soap-like taste. These differences are related to the genetic differences in the sense of taste and smell. Polyphenols and terpenes are the components of the essential oil of coriander leaves and seeds, whereas linalool is the main component of coriander flavor (Zheljzakov, Astatkie and Schlegel, 2014). Raw coriander leaves contain 92.2% water, 3.67 g carbohydrates, 2.13 g protein, 0.5% fat, Vitamin C, total ascorbic acid 27mg, 2.5 mg Vitamin E (alpha-tocopherol), Vitamin A 6750 IU, Magnesium 26 mg, Iron 1.77mg, Phosphorus 48 mg and Potassium 521 mg, per 100 g. (U.S. Department of Agriculture, 2019).

Almost 1% of coriander seed is essential oil, and the compounds of coriander essential oil are used in making perfumes, cosmetics, herbal medicines and flavoring of alcoholic beverages worldwide. In traditional medicine, coriander has been used to relieve

gastrointestinal and respiratory diseases, and other traditional uses include as antibiotic, pain reliever, and treatment for loss of appetite and memory (Sahib *et al.*, 2013; Nematy *et al.*, 2013; Nejad Ebrahimi *et al.*, 2010).

The yield and composition of essential oil of coriander can be different according to the cultivar, plant maturity stage, cultivation conditions and extraction method. It is noteworthy that the essential oil extracted from coriander contains significant amounts of a rare fatty acid called petroselinic acid. Water-soluble components of coriander seeds include monoterpenoid alcohols and their glucosides, alkyl glucosides, and norocarotenoid glucosides. The constituents of fresh coriander leaves include aldehydes and alcohols (such as 2E-decenal, decanal, 2E-decen-1-ol, decanol). Coriander leaves are a rich source of folates, ascorbic acid, caffeic acid, ferulic acid, gallic acid and chlorogenic acid. Coriander seeds, as a spice, contain a significant amount of oil. Adults in India consumes approximately 1.37 grams of coriander seeds daily (Singletary, 2016).

Numerous medicinal properties have been reported for coriander. Many scientific researches and review studies have been published on its various uses, and its use in traditional medicine has been recommended in different ways based on the texts. However, there are limited studies in the field of application of coriander in mental disorders (such as anxiety and memory problems). Mental disorders that can be investigated based on neuropsychological deficits are a broad category of disorders caused by factors such as aging, drug abuse, or other mental disorders. These disorders include Alzheimer's, Parkinson's, epilepsy, migraine headaches, anxiety and panic, etc. According to this gap, the previous studies that are related to the medicinal and therapeutic use of coriander leaves, seeds and other parts of this plant treatment of neurological and psychological disorders have been reviewed in this article.

MATERIAL AND METHODS

According to the aim of this research, the keywords of *Coriandrum sativum*, memory, neurocognitive disease, Alzheimer's disease and brain functions were searched in scientific databases including PubMed, Science Direct and Google scholar, and the findings were analyzed and classified.

Therapeutic uses of coriander for memory disorders

According to the report of the World Health Organization (WHO), the elderly population in the world (i.e., 60 years old and above) was around 962 million people, it is predicted that the elderly population will double by 2050, so the problems and diseases which are related to aging will be increasingly seen in different societies (World Health Organization, 2022).

Dementia is one of the diseases caused by age and Alzheimer's disease is the most common type of memory disorder. The most crucial symptom of Alzheimer's is the loss of memory, the ability to reason, speak and other cognitive functions.

Kocahan and Doğan (2017) reported abnormality in the following parts of brain to explain the etiology of Alzheimer's disease: 1. Brain stem 2. Thalamus and hypothalamus 3. Amygdala 4. Striatum 5. Claustrum. Also, some changes in receptors, biochemical factors and brain atrophy are seen in stages of Alzheimer's disease.

In the brain, due to the accumulation of free radicals in old age, pathological mechanisms are formed in different parts that can make a person prone to Alzheimer's disease (Forster *et al.*, 1996).

Based on this, in new methods for Alzheimer's treatments, especially in the field of medicinal plants, it is emphasized on the use of drugs that have anti-oxidative properties and can be used as food. Coriander, which is popular in countries such as India, Egypt, Japan, Taiwan and Iran as a common vegetable, has significant antioxidant effects and these effects have also been reported for coriander seeds (Mima *et al.*, 2020). According to research by Mani *et al.* (2001), coriander leaves can have a positive effect on memory defects in mice. In a study in Japan, eight 10-week-old Samp8 mice were divided into two groups, a group that received coriander seed extract orally and a control group that received the same diet without coriander seed extract. The Samp8 mouse is a suitable model for evaluating aging processes and disorders such as memory disorders. The dose of coriander seed extract provided was 200 mg/kg body weight and the experiment continued for 12 weeks. The Barnes Maze test was used to evaluate memory and spatial learning, and the results showed that the group that received coriander seed extract performed statistically better when escaping from the maze. Barnes maze is designed to assess memory and learning in laboratory mice. To perform this test, the mouse is placed on a bright space and on a circular surface with round holes embedded on the surface (around the circumference of the circle). Due to the animal's desire to stay in the dark, a dark box called the target box is placed under one of the holes, one side of which is connected to the hole with a gentle slope. The time that takes to recognize the box by animal is measured. The shorter time to escaping from the bright surface shows the better performance of mouse. The test is performed without dietary restrictions and low stress. Because the control group showed more progress with repetition in the maze, the researchers have stated that it is possible to improve slow learning and memory by using coriander seed extract as a supplement. Because the experimental group not only performed better in the maze learning period, but also in the follow-up period, it can be indicated a reduction in damage caused by oxidative stress, which delays the aging process (Mima *et al.*, 2020).

The effect of coriander on migraine

In traditional Iranian medicine, coriander has been used to reduce and treat headaches (for example, in Ibne-Sina's Law book). Approximately 15% of the population suffer from migraine, and 75% of them are women (Zhang *et al.*, 2016). Migraine with an inherited nature, is one of the diseases that there is a large document about its pathophysiology, and published studies approved its family history (Goadsby, 2012). The use of herbal medicines in treating migraine as a chronic disorder is followed by researchers. In a study aimed at the effect of coriander syrup on migraine, 68 patients with migraine between the ages of 18 and

45 have participated. Two groups were assessed during the study one of them was the intervention group that received 500 mg of sodium valproate and 15 ml of coriander syrup, and the other was control group that received 500 mg of sodium valproate and placebo. In the last week of the study both groups, had no significantly difference in terms of migraine control. Nevertheless, the comparison of participants under 30 years old and over 30 years old showed a significant difference. Also, the period time, that patients in the intervention group with coriander syrup suffered from migraine headaches was shorter compared to the control group. Therefore, these researchers have stated that probably the presence of linalool in coriander and similarly the presence of linalool in lavender essential oil, which is effective in the treatment of migraine, plays the leading role and the mechanism of the effect of coriander in migraine. In the mentioned study, no side effects were reported for the coriander syrup, which is probably due to the young age of the participants (average age of 32 years) and the one-month period of intervention under treatment of coriander syrup (Mansouri *et al.*, 2020).

Anti-anxiety uses of coriander

Anxiety is one of the most common psychological disorders, and due to its high prevalence, therapists' attention to use the complementary medicine to control anxiety is increasing. One eighth of the world's people suffer from anxiety (12.5% of the population) and extensive psychopharmacological studies are conducted on it. Therefore, various animal and laboratory models have been proposed regarding anxiety. In a study in which the hydroalcoholic extract of coriander was used in several different animal models (including maze plus elevated figure, open space test, light and dark test, and social interaction test) to control anxiety, diazepam (0.5 mg/kg) was compared with the hydroalcoholic extract of coriander seeds (with doses of 50, 100 and 200 mg/kg). The results have shown that the doses of 100 and 200 mg/kg are similar to diazepam in terms of anti-anxiety effects. However, the dose of 50 mg/kg does not show an anti-anxiety effect in different animal models. In explaining these results, researchers have admitted that the reason for the anti-anxiety the effects of coriander is probably related to the presence of linalool in its seeds (between 60 and 70%) and the presence of flavonoids. Due to the structural similarity of diazepam and coriander flavonoids, the possible cause of effects of coriander are related to gamma-aminobutyric acid (GABA) receptors in controlling anxiety (Mahendra and Bisht, 2011).

In a similar study with the aim of investigating the anti-anxiety properties of coriander, the dried powder of coriander leaves was used to prepare an aqueous extract, and the extract with doses of 50, 100 and 200 mg/kg as food was added to the diet of albino mice (weight of 18 to 25 grams). Comparison of the control group with all three groups receiving coriander extract showed that coriander extract (dose-dependent) could increase anti-anxiety effects in the behaviors of mice (the time spent in the open arm in the plus-shaped maze) (Latha *et al.*, 2015).

Coriander anticonvulsant effect

Investigating the anticonvulsant effect of drugs is often carried out by injecting drugs that cause seizures in the organism (animal model). One of the most common methods of inducing seizures is the injection of pentylenetetrazol (PTZ). Injecting GABA (gamma-aminobutyric acid) inhibitors, including PTZ, even once can lead to brain cell death in various areas, including the hippocampus and limbic system. In a study hydroalcoholic extract of coriander was prepared and PTZ injection to induce convulsant conditions was done for Wistar rats (weight 200 to 250 grams). The coriander plant was collected from Neishabur region (Razavi Khorasan province). The results of this study have shown that the hydroalcoholic extract of coriander has a preventive effect on the occurrence of seizures in hippocampal neurons and overall anticonvulsant properties in an animal model. Pre-seizure induction treatment using coriander delays the onset of seizures and reduces the frequency and duration of seizures (Pourzaki *et al.*, 2017).

Conclusion

Considering the medicinal uses of coriander to control and improve cognitive and neurological disorders, it seems that there is a need to perform more extensive studies on the medicinal properties and effective ingredients of coriander and its seeds (especially linalool and flavonoids) using human subjects. Future studies can be aimed at preparing effective medicines for better neuro-cognitive functions.

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