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Effect of Caraway Extract on the Performance of Selective Attention and Cognitive Flexibility

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Abstract

***Background*:** This trial study is conducted in the field of psychopharmacology aiming to examine psychological effects of caraway.

***Materials and Methods*:** The sample under study consists of two groups including experimental (N=22) and control (N=28); both groups were identical in terms of demographic characteristics. The subjects participated voluntarily in the study; they were placed into experimental and control groups by random selection. The evaluation of attention function test was carried out by computerized Stroop effect test.

***Results*:** The results from analysis of covariance statistical test (ANCOVA) showed that taking caraway with an effective dose may increase functions of selective attention, response inhibition ability as well as cognitive flexibility and change (p<0.005).

***Conclusion*:** Taking advantage of positive effects of caraway extract, it may be used as one of the herbal medicine in treating stress and increasing different attention functions.

Introduction

Today, medical herbalism is popular all around the world appeared as using herbal products and/or their total extract [1]. According to a study conducted by Kamatou, the extract is responsible for many physiological properties of the plants and is utilized as a medicine and or part of it [2]. One of the plants easily available in our country is caraway. It is a plant of annual apiaceous family which is aromatic and herbaceous with a height of 110 cm [3]. Its biologic effects are resulted from cuminaldehyde compounds as well as menthone and Parasymi derivatives [4]. Caraway has a variety of nutritive, pharmaceutical and cosmetic uses which have verified scientifically and experimentally in different centuries. Caraway called traditionally as cumin is one of the important quadratic seeds [5, 6]. The effect of using caraway has been proved effective in treatment of digestive disorders in adults and children [7, 8], dyspepsia [9] and as antispasmodic [10], anti-tumor and having anti-oxidant properties [11], anti-fat and anti-glucose [12, 13], antifungal [14], antibacterial [15], analgesic [16], anticancer [17], and inhibitor of platelet aggregation [18]. The studies conducted by Thekur et al. shows that caraway is effective in reducing the level of FSH and LH hormones which have anti-stress and ant-anxiety nature causing increased adaptability and flexibility [19]. Kharazi and Habibi have introduced caraway as an anticonvulsant material treating epilepsy [20]. From the past to present, human has always been seeking a method to increase the attention functions and his/her learning capabilities. Attention is a mean by which we actively process a limited out of a large amount of information stored in the memory. Psychologists are particularly interested in studying the factors effective in increasing distributed attention, being alert, tracing interests, searching and selective attention. Excitement is a tool for cognitive communication [21, 22]. As many diseases are treated by various chemical medicines, treatment of many physical and mental diseases is also possible via traditional medicine and herbalism. In treating stress by caraway, increased rate of vanillylmandelic acid (VAM) secretion in peripheral blood and its increase in urine have been reported improve memory function in recovery phase [23]. However, other herbal medicines except caraway have been used to treat depression and to improve memory followed by good results. As an instance, thyme and tiger grass are effective in treatment of human brain disorders with relatively similar effects. This investigation led to specify anti-oxidant properties of two related herbal medicines (thyme and tiger grass) in increasing the memory [24]. Furthermore, Bhattacharya et al. revealed in their study on postmenopausal women that isoflavones supplement and soya may improve cognition in such women [24]. Tong et al. showed in their investigations the effects of Fujisan (10 mg/day) on the brain metabolism and measurement of neuropsychology in patients with Alzheimer's (low to moderate) are also indicate that treating by Fujisan may be positively effective in the cognition of behavioral functions and cognitive subscales as well as Alzheimer's disease assessment scale in Alzheimer's patients [25]. In an investigation carried out by Kennedy et al., they showed mental effects of herbal medicines such as *Melissa*

officinalis. The extract of *Melissa officinalis* adheres to nicotinic and muscarinic receptors in the brain; having good ant-stress properties, it can be effective in the treatment of patients with Alzheimer's turmoil and reduction of their cognitive decline solely and or in combination with common medicines [26]. In their latest study using Ellman calorimetrical method conducted on the essential oils extracted from the leaf of *Melissa officinalis* and the leaves of citrus trees, Japana and Aconoge showed that increase of activities of two kinds of anti-cholinesterase inhibitors (acetylcholine-esterase and butyrylcholinesterase) will improve cognitive impairment and the memory of Alzheimer's patients [27]. In an investigation carried out by Sarris et al. analyzing different levels of available evidences and examining side effects arising from using medicinal plants, a range of epigenetic effects and chemical nerve agents in 21 medicinal plants, it was found that Perforatum plant may be effective in treating severe depression. Furthermore, *Piper methysticum*, Chamomile, *Ginkgo biloba* and *Borago officinalis*, have anxiolytic effects and *Borago officinalis*, *Crocus sativus* (saffron) and *Rhydola rose* have antidepressant effects [28]. Besides, Lezak showed in his study that caraway consumption will reduce scopolamine rate and thus decreases amnesia and increases memory function [29].

Materials and Methods

This study is a quasi-experimental investigation arranged in two experimental and control groups without random selection. The subjects in both groups were selected voluntarily among the students of psychology. Using demographic forms and conducting clinical interviews, the students with special health problems including liver, kidney, thyroid, stomach and intestine disorders as well as overweight and underweight and or the people under medicinal treatment were omitted from the study. In order to control confounding variables, professional sportsmen and sportswomen, pregnant and smoking people were also excluded from the main sample which included 250 people. Finally, 80 persons in the age range of 20-32 years with an average age of 26.7 were prepared to participate in the study as divided randomly into two experimental and control groups of 40 persons in each group. It is worth mentioning that subjects could withdraw and exit the examination whenever they wish. They were asked to be regularly in contact with the researcher and to take daily notes of possible effects. Consulting some dietitians and pharmacists and enquiring from Barij Essence pharmaceutical company in Iran, effective dose was prescribed as 15 drops 2 times a day, each time with some liquid before meals for duration of 45 days. The subjects were instructed to report any emotional and physical consequences (positive and negative) in the normal course of their daily lives. It is noteworthy that at the end of 45-day duration, the number of subjects in control and experimental groups were decreased to 28 and 22 persons, respectively.

In the present investigation, the Stroop test formulated by Estrop (1935) was used to measure response inhibition ability, selective attention as well as cognitive change and flexibility. In the revised task of Stroop, the data is processed automatically that includes features like unavailability, uncontrollability, effortlessness, high speed and requiring minimal attention. This test should be convicted in a place and at a time very suitable so that subjects can use their maximum capabilities and have the best performance while they are at high speed. The test consists of two following phases: Phase 1) Naming colors: in this phase, the subject was asked to specify the color of the related shape in a colorful collection (for example, he/she is asked to specify the color of a circle shown in four colors of red, blue, yellow and green). The purpose of this phase is merely to exercise and recognize colors and the place of keys in computer keyboard and it has no effect on the final result. Phase 2) As the main phase of Stroop test, 48 colorful congruent words and 48 colorful incongruent words were displayed to the subjects with red, blue, yellow and green colors.

Congruent word means that the color of the word is equal to its meaning; for example, the word green which is showed in green color. Incongruent word means that the color of the word is different from its meaning; the word green is showed in red, blue or yellow color. Totally, 96 colorful congruent and incongruent words were displayed randomly and consecutively. The subject's task is to specify apparent color of the words disregard of their meaning. Every stimulus is displayed on the screen for 2 seconds and the interval between displays of the stimuli is 800 ms. the researchers believe that color-word task (second phase of the test) will help to measure mental flexibility, interference and response inhibition. The level of interference is calculated by correct congruent quantity score deducted by correct incongruent quantity score. The researches performed by Baron on this test indicate its reliability and validity to measure inhibition in adults and children. The reliability of this test was reported in a range of 0.80-0.91 by test-retest [30]. Finally, the data so collected were statistically analyzed by ANCOVA method using SPSS-17 software. The significance level of the findings was considered as $p \leq 0.05$.

Results

The mean and standard deviation of the subjects in both experimental and control groups were shown separately in table 1. As shown in the tables 1 and 2, mean of attention functions scores in both control ad experimental groups are at the same level; however, they change considerably after exercising caraway diet. The results of table 3 shows that F-statistics is related to the effect of caraway diet on the experimental group after adjusting pretest scores affected in all aspects of the time tested, number of test errors, number of correct responses, time of reaction and interference score and increased different attention functions (p=0.05).

Table 1. Mean and standard deviation of the subjects in experimental and control groups in pretest

Group	Variables	Mean±SD
Control	Times tested	46.357±6.91
	Number of errors	0.214±0.417
	Number of correct	47.35±0.951
	Reaction time	891.607±262.486
	Interference score	1.107±1.0306
Experimental	Times tested	43.86±6.548
	Number of errors	0.455±0.213
	Number of correct	47.50±0.801
	Reaction time	875.72±233.02
	Interference score	1.045±0.988

Table 2. Descriptive characteristics of both experimental and control groups in post-test

Group	Variables	Mean±SD
Control	Times tested	50.0357±0.965
	Number of errors	0.714±0.534
	Number of correct	46.250±1.601
	Reaction time	995.00±154.347
	Interference score	1.333±1
Experimental	Times tested	39.74±6.546
	Number of errors	0.045±0.213
	Number of correct	51.636±0.581
	Reaction time	861.500±231.91
	Interference score	1±0.976

Table 3. The results of ANCOVA analysis of intergroup factors (experimental and control)

Source	Total squares	Degrees of freedom	Mean square	F	*p*-Value
Times tested	64.273	1	64.273	4.63	0.037
Number of test errors	31.37	1	31.37	2.42	0.023
Number of correct responses	66.75	1	66.75	23.29	0.001
Reaction time	159.39	1	159.39	159.39	0.001
Interference score	5.683	1	5.683	7.562	0.008

Discussion

The purpose of this trial study was to investigate the effect of caraway extract on the cognitive functions including selective function, the ability of cognitive variability and cognitive flexibility. The data found in table 1 and 2 indicate that post-test mean scores of experimental group in variables including the time tested, number of errors, reaction time and interference score showed a significant reduction compared to mean scores of the same group and that of the experimental group after receiving caraway extract for 45 days. Furthermore, post-test score of mean subscale number of correct responses in the experimental group showed a significant increase compared to post-test mean scores of the same group and that of the experimental group. Besides, according to the findings shown in table 3, pre-test scores of experimental group showed increases in cognitive functions subscales including the time tested, number of test errors, number of correct responses, reaction time and interference score indicating the effect of diet on the improvement of attention functions.

El-Sherbiny and Khalifa stated in their study that caraway consumption along with scopolamine rate reduction may be effective in reducing amnesia and increasing memory function [31]. Since this study had limitations to the effect of caraway on cognitive capabilities and memory, the researcher has taken advantage of other studies on herbal medicines in this respect, the results of which are consistent with those of the present investigation. Kennedy et al. showed that *Melissa officinalis* extract having anxiolytic properties may be effective to treat turmoil in Alzheimer's patients and to reduce their cognitive decline singly or in combination with common medicines [26]. Furthermore, Bi et al. stated that treatment by Fujisan (among Chinese medicinal plants) had positive effects on the cognition of behavioral functions, cognitive subscales and Alzheimer's disease assessment scale in Alzheimer's patients [25]. Meanwhile, the study conducted by Duw et al. who believed in anti-oxidant properties of both well-known herbal medicines including thyme and tiger grass being effective in increased memory, were consistent with the results of the present investigation [3]. Also, the investigation carried out by Clement et al. about the effect of isoflavones supplement and soya on the improvement of cognitive functions of postmenopausal women were consistent with the results of this study [31]. In addition, Ramzi in Iran concluded in his study into the effect of *Melissa officinalis* on depression that it may decrease depression scores and cause to improve mental power in the patients with depression; it seems that *Melissa officinalis* may be also effective in improving mental capabilities of depressed patients [31]. Due to long research period, some of the subjects exited the study; this issue may lead to reduce generalization of the results. Low number of studies consistent with the subject of the present investigation, unavailability of similar research background, finding healthy subjects who took no medicine or did no smoking and the women who were not pregnant, all made the study conduction somewhat difficult. In the meantime, most of the studies carried out inside and outside Iran about medicinal and traditional plants were on small mammals such as rats the results of which cannot be generalized to human research.

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Authors' Contributions

The present study is conducted by the management and supervision of Dr. Zare. Trial procedure is performed by Ziba Barghi-Irani and the diet is planned by Ms. Shahnaz Nouhi.

Conflict of Interest

The authors declare no conflict of interest.

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