A study on comparison of memory boosting and regaining effects of oral administration of peppermint and coriander in wistar albino rats.

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Abstract

The present study provides further evidence that oral administration of peppermint and coriander extracts are having memory boosting and memory regaining effects. The present study was undertaken to compare memory boosting and regaining effects of oral administration of peppermint and coriander extracts in adult wistar rats. Here we investigate the influence of oral intake of peppermint and coriander extracts on behavioral task performance by using T-maze and radial arm maze and physiological measures relative to a milk control group. When coriandrum and peppermint groups are compared, the memory boosting and regaining effects of peppermint is significant in R-maze, whereas memory boosting and regaining effects of coriandrum is significant in T-maze. We conclude that oral administration of peppermint and coriander extracts are having memory boosting and memory regaining effects. Hence we recommend peppermint and coriander can be used as a remedy in the management of Alzheimer's disease and we also recommend further research in this area by investigating compound metabolism to optimize quantification of memory performance following peppermint and coriander ingestion.

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Introduction

Herbs and spices have been long used to help promote healthy memory and neurological function. Recent research suggests the potential for natural compounds to serve a protective function in the preservation of memory and cognition[1]. Peppermint (*Mentha × piperita*, also known as *M. balsamea* Willd.) is a hybridmint, a cross between watermint and spearmint.The plant, indigenous to Europe, is now widespread in cultivation throughout all regions of the world. The peppermint plant (Mentha piperita) contains over 40 distinct chemical compounds (including menthol, menthone, and menthyl acetate), and has been proven safe for consumption (both in its plant and essential oil stages) in toxicological investigations. Combination of peppermint oil, eucalyptus oil, and ethanol increases cognitive performance[2]. Peppermint odour enhances memory[3].

Coriander (*Coriandrum sativum*), also known as cilantro, Chinese parsley or dhania is an annual herb in the family Apiaceae. Pharmacological studies in animals have shown that coriander has anti-diabetic[4,5] hypolipidemic[6,7] and anti-cancer effects[8]. *Coriandrum sativum* have been used as a drug for indigestion, against worms, rheumatism and pain in the joints[9]. The essential oil produced from *Coriandrum sativum* has been shown to exhibit antimicrobial effects[10]. The sedative-hypnotic activity of *Coriandrum sativum* seeds has been evaluated in mice[11]. It also have reversal of memory deficits[12]. The leaf extract of the plant exerted an anti-anxiety effect on mice in the elevated plus maze and open field test[13]. Coriander leaf was found to prevent deposition of lead in mice, due to a

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presumptive chelation of lead by substances in the plant[14]. The present study was undertaken with an objective to compare memory boosting and regaining effects of oral administration of peppermint and coriander extracts.

Methods

A total of 36 male and female wistar albino rats were used for this study. They were housed in groups, in propylene cages in an acclimatized (25-27°C) room and were maintained on a 12hr light / dark cycle. Food and water was given ad libitum until they aged 30 days at the beginning of the experiment. They were randomly assigned into control, peppermint groups and coriander group with 6 rats in each group. Peppermint was administered to Peppermint group, coriander was administered to coriander group and milk was administered to control group.

The T-maze is made of wood with smooth polished surface. It consists of a stem (35 x 12 cm), a choice area (12 x 12 cm) and two arms (35 x 12 cm); at the end of each arm contain a food well. The sidewalls are 40 cm high. The choice area is separated from the arms by a sliding door.

Radial arm maze is made of Plexiglas; consist of eight equally spaced arms radiating from an octagonal central platform. Each arm was having a length of 56.2 cm, width of 7.9 cm and height of 10 cm. The entire maze is elevated 80 m above the floor for easy locating of spatial cues by rats.

Peppermint extract

Peppermint (Mentha × piperita, also known as M. balsamea Willd.) is a hybridmint, a cross between watermint and spearmint. *Mentha piperita* leaves were washed, weighed (100g/L), and triturated with water in a blender for 7 minutes. The juice was filtered and frozen in an amber flask. Each flask was thawed daily at ambient temperature two hours prior to administration

Coriander extract

Coriander (*Coriandrum sativum*) , also known as cilantro were washed, weighed (100g/L), and triturated with water in a blender for 7 minutes. The juice was filtered and frozen in an amber flask. Each flask was thawed daily at ambient temperature two hours prior to administration

Pharmacological drug

Buscopan® tablets manufactured by Cadila Healthcare limited, is used in the present study. Each Buscopan tablet contained Hyoscine (scopolamine) Butylbromide I P 10 mg and excipients (q. s.). The tablets were powdered and mixed with 50ml sterile 0.9% w/v normal saline. It was administered to the rats as intraperitoneal injection at a dose of 1 mg / Kg. Deficits in short-term memory have been reported following scopolamine administration in monkeys and in humans[15,16]. Scopolamine is named after the plant genus *Scopolia*. Scopolamine is a muscarinic antagonist structurally similar to the neurotransmitter acetylcholine and acts by blocking the muscarinic acetylcholine receptors and is thus classified as an anticholinergic[17].

Experimental design

The rats in the peppermint group and coriander group were given 5mg/kg body weight of peppermint and coriander leaf extract orally for 30 days continuously. The control rats were given equal quantity of milk for 30 days without any extract. All the rats were fed with pellets and water mixed with B complex tonic liberally in these 30 days. After 30 days, the rats were starved for 48 hours and after 48hours the behavioural task is performed on T-maze and radial arm-maze for acquisition.

This task is continued till we recorded full score without any error. Now ten days gap was given for the retention of the task. In these ten days only pellets and water mixed with Bcomplex tonic was given to both the groups. On eleventh day behavioural task is performed on T-maze and radial arm-maze and number of trials required to get full score is recorded in both the groups to test memory boosting effect of peppermint and coriander extract. From the next day we have started administration of scopolamine intraperitoneally to both the three groups to cause partial

amnesia. This procedure continued for 9 days. Scopolamine administration was done at 10 am daily. Only water mixed with B complex tonic is given to both the groups during this 9 days. From tenth day administration of scopolamine is stopped and peppermint and coriander is administered to peppermint group and coriander group where milk is given to the control group. This procedure continued for 30 days and food and water mixed with b complex was given to both the groups during these 30 days. On 31st day behavioural task is performed on T-maze and radial arm maze in both the groups for acquisition and number of trails required to get the full score is recorded. Now ten days gap is given where only food and water mixed with B complex is given to the rats in both the groups. On eleventh day behavioural tasks were performed on both the mazes to test the retention in both the groups and number of trails required to get the full score is recorded. The memory score was calculated by taking the difference between the number of trials required for acquisition test and number of trials for retention test.

The body weight was maintained at 85% of the original body weight, throughout experiment. Behavioural experiments were conducted in the same room with the same allocentric cues, such as doors, windows, posters and on investigators.

T-maze task

This was analogous to non-matching to sample task, where the rat was rewarded only if the current choice doesn't match the previous one. As reward is used it can also be considered as a learned alternation procedure. In the orientation phase, the starved rats were allowed to spend 10 minutes / day for three days in the T-maze and trained to collect food pellet from the food wells.

During the acquisition test, all the rats were given six trials / day with an inter trial interval of one hour. Each trial consists of four sample and choice run. In the sample run, the rat was placed at the start end of the T-maze stem. Allowed to move towards one arm and collect the food pellet, while keeping the sliding door of other arm closed. In the choice run, the rat was placed at the start end of stem and both arms were kept open.

If the rat visits the same arm as that of sample run, it was recorded as error and the rat was not rewarded with food. Instead, if the rat visits the alternate arm, it was recorded as correct score and the rat was allowed to eat food pellet (reward) in the food well. There was an interval of 30s between each run. Score was given for alternate selection of arm during choice run and a maximum score of '4' can be obtained per trial.

Radial arm maze task

The rats was placed in the centre of the maze and allowed to freely explore the maze for 15 minutes on the first day. The rats were required to take the food pellets from each arm without making a re-entry into the arm already visited.

The trial was terminated when the animal takes the food reward from all the eight arms or after 10 minutes if all the eight arms were not visited. Correct sore was give when the visits an arm and collects the food reward, and a maximum score of '8' can be attained per trial. When a rat reenters an already visited arm it was taken as a working memory error.

Data Analysis

Two Sample T-Test, One Way Anova are used for the data analysis.

Result

	Control group	Coriander group	p value
acquisition	27.33±3.01	16.17±3.97	<.001
retention	17.00±2.37	10.50±3.27	0.003

Tab.1: Number of mean trials of acquisition and retention in control and coriander (R-maze memory boosting)

The number of mean trials of acquisition in control group is 27.33±3.01 and in coriander is 16.17±3.97, which indicates that coriander group is having more memory boosting effect than control group. This is statistically significant ($p<0.001$). The mean retention of control group is 17.00±2.37 and in coriander is 10.50±3.27, which indicates that coriander group is having more memory boosting effect than control group. This is statistically significant ($p<0.003$).

Tab.2: Number of mean trials of acquisition and retention in control and coriander (R-maze memory boosting)

The number of mean trials of acquisition in control group is 27.33±3.01 and in peppermint is 12.17±2.32, which indicates that peppermint group is having more memory boosting effect than control group. This is statistically significant (p<0.001). The mean retention of control group is 17.00±2.37 and in peppermint is 6.83±1.47, which indicates that group coriander is having more memory boosting effect than control group. This is statistically significant (p<0.001).

	Coriander group	Peppermint group	p value
acquisition	16.17+3.97	12.17±2.32	0.059
retention	10.50+3.27	6.83±1.47	0.031

Tab.3: Number of mean trials of acquisition and retention in coriander and peppermint (R-maze memory boosting)

The number of mean trials of acquisition in coriander group is 16.17+3.97 and in peppermint is 12.17±2.32, which indicates that peppermint group is having more memory boosting effect than coriander group. This is not statistically significant (p0.059). The mean retention of coriander group is 10.50+3.27 and in peppermint is 6.83±1.47, which indicates that peppermint group is having more memory boosting effect than coriander group. This is statistically significant (p<0.031).

	Control group	Coriander group	p value
acquisition	40.83±1.94	28.17±5.12	<.001
retention	20.50±1.87	19.17±4.54	0.521

Tab.4: Number of mean trials of acquisition and retention in control and coriander (R-maze memory regaining)

The number of mean trials of acquisition in memory loss group is 40.83±1.94 and in coriander is 28.17±5.12, which indicates that coriander group is having memory regaining effect. This is statistically significant (p<0.001). The mean retention of memory loss group is 20.50±1.87 and in coriander is 19.17±4.54, which indicates that coriander group is having memory regaining effect. This is not statistically significant (p0.521).

	Control group	Peppermint group	p value
acquisition	40.83±1.94	18.67±2.16	<.001
retention	20.50±1.87	11.83±2.14	<.001

Tab.5: Number of mean trials of acquisition and retention in control and peppermint (R-maze memory regaining)

The number of mean trials of acquisition in memory loss group is 40.83±1.94 and in peppermint is 18.67±2.16, which indicates that peppermint group is having memory regaining effect. This is statistically significant (p<0.001). The mean retention of memory loss group is 20.50±1.87 and in peppermint is 11.83±2.14, which indicates that peppermint group is having memory regaining effect. This is statistically significant (p<0.001).

	Coriander group	Peppermint group	p value
acquisition	28.17±5.12	18.67±2.16	0.002
retention	19.17±4.54	11.83±2.14	0.005

Tab.6: Number of mean trials of acquisition and retention in coriander and peppermint (R-maze memory regaining

The number of mean trials of acquisition in coriander group is 28.17±5.12 and in peppermint is 18.67±2.16, which indicates that peppermint group is having more memory regaining effect. This is statistically significant (p<0.002). The mean retention of coriander group is 19.17±4.54 and in peppermint is 11.83±2.14, which indicates that peppermint group is having memory regaining effect. This is statistically significant (p 0.005).

	Control group	Coriander group	p value
acquisition	13.50±3.27	7.83±1.33	0.003
retention	9±2.61	5.50±0.84	0.011

Tab.7: Number of mean trials of acquisition and retention in control and coriander (T-maze memory boosting)

The number of mean trials acquisition in control group is 13.50±3.27 and in coriander is 7.83±1.33, which indicates that coriander group is having more memory boosting effect than control group. This is statistically significant (p<0.003). The mean retention of control group is 9±2.61 and in coriander is 5.50±0.84, which indicates that coriander group is having more memory boosting effect than control group. This is statistically significant (p<0.011).

	Control group	Peppermint group	p value
acquisition	13.50±3.27	6.67±0.82	0.001
retention	9±2.61	4.33±0.52	0.002

Tab.8: Number of mean trials of acquisition and retention in control and peppermint (T-maze memory boosting)

The mean acquisition of control group is 13.50±3.27 and in peppermint is 6.67±0.82, which indicates that peppermint group is having more memory boosting effect than control group. This is statistically significant (p<0.001). The mean retention of control group is 9±2.61 and in peppermint is 4.33±0.52, which indicates that peppermint group is having more memory boosting effect than control group. This is statistically significant (p<0.002).

	Coriander group	Peppermint group	p value
acquisition	7.83±1.33	12.17±2.32	0.097
retention	5.50±0.84	6.83±1.47	0.016

Tab.9: Number of mean trials of acquisition and retention in coriander and peppermint (T-maze memory boosting)

The number of mean trials acquisition in coriander group is 7.83±1.33 and in peppermint is 12.17±2.32, which indicates that coriander group is having more memory boosting effect than peppermint group. This is statistically significant (p 0.097). The mean retention of coriander group is 5.50±0.84 and in peppermint is 6.83±1.47, which indicates that coriander group is having more memory boosting effect than peppermint group. This is statistically significant (p 0.016).

	Control group	Coriander group	p value
acquisition	24.17±3.66	14.00±1.41	<.001
retention	13.83±2.48	10.17±1.72	0.014

Tab.10: Number of mean trials of acquisition and retention in control and coriander (T-maze memory regaining)

The number of mean trials acquisition in memory loss group is 24.17±3.66 and in coriander is 14.00±1.41, which indicates that coriander group is having memory regaining effect. This is statistically significant (p<0.001). The mean retention of memory loss group is 13.83±2.48 and in coriander is 10.17±1.72, which indicates that coriander group is having memory regaining effect. This is statistically significant (p 0.014).

	Control group	Peppermint group	p value
acquisition	24.17±3.66	11.17±1.47	<.001
retention	13.83±2.48	8.00±0.63	<.001

Tab.11: Number of mean trials of acquisition and retention in control and peppermint (T-maze memory regaining)

The number of mean trials of acquisition in memory loss group is 24.17±3.66 and in peppermint is 11.17±1.47, which indicates that peppermint group is having memory regaining effect. This is statistically significant (p<0.001). The mean retention of memory loss group is 13.83±2.48 and in coriander is 8.00±0.63, which indicates that peppermint group is having memory regaining effect. This is statistically significant (p<0.001).

	Corlander group	Peppermint group	p value
acquisition	14.00±1.41	11.17±1.47	0.007
retention	10.17±1.72	8.00±0.63	0.016

Tab.12: Number of mean trials of acquisition and retention in coriander and peppermint (T-maze memory regaining)

The number of mean trials acquisition of coriander group is 14.00±1.41 and in peppermint is 11.17±1.47, which indicates that peppermint group is having memory regaining effect. This is statistically significant (p 0.007). The mean retention of coriander group is 10.17±1.72 and in peppermint is 8.00±0.63, which indicates that peppermint group is having memory regaining effect. This is statistically significant (p 0.016).

ANOVA

		Sum of Squares	df	Mean Square	F	P value
acq	Between Groups	741.444	2	370.722	36.827	<.001
	Within Groups	151.000	15	10.067		
	Total	892.444	17			
retention	Between Groups	318.111	2	159.056	25.839	<.001
	Within Groups	92.333	15	6.156		
	Total	410.444	17			

Tab.13: Memory boosting effect of R-maze

The number of trials for acquisition of Control group, First group and Second group were compared by one way ANOVA the significant difference was observed (p<0.001). Then the

number of trials for retention of these three groups compared by using a one way ANOVA indicates a significant difference with ($p<0.001$) between the groups were observed.

		Sum of Squares	df	Mean Square	F	P value
acq	Between Groups	1484.111	2	742.056	64.340	<.001
	Within Groups	173.000	15	11.533		
	Total	1657.111	17			
retention	Between Groups	261.333	2	130.667	13.690	<.001
	Within Groups	143.167	15	9.544		
	Total	404.500	17			

Tab.14: Memory Regaining in R-maze

The number of trials for acquisition of Control group, First group and Second group were compared by one way ANOVA the significant difference was observed ($p<0.001$). Then the number of trials for retention of these three groups compared by using a one way ANOVA indicates a significant difference with ($p<0.001$) between the groups were observed.

		Sum of Squares	df	Mean Square	F	P value
acq	Between Groups	160.333	2	80.167	18.312	<.001
	Within Groups	65.667	15	4.378		
	Total	226.000	17			
retention	Between Groups	70.778	2	35.389	13.670	<.001
	Within Groups	38.833	15	2.589		
	Total	109.611	17			

Tab.15: Memory Boosting in T-maze

The number of trials for acquisition of Control group, First group and Second group were compared by one way ANOVA the significant difference was observed ($p<0.001$). Then the number of trials for retention of these three groups compared by using a one way ANOVA indicates a significant difference with ($p<0.001$) between the groups were observed.

		Sum of Squares	df	Mean Square	F	P value
acq	Between Groups	560.778	2	280.389	47.975	<.001
	Within Groups	87.667	15	5.844		
	Total	648.444	17			
retention	Between Groups	104.333	2	52.167	16.416	<.001
	Within Groups	47.667	15	3.178		
	Total	152.000	17			

Tab.16: Memory Regaining in T-maze

The number of trials for acquisition of Control group, First group and Second group were compared by one way ANOVA the significant difference was observed ($p<0.001$). Then the number of trials for retention of these three groups compared by using a one way ANOVA indicates a significant difference with ($p<0.001$) between the groups were observed.

Discussion

It was reported that the aroma of peppermint has been found to enhance memory and alertness.[18,19] It was reported that Peppermint aroma enhances memory[20, 21]. Peppermint aroma produced a marked increase in word recall accuracy[22]. Consumption of peppermint does not mediate alertness or enhanced cognitive performance but improves concentration[23]. In contrast it was reported that chewing peppermint gum increases working memory and visual motor response[24]. This mechanism would require pharmacological action, including compound absorption and subsequent neuronal action. This study as we have observed significant memory boosting and memory regaining effect of peppermint when administered orally. This effect may be due to improvement of the blood flow to the brain and increasing the concentration power.

Oral administration of coriandum sativum leaves in scopolamine induced rats showed improved memory. Moreover, coriandum sativum leaves also demonstrate AChE inhibitory activity[25]. Learning after coriander administration can be improved in the long term[26]. Coriander sativam leafs may be a useful remedy in the management of Alzheimer's disease with its anticholinesterase activity[27]. These studies as we have observed significant memory boosting and memory regaining effect by oral administration of coriandrum extract.

When coriandrum and peppermint groups are compared, the memory boosting and regaining effects of peppermint is significant in R-maze, whereas memory boosting and regaining effects of coriandrum is significant in T-maze.

Conclusion

The oral administration of peppermint and coriander extracts are having memory boosting and memory regaining effects. Hence we recommend peppermint and coriander can be used as a remedy in the management of Alzheimer's disease and we also recommend further research in this area by investigating compound metabolism to optimize quantification of memory performance following peppermint ingestion.

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