

## A study on effect of oral administration of cardamom on memory boosting and regaining in wistar albino rats.

Prabha V Setty<sup>1</sup>, Kumar Sai Sailesh<sup>2</sup>, Neethu<sup>3</sup>, Mukkadan J.K<sup>4</sup>

<sup>1</sup>Assistant Professor, Department of Physiology, Vinayaka Mission's Kirupananda Variyar Medical College & Hospitals, Salem, Tamil Nadu, India.

<sup>2</sup>Assistant professor, Department of Physiology, Travancore Medical College, Kollam, Kerala, India.

<sup>3</sup>PG student, LIMSAR, Angamaly, Kerala, India.

<sup>4</sup>Research Director, Little Flower Medical Research Centre, Angamaly, Kerala, India.

### Abstract

This study provides further evidence for improvement of memory by oral consumption of cardamom. The present study was undertaken with an objective to study the effects of oral administration of cardamom on memory boosting and regaining. Here we investigate the influence of oral intake of cardamom on behavioral task performance by using T-maze and radial arm maze and physiological measures relative to a milk control group. We have observed significant memory boosting and memory regaining effects of cardamom when administered orally. This effect may be due to facilitation of acetylcholine activity by decreasing acetyl cholinesterase activity of cardamom. Hence we recommend further research in this area by investigating compound metabolism to optimize quantification of memory performance following cardamom consumption

**Key Words:** Memory boosting, Memory retention, Cardamom consumption.

### INTRODUCTION

Learning is change in behavior based on the past experience for the stimulus. There are two types of learning namely associative and non-associative. Memory is the ability of the organism to register, retain and recall the information at a later date. The different types of memory are short-term and long-term.[1]

The United Nations estimates that the number of people with dementia in developed countries will increase from 13.5 million to 36.7 million between 2000 and 2050.3 Alzheimer's disease (AD) is the most frequent form of dementia in developed countries, with a prevalence of about 1% at the age of 65 and over 25% in people older than 85 years of age. It is characterized by progressive cognitive deterioration, behavioral disturbances, and functional decline. [2] Although there has been important progress in describing and understanding Alzheimer's disease, there is no cure, and researchers are still trying to understand its etiology and pathophysiology.[4] The best developed approach to treatment aims at correcting the deficit of acetylcholine which is associated with Alzheimer's disease. Acetyl cholinesterase inhibitors are currently the most successful drugs used to enhance the transmission of acetylcholine, and they may be more beneficial than direct activation of cholinergic receptors.[4] Epidemiologic studies have suggested that in women estrogen replacement therapy may significantly delay the onset of Alzheimer's disease and lower the risk of developing it.[5,6] The consensus statement on the diagnosis and treatment of dementia suggested that antipsychotic agents could be helpful in controlling the behavioral problems that may occur, such as agitation and aggression. The statement cautions that such agents can have adverse side effects ranging from Parkinson's

symptoms to delirium and sedation.[4]

Medicinal plants improve memory by their acetyl choline esterase inhibitory activity.[7] Cardamom belongs to the family zingiberaceae, is an evergreen perennial with thick rhizomes and erect stems. It is referred to as the "queen of spices.[11] The seeds and oil are used in herbal preparations and the seeds to flavor baked goods, curries, coffee, pickles. The monoterpenes found in the oil contained in the seeds have antibacterial, antiviral, anti fungal as well as anti spasmodic properties. Cardamom is perhaps the best source of a phyto chemical called cineole, which calms your nerves and clears your head.[8]

The present study was undertaken with an objective to study the effects of oral administration of cardamom on memory boosting and regaining.

### METHODS

#### Subjects

A total of 24 male and female wistar albino rats were used for this study. They were housed in groups, in polypropylene 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 and cardamom groups with 12 rats in each group. Cardamom was administered to cardamom group and milk without cardamom was given to control group.

#### Materials

##### T-maze

The T-maze is made of wood with smooth polished surface. It consists of a stem (35x12cm), a choice area (12x12cm) and two arms (35x12cm); at the end of each arm contains a food well. The sidewalls are 40cm high. The choice area is separated from the arms by a sliding door.

### Address for correspondence\*

Dr. Prabha V,

Assistant professor, Department of Physiology, Vinayaka Mission's Kirupananda Variyar Medical College & Hospitals, Sankari main road, (NH-47), Veerapandi post, Salem- 636308, Tamil Nadu, India. Email: prabhavsetty@gmail.com

## Radial arm maze

Radial arm maze is made of Plexiglass; consist of eight equally spaced arms radiating from an octagonal central platform. Each arm was having a length of 56.2cm, 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.

## Cardamom extract

Cardamom extract is purchased from Kancor ingredients limited, Kancor road, Angamaly, Kerala, India.

## Pharmacological drug administration

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. [9]

Scopolamine was injected at a dose of 1 mg / Kg body weight of rat, only during the phases where it was assigned. In those groups where the drug is administered, SC was injected 30 minutes before beginning the behavioral trials, every day, either during acquisition or retention depending on the group. [10, 11, 12, 13]

## Polybion

Polybion contains Vitamin B complex, manufactured by Merck, Germany, Thiamine mononitrate 10 mg, pyridoxine hydrochloride 3 mg, cyanocobalamin 15 mcg, riboflavin 10 mg, nicotinamide 100 mg, calcium pantothenate 50 mg, ascorbic acid 150 mg, folic acid 1.5 mg, biotin 100 mcg

## Experimental design

It is a modified questionnaire by Folstein et al., [8]. This modified version is developed by Indo-US Cross National Dementia Epidemiology Study and is a collaborative programme of University of Pittsburgh, School of Medicine, Dept. of Psychiatry, Graduate School of Public Health, US and Center for Aging Research in India, New Delhi, India.

The rats in the cardamom group were given 1-2 mg/kg body weight of cardamom extract orally for 30 days continuously. The control rats were given equal quantity of milk for 30 days without cardamom 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 48 hours the behavioral 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 B complex tonic was given to both the groups. On eleventh day behavioral 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 cardamom.

From the next day we have started administration of scopolamine intraperitoneally to both the 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 cardamom is administered to cardamom group where milk without cardamom 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 behavioral task is performed on T-maze and radial arm maze in both the groups for acquisition and number of trials 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 behavioral tasks were performed on both the mazes to test the retention in both the groups and number of trials 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. Behavioral experiments were conducted in the same room with the same allocentric cues,



**Fig. 1:- T – maze**

such as doors, windows.

## 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.

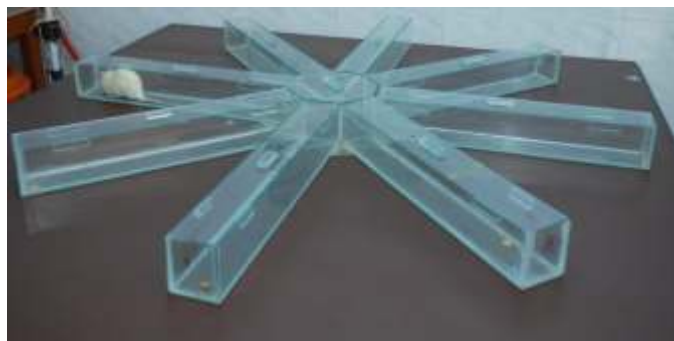
During the acquisition test, all the rats were given six trials / day with an inter trial interval of one hour. Each trial consists of four sample and choice run. In the sample run, the rat was placed at the start end of the T-maze stem.

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



**Fig. 2:- Radial arm maze**

**Table 1: Mean trials of acquisition and retention in control and cardamom (R-maze memory boosting)**

Memory	Control	Cardamom	p value
Acquisition	28.67±2.07	15.86±3.72	<0.001
Retention	23.17±1.94	9.57±2.51	<0.001

**Table 2: Mean trials of acquisition and retention in control and cardamom (R-maze memory regaining)**

Memory	Control	Cardamom	p value
Acquisition	34.00±3.41	33.17±3.76	0.696
Retention	25.33±3.27	18.33±3.39	0.005

**Table3: Mean trials of acquisition and retention in control and cardamom (T-maze memory boosting)**

Memory	Control	Cardamom	p value
Acquisition	16.50±1.87	11.50±1.38	<0.001
Retention	12.83±1.33	9.00±1.26	<0.001

**Table 10: Mean trials of acquisition and retention in control and cardamom (T-maze memory regaining).**

Memory	Control	Cardamom	p value
Acquisition	34.00±3.41	33.17±3.76	0.696
Retention	25.33±3.27	18.33±3.39	0.005

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 score was given when the rat 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

The analysis of data was done by SPSS Version 20.0. The Independent-Samples t Test is used to compare means for two groups of cases.

#### Ethical approval

The study protocol was approved by Institutional Ethics Committee of Little Flower Medical Research Centre,

Angamaly.

The mean trial of acquisition in control group is (28.67±2.07) and in cardamom group is (15.86±3.72), which indicates that cardamom group is having memory boosting effect. This is statistically significant ( $p<0.001$ ). The mean retention of control group is (23.17±1.94) and in cardamom group is (9.57±2.51) which indicates that cardamom group is having memory boosting effect. This is statistically significant ( $p<0.001$ ).

The mean trial of acquisition in control group is (34.00±3.41) and in cardamom group is (33.17±3.76), which indicates that cardamom group is having memory regaining effect. However, this is not statistically significant ( $p=0.696$ ). The mean retention of control group is (25.33±3.27) and in cardamom group is (18.33±3.39) which indicates that cardamom group is having memory boosting effect. This is statistically significant ( $p=0.005$ ).

The mean acquisition of control group is (16.50±1.87) and in cardamom group is (11.50±1.38), which indicates that cardamom group is having memory boosting effect. This is statistically significant ( $p<0.001$ ). The mean retention of control group is (12.83±1.33) and in cardamom group is (9.00±1.26) which indicates that cardamom group is having memory boosting effect. This is statistically significant ( $p<0.001$ ).

#### DISCUSSION

Alzheimer's disease is a progressive neurodegenerative brain disorder that is slow in onset but leads to dementia, unusual behavior, personality changes and ultimately death [1]. Cardamom is the queen of spice and third most expensive spice in the world. Cardamom is strong and aromatic. It has a warm, spicy-sweet and lemony flavor. Both the husk and seeds are of great importance. Cardamom tea curbs Migraine. It's also used for treating digestive disorders. Also fights Oral health like gum infection prevents bad breath. In modern Ayurvedic medicine cardamoms are a popular remedy for nervous digestive upsets in children, and are often combined with fennel. [9] Cardamom is a non-toxic, non-sensitizing, non-irritant spice that improves memory.[10] E. cardamomum was found to possess anti-inflammatory activity [26] and antioxidant activity [27].

In the present study, we have observed significant memory boosting and memory regaining effects of cardamom consumption. Therefore, the memory improving activity of cardamom may be attributed to its antioxidant, anti-inflammatory, neuro protective, pro-cholinergic and anti-acetyl cholinesterase properties of various components of the multi-herbal preparation and hence may be of enormous use in delaying the onset and reducing the severity of Alzheimer's disease. However, further investigations are warranted to explore the possible involvement of other neurotransmitters, such as glutamate, GABA and catecholamines (41), responsible for memory improving property of cardamom.

#### CONCLUSION

We conclude that oral administration of cardamom is having memory boosting and memory regaining effects in rats. We recommend that cardamom can be used as remedies in the management of Alzheimer's disease. Hence we recommend further research in this area by investigating compound metabolism to optimize quantification of memory performance following cardamom consumption.

#### REFERENCES

1. C.N. Chandrashekar. Manipal manual of physiology. CBS publishers, New Delhi. 2012; 5th edition: 116-117.
2. R. Cacabelos, L. Fernandez-Novoa, V. Lombardi, Y. Kubota, and M. Takeda, "Molecular genetics of Alzheimer's disease and aging," *Methods and Findings in Experimental and Clinical Pharmacology*, vol. 27, pp. 1-573, 2005.
3. United Nations. World population prospects: the 1996 revision. Washington, DC: Population division of the Department of Economic and Social Affairs of the United Nations Secretariat, 1998.
4. Ruth O'Hara, Martin S Mumenthaler, and Jerome A Yesavage. Update on Alzheimer's disease; recent findings and treatments. *West J Med*. 2000 February; 172(2): 115-120.
5. Kawas C, Resnick S, Morrison A, et al. A prospective study of estrogen replacement therapy and the risk of developing Alzheimer's disease: the Baltimore longitudinal study of aging. *Neurology* 1997;48:1517-1521
6. Henderson VW. The epidemiology of Alzheimer's disease: the role of estrogen in reducing risk. In: Mayeaux R, Christen Y, eds. *Epidemiology of Alzheimer's disease: from gene to prevention*. New York: Springer-Verlag; 1999:49-63.
7. Joseph J. The Nutmeg, its Botany, Agronomy, Production, Composition and Uses. 1980; 2: 61-67.
8. Duke, James A, Ph.D. The Green Pharmacy Herbal Handbook, Rodale, 2000: 61-62.
9. <http://annemcintyre.com/articles/caradmom>
10. [http://plantpower.ca/?page\\_id=27](http://plantpower.ca/?page_id=27).
11. <http://www.jonbarron.org/herbal-library/foods/cardamom-seed-benefits>.
12. Jewart RD, Green J, Lu CJ, Cellar J, Tune LE. Cognitive, behavioral, and physiological changes in Alzheimer disease patients as a function of incontinence medications. *Am J Geriatr Psychiatry*. 2005;13:324-8. []
13. Al-Zuhair H, el-Sayeh B, Ameen HA, al-Shoora H. Pharmacological studies of cardamom oil in animals. *Pharmacol Res*. 1996;34:79-82. [PubMed]
14. Lee HJ, Lee JH. Effects of medicinal herb tea on the smoking cessation and reducing smoking withdrawal symptoms. *Am J Chin Med*. 2005;33:127-38. [PubMed]
15. Milind Parle, Dinesh Dhingra, Kulnari SK. Neurochemical basis of learning and memory. *Ind J Pharm Sci*. 2004;66:371-6.