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Evaluation of Nootropic activity of leaves extract of *Mangifera indica* in experimental animals

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ABSTRACT: Background: *Mangifera indica* commonly known as Mango belonging to family *Anacardiaceae*, is belived to have stimulant effect as per the traditional information. **Aim:** The present research was aimed to evaluate the leaves of *M. indica* for nootropic activity. **Method:** *M. indica* leaves aqueous extract at doses of 200, 400 and 600 mg/kg was administered orally for 7 days, which have improved learning and memory of rat significantly in the elevated plus and radial arm maze models by using the Wistar albino rat as animal model. The Piracetam was used as 200mg/kg, p.o. The negative control group animals were received Scopolamine 0.4mg/kg i.p. In radial arm maze model *M. Indica* leaves extract possess nootropic activity by decreasing the time taken to reach reward arm (s). **Results:** The M. indiac significantly showed the nootropic activity which is well comparable with the standard drug. It was observed that as dose of the tested extract was increased, the nootropic activity was also increased. Scopolamine also interferes with memory and cognition in humans and laboratory animals by blocking muscarinic receptors and generating transient memory deficiency. Scopolamine decreases cerebral blood flow due to cholinergic hypo function. In present study of *M. indica leaves extract* inhibited acetyl cholinesterase enzyme, there by elevating acetylcholine concentration in the brain. **Conclusion:** *M. indica* possessed neuroprotective, memory-stimulating effect and could be used in the treatment of dementia.

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Keywords: *Mangifera Indica*, Nootropic Activity, Scopolamine, Dementia, Radial arm maze model.

INTRODUCTION:

Dementia is also a symptom of a variety of specific structural brain diseases and several degeneration of the system. Dementia is the 7th most common cause of death worldwide, with 50 million people living with dementia [1]. A new case of dementia diagnosed every 3 s. Dementia has a tremendous impact on the economy. Dementia focuses on the life of the individual [2]. Alzheimer's disease (AD) accounts for nearly 50 % of all cases of dementia [3]. It affects about 6 % of the population aged over the 65 and increases the incidence

with age. Alzheimer's disease (AD)[4] is a neurodegenerative disorder that destroys cells in the brain associated with loss of neurons in distinct brain areas [5]. Currently, various nootropic drugs are available in the market for treating AD as well as dementia like physostigmine, rivastigmine, piracetam, donepezil, galantamine and tacrine [6,7].

These drugs are effective, but they are associated with side effects such as arousal, seizures and tremors and should be used with caution in patients with gastroduodenal ulcers, asthma and hypotension [8,9].

Hence, there is need of a drug which is effective for neuroprotection, learning and memory enhancement; Hence in present investigation, an attempt was made to evaluate beneficial effect of an aqueous extract of *Mangifera indica* on nootropic activity. The general purpose of the proposed study was to assess the nootropic activity of leaves extracted from *Mangifera indica* on scopolamine-induced dementia in rats.

MATERIALS AND METHODS:

Chemicals and drugs:

All chemicals used in the analytical quality study as well as lists of various reagents used in the study. Leaves of *Mangifera indica* were harvested from the Botanical Garden of YSPM Satara. Piracetam tablets and Hyoscine butyl bromide (Scopolamine) was purchased from Dr. Reddy's Laboratories and APP pharmaceutical respectively. All other chemicals and reagents used in this study were of analytical grade and procured from the authorized dealer.

Evaluation of nootropic activity:

Animals:

Wistar albino rats (150 to 200 g) either sex were used for study.

Housing conditions:

Animals were maintained under the standard laboratory conditions at 25 ± 2°C, relative humidity 50 ± 15 % and normal photoperiod (12 h dark \12 h light). The animal had free access to pellet diet and water were provided *ad libitum.*

Institutional Animal Ethics Committee (IAEC) approval:

The animals were maintained under standard condition in an animal house approved by Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA). The study protocol was approved by IAEC of YTC, Faculty of Pharmacy Wadhe Satara (YSPM/YTC/PHARMA-IAEC/2020-2021/05).

Route of dose administration.

The Vehicle (1ml/kg), Leaves extract of *Mangifera indica* (200mg/kg), Leaves extract of *Mangifera indica* (400mg/kg), Leaves extract of *Mangifera indica* (600mg/kg), Scopolamine (0.4mg/kg) & Piracetam (200mg/kg) were administered per orally[10].

Elevated plus maze model:

Principle:

Elevated plus maze test is a novel test for the selective identification of anxiogenic and anxiolytic drug effects in rodents. The test is principally based on the observations of Montgomery showing that exposure of animals to an elevated (open) maze alley evokes an approach- avoidance conflict that is considerably stronger than that evoked by exposure to an open maze alley. Exposure of rats to novel stimuli can evoke both exploratory drive and fear drive and generate approach-avoidance conflict response. Elevation of the maze causes greater fear and more avoidance conflict and study the effect on learning and retention memory [11-13].

Requirements:

Animals used in this study were 36 Wistar albino rat (either sex) Body weight 150 to 200 g. Chemicals used are saline solution, leaves extract of *M. indica,* Scopolamine and Piracetam. Apparatus and instruments used were digital weighing balance and Elevated plus maze apparatus.

Procedure:

Albino rat of either sex having weight between 150 to 200 g and grouped as 6 animals each in 6 groups was selected. The group 1 animals treated as control group received saline solution (10 ml/kg. p.o.), group 2 animals treated as negative group received Scopolamine (0.4 mg/kg i.p.), group 3 animals treated as standard group received Piracetam (200 mg/kg, p.o.), group 4, 5 and 6 animals received test drug that is aqueous extract of *M. indica* AEMI at a dose of 200, 400 and 600 mg/kg, p.o. respectively. The specific marking was made on paw region of each rat with the picric acid for identification. Before the experiment animals was kept in elevated plus maze for acclimatization for 7 days and was housed in group of six rat in one cage under the standard condition like room temperature is 22 ± 3 °C, relative humidity 45 to 55 % and light and dark cycle of 12 h. All animals were fed with standard diet and water was supplied ad libitum under hygienic conditions. On the first day, each rat was placed at the end of open arm, facing away from the central platform. Transfer latency

(TL) was taken as the time taken by the rat to move into any of the covered arms with all its four legs. TL was recorded on the first day. If rat does not enter into one of the covered arms within 90 s, it was gently pushed into one of two covered arms and TL was assigned as 90 s. The rat was allowed to explore the maze for 10 s and then it returns to its home cage. The TL on the first day serves as acquisition learning) and the retention consolidation (memory) was examined 24 hrs after the first day trial. The reduction in transfer latency score was observed and percent of time taken to enter open arm to closed arm was measured.

Radial arm maze model:

Principle:

Working memory is analogous to recent memory in humans, which refers to a brain system that provides temporary storage and manipulation of the information necessary for such complex cognitive tasks as comprehension, learning and reasoning. This type of memory is more severely impaired than remote memory in human dementia; a radial arm maze is used to evaluate the working memory in animals [14].

Requirements:

Animals used in this study were 36 Wistar albino rat (either sex) Body weight 150 to 200 g. Chemicals used in this method were Citrate buffer, alloxan monohydrate, saline solution, leaves extract of *M. indica*, Piracetam. Apparatus and instruments used were digital weighing balance and Radial arm maze apparatus.

Procedure:

Albino rat of either sex having weight between 150 to 200 g and grouped as 6 animals each in 6 groups was selected. The group 1 animals treated as control group received saline solution (10 ml/kg. p.o.), group 2 animals treated as negative group received Scopolamine (0.4 mg/kg i.p.), group 3 animals treated as standard group received Piracetam (200 mg/kg, p.o.), group 4, 5 and 6 animals received test drug that is aqueous extract of *M. indica* AEMI at a dose of 200, 400 and 600 mg/kg, p.o. respectively. The specific marking was made on paw region of each rat with the picric acid for identification. Before the experiment animals was kept in radial arm maze for acclimatization for 7 days and they was housed in group of two rats in one cage under the standard condition like room temperature is 26 ± 2°C, relative humidity 45 to 55 % and light and dark cycle of 12 h. All animals were fed with standard diet and water is supplied ad libitum under hygiene conditions. The beginning of trial, a food pellet was placed in end of arms the trial animals was fasted overnight prior to test but water was supplied at libitum Overnight fasted rat was placed at central hub and allow choosing the arm freely to get the food pellet. The trial was considered to be complete when rat visits all eight arms. Observe the entry of rat in the arms is not previously visited was recorded as a correct response and re-entry was recorded as error. In trial the animal made no error and one error at the 8 choice was recorded as successful trial. The percentage of successful trial was calculated as the index of radial arm maze task performance. On 11th day, 60 min after the last dose, each rat was placed on central hub and tested again for successful trial. The index of radial arm maze task performance of rat before and after drug treatment was determined.

Estimation of acetyl cholinesterase activity:

Requirements:

Animals used in this study were 36 Wistar albino rat (either sex) Body weight 150 to 200 g. Chemicals used in this method were saline solution, M. indica leave extract, Piracetam, 0.05M phosphate buffer (pH 7.2), 5,5-dithiobis nitrobenzoic acid (DTNB), acetylcholine Chloride (10mm), formalin Solution [15].

Principle:

Acetylcholine is considered to be the most important transmitter involved in the regulation of cognitive functions such as learning and memory. ACHE inhibitors which enhance the availability of acetylcholine in the synaptic cleft. There are extensive evidences are present in the decrease of ACHE enhancement of memory. In this study, we used a photometric method to determine the ACHE quantity in the brain tissue. The enzyme activity is measured by following the increase of yellow produced from thiocholine when it reacts with dithiobis nitro benzoate ion [16]. The reaction is acetylthiocholine-thiocholine + acetate Thiocholine + dithiobis nitrobenzoic Yellow.

Procedure:

Albino rat of either sex having weight between 150 to 200 g and grouped as 6 animals each in 6 groups was selected [16]. The group 1 animals treated as control group received saline solution (10 ml/kg. p.o.), group 2 animals treated as negative group received Scopolamine (0.4 mg/kg i.p.), group 3 animals treated as standard group received Piracetam (200 mg/kg, p.o.), group 4, 5 and 6 animals received test drug that is aqueous extract

of *M. indica* AEMI at a dose of 200, 400 and 600 mg/kg, p.o. respectively. The specific marking was made on paw region of each rat with picric acid for identification. Before the experiment animals was kept in acclimatization for 7 days and housed in group of two rats in one cage under the standard condition like room temperature is 26 ±1 °C. Relative humidity 45 to 55 % and light and dark cycle of 12 h. All animals were fed with standard diet and water was supplied ad lithium under hygienic conditions. Dissection wistar rats (150 to 200 g body weight) are used for the experiment. The rats were sacrificed after 60 min of treatment with vehicle, Scopolamine, Piracetam, test drug: brains are removed quickly and placed in ice-cold saline. Frontal cortex, hippocampus and septum (and any other regions of interest) are quickly dissected out on a Petri dish chilled on crushed ice. The tissues was weighed and homogenized in 0.05M phosphate buffer (pH 7.2). 0.4ml aliquot of the homogenate is added to a cuvette containing 2.6 ml phosphate buffer and 100ul of DTNB. The contents of the cuvette were mixed thoroughly by bubbling air and absorbance is measured at 412 nm in a spectrophotometer. When the absorbance reaches a stable value, it is recorded as the basal reading. Acetylthiocholine iodide was added and change in absorbance is recorded for a period of 10 min at intervals of 2 min. Change in the absorbance per minute is determined. The mean change in absorbance was considered for calculation and acetyl cholinesterase activity is measured as M/U/min/gm of tissue. The Level of acetyl cholinesterase was measured.

RESULTS:

Effect of Aqueous Extract of *Mangifera Indica* on Transfer latency and memory retention by using elevated plus maze:

Negative group compared with control group only showed significant increase ($p<0.001$) in transfer latencies. Animal treated with standard (piracetam 200 mg/kg) showed significant decrease ($p<0.001$) in transfer latencies as compared to negative group. Animal treated with AEMI (200 mg/kg) showed significant decrease ($p<0.001$) in transfer latencies as compared to negative group. Animal treated with AEMI (400 mg/kg) showed significant decrease ($p<0.001$) in transfer latencies as compared to negative group. Animal treated with AEMI (600 mg/kg) showed significant decrease ($p<0.001$) in transfer latencies as compared to negative group. Animal treated with AEMI (200 mg/kg) showed significant decrease ($p<0.001$) in time taken to reach reward arm as compared to positive group (piracetam 200 mg/kg). Animal treated with AEMI (400 mg/kg) showed significant decrease ($p<0.001$) in time taken to reach reward arm as compared to positive group (piracetam 200 mg/kg). Animal treated with AEMI (600 mg/kg) showed significant decrease ($p<0.001$) in time taken to reach reward arm as compared to positive group (piracetam 200 mg/kg). The result of effect of aqueous extract of *M. indica* on Transfer latency and memory retention by using elevated plus maze is presented in Table 1 and Fig 1 and 2.

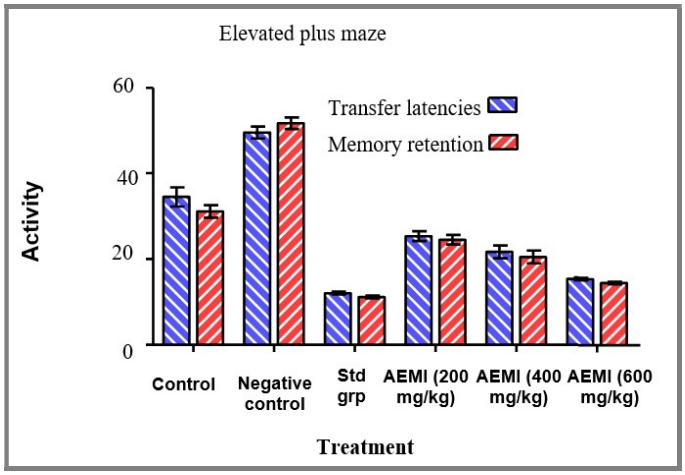

Fig 1. Effect on transfer latency and memory retention in scopolamine induced dementia in rats (paired t test).

All values are presented as mean ± sem. Analysis was performed using paired t-test.

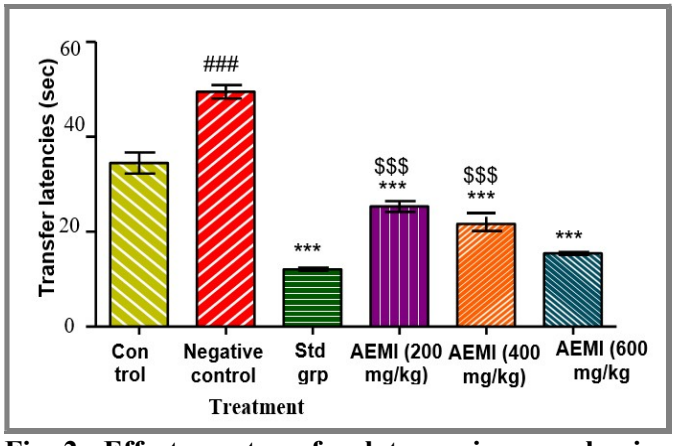

Fig 2. Effect on transfer latency in scopolamine induced dementia in rats.

All values are presented as mean ± sem. Analysis was performed using one way ANOVA followed by Bonferroni multiple comparison posttest. # indicates comparison with control group. * indicate comparison of negative group. $ indicate comparison with positive control. #/*/$ indicate p<0.05, ##//$$ indicate p<0.01 and ###/***/$$$ indicate p<0.001.**

Table 1. Effect of Aqueous Extract of *Mangifera Indica* Transfer latency and memory retention by using elevated plus maze.

Group	Treatment	After treatment 7th day	
		Transfer latencies (sec)	Memory retention (sec)
1	Control	34.40 ± 2.2421	30.12 ± 1.4450
2	Negative control	47.40 ± 1.4230 ###	54.57 ± 1.4340 ###
3	Standard group	13.12 ± 0.2320 ***	13.17 ± 0.2320 ***
4	AEMI (200 mg/kg)	24.36 ± 1.2150 *** $$$	23.50 ± 1.1250 *** $$$
5	AEMI (400 mg/kg)	23.67 ± 1.5890 *** $$$	22.50 ± 1.5690 *** $$$
6	AEMI (600 mg/kg)	17.43 ± 0.3136 ***	15.50 ± 0.3059 ***

All values are presented as mean ± sem. Analysis was performed using one way ANOVA followed by Bonferroni multiple comparison posttest. # indicates comparison with control group. * indicate comparison of negative group. $ indicate comparison with positive control. #/*/$ indicate p<0.05, ##//$$ indicate p<0.01 and ###/***/$$$indicate p<0.001.**

Effect on Memory retention in scopolamine induced dementia in rats:

Negative group compared with control group only showed significant increase (p<0.001) in transfer latencies. Animal treated with standard (piracetam 200 mg/kg) showed significant decrease (p<0.001) in transfer latencies as compared to negative group. Animal treated with AEMI (200 mg/kg) showed significant decrease (p<0.001) in transfer latencies as compared to negative group. Animal treated with AEMI (400 mg/kg) showed significant decrease (p<0.001) in transfer latencies as compared to negative group.

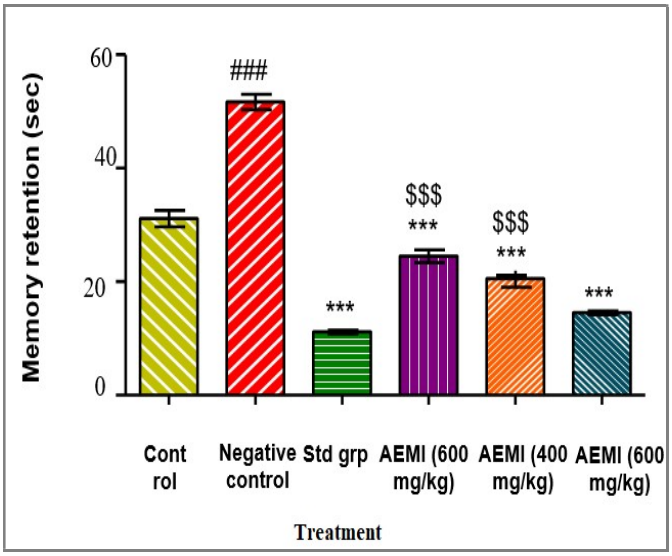

Fig 3. Effect on Memory retention in scopolamine induced dementia in rats.

All values are presented as mean ± sem. Analysis was performed using one way ANOVA followed by Bonferroni multiple comparison posttest. # indicate comparison with control group. * indicate comparison of negative group. $ indicate comparison with positive control. #/*/$ indicate p<0.05, ##//$$ indicate p<0.01 and ###/***/$$$indicate p<0.001.**

Animal treated with AEMI (600 mg/kg) showed significant decrease (p<0.001) in transfer latencies as compared to negative group. Animal treated with AEMI (200 mg/kg) showed significant decrease (p<0.001) in time taken to reach reward arm as compared to positive group (piracetam 200 mg/kg). Animal treated with AEMI (400 mg/kg) showed significant decrease (p<0.001) in time taken to reach reward arm as compared to positive group (piracetam 200 mg/kg). Animal treated with AEMI (600 mg/kg) showed significant decrease (p<0.001) in time taken to reach reward arm as compared to positive group (piracetam 200 mg/kg). The data is given in Fig 3.

Effect of *Mangifera indica* on time taken to reach reward arm (sec) by using radial arm maze:

***Interpretation*:**

The data is presented in Table 2 and Fig 4. Negative group compared with control group only showed significant increase (p<0.001) in memory retention. Animal treated with standard (piracetam 200 mg/kg) showed significant decrease (p<0.001) in memory retention as compared to negative group. Animal treated with AEMI (200 mg/kg) showed significant decrease (p<0.001) in memory retention as compared to negative group. Animal treated with AEMI (400 mg/kg) showed significant decrease (p<0.001) in memory retention as compared to negative group. Animal treated with AEMI (600 mg/kg) showed significant decrease (p<0.001) in memory retention as compared to negative group. Animal treated with AEMI (200 mg/kg) showed significant decrease (p<0.001) in time taken to reach reward arm as compared to positive group (piracetam 200 mg/kg). taken to reach reward arm as compared to positive group (piracetam 200 mg/kg).

Table 2. Effect of *Mangifera Indica* on time taken to reach reward arm (sec) by using radial arm maze.

Group no	Group	Average Time taken to reach reward arm (sec)	
		Before Scopolamine	After Scopolamine
1	Normal Control	176.7 ± 1.4880	169.6 ± 1.4880
2	Negative control	175.3 ± 1.6780 ###	323.5 ± 1.7990 ###
3	Standard group	134.4 ± 0.6878 ***	147.5 ± 0.6719 ***
4	AEMI (200 mg/kg)	171.6 ± 1.4810 *** $$$	181.0 ± 1.5110 *** $$$
5	AEMI (400 mg/kg)	138.4 ± 1.1980 *** $$$	171.9 ± 1.1890 *** $$$
6	AEMI (600 mg/kg)	139.0 ± 0.7836 *** $$$	129.7 ± 0.8816 *** $$$

All values are presented as mean ± sem. Analysis was performed using one way ANOVA followed by Bonferroni multiple comparison post test. # indicates comparison with control group. * indicate comparison of negative group. $ indicate comparison with positive control. #/*/$ indicate p<0.05, ##//$$ indicate p<0.01 and ###/***/$$$indicate p<0.001.**

Animal treated with AEMI (400 mg/kg) showed significant decrease (p<0.001) in time taken to reach reward arm as compared to positive group (piracetam 200 mg/kg). Animal treated with AEMI (600 mg/kg) showed significant decrease (p<0.001) in time taken to reach reward arm as compared to positive group (piracetam 200 mg/kg).

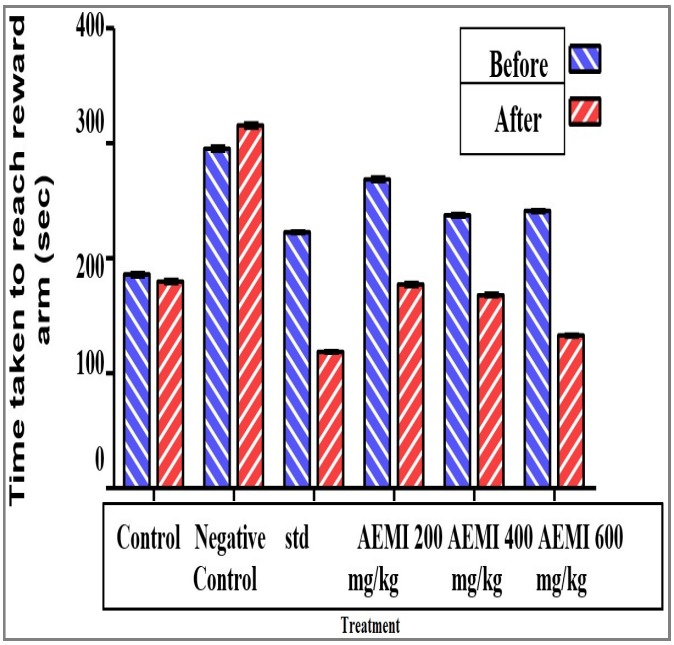

Fig 4. Effect of Mangifera Indica on time taken to reach reward arm (s) by using radial arm maze.
All values are presented as mean ± sem. Analysis was performed using paired t-test.

Radial arm Model (Before Drug Treatment):

The data is given in Fig 5 and 6. Negative group compared with control group only showed significant increase (p<0.001) in time taken to reach reward arm. Animal treated with standard (piracetam 200 mg/kg) showed significant decrease (p<0.001) in time taken to reach reward arm as compared to negative group.

Animal treated with AEMI (200 mg/kg) showed significant decrease (p<0.001) in time taken to reach reward arm as compared to negative group. Animal treated with AEMI (400 mg/kg) showed significant

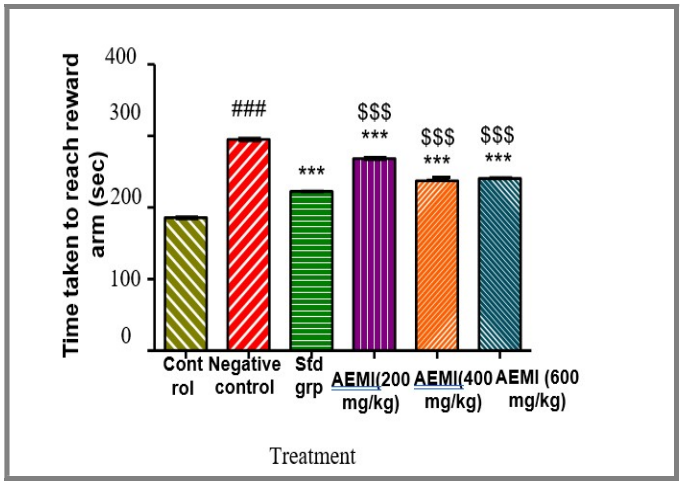

Fig 5. Effect of Mangifera Indica on time taken to reach reward arm (sec) by using radial arm maze.
All values are presented as mean ± sem. Analysis was performed using one way ANOVA followed by Bonferroni multiple comparision posttest. # indicate comparision with control group. * indicate comparision of negative group. $ indicate comparision with positive control. #/*/$ indicate p<0.05, ##//$$ indicate p<0.01 and ###/***/$$$indicate p<0.001.**

decrease (p<0.001) in time taken to reach reward arm as compared to negative group. Animal treated with AEMI (600 mg/kg) showed significant decrease (p<0.001) in time taken to reach reward arm as compared to negative group. Animal treated with AEMI (200 mg/kg) showed significant decrease (p<0.001) in time taken to reach reward arm as compared to positive group (piracetam 200 mg/kg). Animal treated with AEMI (400 mg/kg) showed significant decrease (p<0.001) in time taken to reach reward arm as compared to positive group (piracetam 200 mg/kg). Animal treated with AEMI (600 mg/kg) showed significant decrease (p<0.001) in time taken to reach reward arm as compared to positive group (piracetam 200 mg/kg).

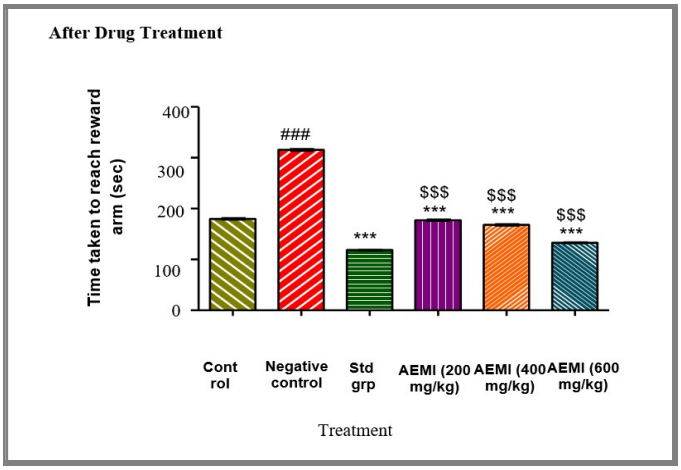

Fig 6. Effect of Mangifera Indica on time taken to reach reward arm (s) by using radial arm maze.

All values are presented as mean ± sem. Analysis was performed using one way ANOVA followed by Bonferroni multiple comparision posttest. # indicates comparision with control group. * indicate comparision of negative group. $ indicate comparision with positive control. #/*/$ indicate p<0.05, ##//$$ indicate p<0.01 and ###/***/$$$indicate p<0.001.**

Effect of *Mangifera Indica* on Acetyl cholinesterase activity:

The data is given in Table 3 and Fig 7. Negative group compared with control group only showed significant increase (p<0.01) in Ache level. Animal treated with standard (Piracetam 200 mg/kg) showed significant decrease (p<0.01) in Ache level as compared to negative group.

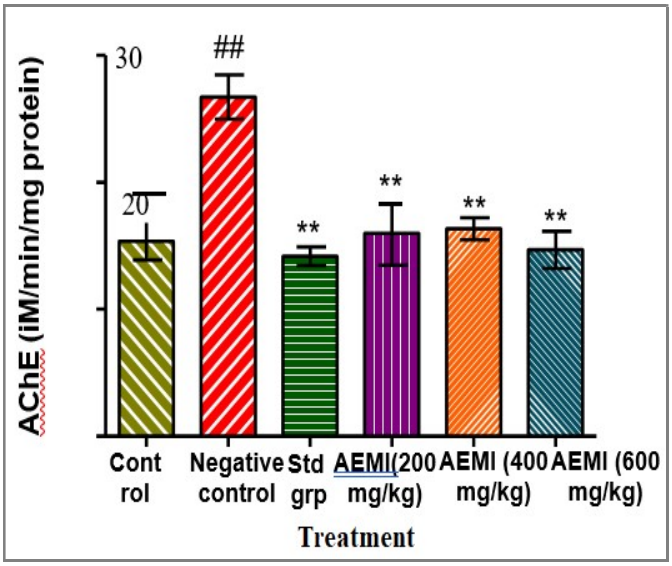

Fig 7. Effect of Mangifera Indica on acetyl cholinesterase activity.

All values are presented as mean ± sem. Analysis was performed using one way ANOVA followed by Bonferroni multiple comparison posttest. # indicates comparison with control group. * indicate comparison of negative group. #/* indicate p<0.05, ##/ indicate p<0.01.**

Animal treated with AEMI (200 mg/kg) showed significant decrease (p<0.01) in Ache level as compared to negative group. Animal treated with AEMI (400 mg/kg) showed significant decrease (p<0.01) in Ache level as compared to negative group. Animal treated with AEMI (600 mg/kg) showed significant decrease (p<0.01) in Ache level as compared to negative group.

DISCUSSIONS:

The concept and definition of a "nootropic drug" was first proposed in 1972 by C E Guirgea and coined the term "nootropic" from the italic words "noos" (mind) and "tropein" (to turn toward), to mean enhancement of memory. Typically nootropics are thought to work by increasing the brain's supply of neurochemicals (neurotransmitters, enzymes and hormones) improving brain oxygen supply or by stimulating nerve growth.

ACh as a neurotransmitter primarily involved in learning and memory, ACh is a neurotransmitter that has long received much attention in memory research. Although the effects of ACh on memory have to be regarded separately for the acquisition, consolidation, and recall phase and for different memory systems, it remains a fact that ACh acts on cholinergic receptors that are widely distributed throughout in the brain. Cholinergic antagonism is reported to produce cognition deficit which imitates Alzheimer's disease similar to hippocampal lesion-induced cognitive deficits.

Several studies have now established the association of neuronal oxidative stress with Alzheimer disease (AD). This stress is manifested by damage to proteins, lipids, and nucleic acids, i.e. nuclear and mitochondrial DNA as well as RNA. Apolipoprotein E (Apo E) 4 allele (corresponding protein, ApoE4), a major risk factor for AD, is associated with oxidative damage in brain tissue of cases of AD. Studies support an important role for Aß in oxidative balance; some of them argue AB is the cause while others argue AB is the result of oxidative stress.

Scopolamine, an anti-muscarinic agent, competitively antagonizes the effect of acetylcholine on the muscarinic receptors by occupying postsynaptic receptor sites with affinity and increases ACE activity in the cortex and hippocampus. Scopolamine also interferes with memory and cognition function in humans and experimental animals by blocking muscarinic receptors and produce transient memory deficit. Scopolamine diminishes cerebral blood flow due to cholinergic hypo function. Scopolamine additionally triggers ROS, inducing free

radical injury and an increase in a scopolamine-treated group brain MDA levels and deterioration in antioxidant status. Scopolamine induces neuro- inflammation by promoting high level of oxidative stress and pro inflammatory cytokines the hippocampus. Scopolamine is proven to increase levels of APP and Tau. Administration of scopolamine led to marked histopathological alterations in the cerebral cortex, including neuronal degeneration.

Table 3. Effect of *Mangifera Indica* on acetyl cholinesterase activity

Group no	Group	Acetylcholinesterase level (µM/L/min/mg Protein)
1	Control	16.36 ± 1.550
2	Negative control	25.72 ± 1.757 ##
3	Standard group	15.19 ± 0.7532 **
4	AEMI (200 mg/kg)	14.98 ± 2.511 **
5	AEMI (400 mg/kg)	15.33 ± 0.8849 **
6	AEMI (600 mg/kg)	15.68 ± 1.516 **

All values are presented as mean ± sem. Analysis was performed using one way ANOVA followed by Bonferroni multiple comparison posttest. # indicates comparison with control group. * indicate comparison of negative group. #/* indicate p<0.05, ##/ indicate p<0.01.**

CONCLUSION:

In the conclusion, presence study suggested that *Mangifera Indica Leaves* selected for evaluation of nootropic activity. *Mangifera indica Leaves Extract* at dose 200, 400 and 600 mg/kg was administered orally for 7 days, which have improved learning and memory of rat significantly in the elevated plus maze model. In radial arm maze model *Mangifera indica Leaves Extract* possess nootropic activity by decreasing the time taken to reach reward arm (sec).In present study of *Mangifera indica Leaves Extract* inhibited acetyl cholinesterase enzyme, there by elevating acetylcholine concentration in the brain. Thus, present data indicates that *Mangifera indica* is to be a safe Neuroprotective, memory enhancer effect and could be used as a part of therapy to treat dementia.

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REFERENCES:

1. Figueiredo CP, Clarke JR, Ledo JH, Ribeiro FC, Costa CV, Melo HM, *et al*. Memantine Rescues Transient Cognitive Impairment Caused by High-Molecular-Weight Aβ Oligomers But Not the Persistent Impairment Induced by Low-Molecular-Weight Oligomers. J. Neurosci, 2013; 33: 9626–9634.
2. Jain KK. Evaluation of memantine for neuroprotection in dementia. Expert Opin Investig Drugs, 2000; 9: 1397-1406.
3. Ashford JW. APOE genotype effects on alzheimer's disease onset and epidemiology. J Mol Neurosci, 2004; 23: 157-165.
4. Povova J, Ambroz P, Bar M, Pavukova V, Sery O, Tomaskova H, *et al*. Epidemiological of and risk factors for Alzheimer's disease: A review. Biomed Pap, 2012; 156: 108-114.
5. Hendrie HC. Epidemiology of Dementia and Alzheimer's Disease. Am J Geriatr Psychiatry, 1998; 6: S3-S18.
6. Sahoo SK, Sahoo HB, Priyadarshini D, Soundarya G, Rani KU. Antiulcer Activity of Ethanolic Extract of *Salvadora indica* (W.) Leaves on Albino Rats. J Clin Diagn Res, 2016; 10(9): FF07–FF10.
7. Sahoo AK, Dandapat J, Dash UC, Kanhar S. Features and outcomes of drugs for combination therapy as multi-targets strategy to combat Alzheimer's disease. J Ethnopharmacol, 2018; 215: 42-73.
8. Cavalcante Y, Goulart F, Sela VR, Obici S, Vanessa J, Martins C, *et al*. Evaluation of Gastric Anti-ulcer Activity in a Hydro- ethanolic Extract from *Kielmeyera coriacea*. Braz Arch Biol Technol, 2005; 48(2): 211-216.
9. Rajinikanth PS, Mishra B. Floating in situ gelling system of acetohydroxamic acid for clearance of *H. pylori*. Drug Dev Ind Pharm, 2008; 34: 577-587.
10. Sharma SR, Dwivedi SK, Swarup D. Hypoglycaemic Potential of *Mangifera indica* Leaves in Rats. Int J Pharmacogn, 1997; 35: 130-133.
11. Rodgers RJ, Dalvi A. Anxiety, defence and the elevated plus-maze. Neurosci Biobehav Rev, 1997; 21: 801-810.
12. Robertson S, Gray GA, Duffin R, McLean SG,

Shaw CA, Hadoke PWF, *et al*. Diesel exhaust particulate induces pulmonary and systemic inflammation in rats without impairing endothelial function *ex vivo* or *in vivo*. Part Fibre Toxicol, 2012; 9: 9-21.

13. Wenk GL. Assessment of Spatial Memory Using the Radial Arm Maze and Morris Water Maze. Curr Protoc Neurosci, 2004; 26:8.5A.1-8.5A.12.
14. J.S. Torrecilla, J. García, E. Rojo, F. Rodríguez, Estimation of toxicity of ionic liquids in Leukemia Rat Cell Line and Acetylcholinesterase enzyme by principal component analysis, neural networks and multiple lineal regressions, J. Hazard. Mater. 164 (2009) 182–194. https://doi.org/https://doi.org/10.1016/j.jhazmat.2008.08.022.
15. Pickering CE, Pickering RG. Methods for the estimation of acetylcholinesterase activity in the plasma and brain of laboratory animals given carbamates or organophosphorus compounds. Arch Toxikol, 1971; 27: 292-310.
16. Velázquez-Libera JL, Caballero J, Toropova AP, Toropov AA. Estimation of 2D autocorrelation descriptors and 2D Monte Carlo descriptors as a tool to build up predictive models for acetylcholinesterase (AChE) inhibitory activity. Chemom Intell Lab Syst, 2019; 184: 14-21.

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