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Research Article

A STUDY ON NOOTROPIC ACTIVITY OF *CELASTRUS PANICULATA WILLD* WHOLE PLANT METHANOLIC EXTRACT IN RATS

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ABSTRACT

Objective: The objective of the present study was to evaluate the nootropic activity of *Celastrus paniculata Willd* whole plant methanolic extract (CPPME) using different models.

Methods: Nootropic activity in rats with the treatment of CPPME (100, 200, 400 mg/kg, oral.) and piracetam (200 mg/kg, i.p.) were administered to different groups of rats. Effect of drugs on learning and memory of rats was evaluated using elevated plus maze, morris water maze on scopolamine, and aluminum-induced amnesia models, and also estimated the brain acetylcholinesterase (AChE) concentration and the percentage of inhibition of AChE.

Results: CPPME shows significantly improved in learning and memory of rats, as indicated by the decline in transfer latency using elevated plus maze and also decrease in escape latency during training and retrieval using morris water maze. Memory-enhancing activity of CPPME (100, 200, 400 mg/kg, oral.) was comparable to piracetam (200 mg/kg, i.p.). CPPME, Mentat (Nootropic Herbal formulation), and piracetam also notably reduced brain AChE concentration and increased the percentage of inhibition of AChE activity in rat brain.

Conclusion: Thus, CPPME showed nootropic activity in rats probably by inhibiting brain AChE activity.

Keywords: Nootropic activity, *Celastrus paniculata Willd* whole plant, Methanolic extract, Scopolamine-induced amnesia, Aluminum-induced amnesia, Spatial memory in Morris water maze test and acetylcholinesterase enzyme.

INTRODUCTION

Celastrus paniculatus Wild (Celastraceae) is a woody liana, popularly known as "Jyotishmati." The Indian medicine in different regions of India has claimed the use of *C. paniculatus* in the treatment of wide range of disorders [1]. The seed oil of Jyotishmati is used as brain tonic due to its beneficial effect on memory and intellect [2].

The most important chemical constituents of *Celastrus paniculata* Willd whole plant methanolic extract (CPPME) are alkaloids, tannins, flavonoids, glycosides, phytosterols, triterpenoids, proteins, amino acids [3], sesquiterpenes, alkaloids celastrine, celapanine, celapanigine, celapagine [4], poly alcohol (malangunin, malkanginnol, malkanguniol, and paniculatusdiol) [5]. It contains triterpenoid pristimerin [6] and sterols (β-amyrin and β-sitosterol), sesquiterpeniod polyol esters have also been isolated from *C. paniculatus* [7].

Different parts of *C. paniculatus* have been evaluated for various pharmacological activities. Leaves of the plant have shown the wound healing activity [8] *C. paniculatus* seeds were found to have hypolipidemic [9] and antioxidant activity [10]. The seed oil of plant reversed the scopolamine (SCP) -induced deficits in navigational memory performance [11]. Seeds also showed potent relaxant effect on ileum [12]. Biogenic amines were found to be decreased in rats after treatment with *C. paniculatus* seed oil [13]. Extract of the whole plant of *C. paniculatus* has anti-epileptic activity [14].

Alzheimer's disease (AD) is a neurodegenerative disorder, and it is an age-related disease is characterized by a range of anatomical and functional changes in the brain. It is the most common form of dementia and affects more than 6% of people older than 65 years [15]. The loss of cholinergic neurons, predominantly in the basal forebrain, is accompanied by loss of the neurotransmitter acetylcholine. A decrease in brain acetylcholine (ACh) level appears to be a critical element in producing dementia in AD patients [16]. The current therapeutic approach is mainly based on inhibiting the acetylcholinesterase (AChE) enzyme which includes donepezil, galantamine, rivastigmine, and memantine [17].

Although, several drawbacks which limit these drugs to be rationale drug candidates in the therapeutics of AD have limited efficacy, poor bioavailability, adverse cholinergic side effects in the periphery, narrow therapeutic ranges and hepatotoxicity [15].

The Indian system of medicine emphasizes use of herbs, nutraceuticals of lifestyle changes for controlling age-related neurodegenerative disorders [18]. In the present study, we investigated the nootropic activity of *C. paniculatus* wild, the whole plant methanolic extract was selected. Flavonoids are the largest group of polyphenols present in many plants which are known to promote a number of physiological benefits, especially in scavenging free radicals, cognitive impairment, learning, and memory [19].

Thus, to accomplish the above prospective, the primary objective of the present study was to investigate nootropic effect of CPPME in SCP-induced amnesia, aluminum-induced amnesia, spatial memory learning, and estimation of acetylcholinesterase (AChE) in rat brain. Thus, SCP-induced amnesia models widely used to probe drugs attenuating cognitive deficits [16].

METHODS

Animals

Albino rats (150-175 gms) of both the sex were utilized in this study. Animals were maintained under standard laboratory conditions with alternating light and dark cycles of 12 hrs and provided food and water. The rats were fed with pellet diet and were acclimatize to laboratory conditions for 7 days prior to the experiment. The animals were housed in groups each group of six rats and were maintained under standard conditions. Rats were fasted 12 hrs prior to drug administration and

during the experiment. All experiments were carried out during the light period (08:00-16:00 hrs). The experimental protocol was approved by the Institutional Animals Ethics Committee (IAEC No. IAEC/SVCP/2012/001) and which is registered under the Committee for the Purpose of Control and Supervision on Experiments on Animals, India.

Drugs/chemicals

Piracetam (Intas Pharmaceuticals Limited, India), SCP butyl bromide (German remedies, Mumbai), aluminum chloride (sarabhai chemicals ltd), acetylthiocholine iodide (ATCI), AChE from bovine erythrocytes, 5,5′-dithiobis [2-nitrobenzoic acid] (DTNB), and galantamine were obtained from Sigma Ltd (Mumbai, India) and methanol and all other chemicals and reagents used in the experiments were of analytical grade were used in this study.

Preparation of extracts

Methanol is used for the extraction process because almost all the components of *C. paniculatus* wild whole plant are soluble in methanol solvent. *C. paniculatus* wild whole plant were dried in shadow and grounded with the help of an electrical grinder to get a free flowing powder. This powder was subjected to extraction with dehydrated alcohol at room temperature. The extract obtained was filtered through Whatman filter paper and dried at 40-50°C temperature for 24 hrs using soxhlet which was taken for the study.

Pharmacological screening

SCP-induced amnesia on elevates plus maze

Group I: Control (vehicle used 2% gum acacia suspension)
Group II: SCP (0.5 mg/kg)
Group III: SCP (0.5 mg/kg) + piracetam (200 mg/kg)
Group IV: SCP (0.5 mg/kg) + CPPME (100 mg/kg)
Group V: SCP (0.5 mg/kg) + CPPME (200 mg/kg)
Group VI: SCP (0.5 mg/kg) + CPPME (400 mg/kg).

All the extracts were administered orally, but SCP and piracetam were given intra peritoneally. The rats were placed individually at the end of the open arm facing away from the center of the maze and at the time the rat took to move from open arm to either of the enclosed arms (transfer latency [TL]) was recorded. On before administration of extracts and drugs, the rats were allowed to explore the plus maze for 20 seconds for trial. On the day, one after administration of SCP 30 minutes after extracts were administered and TL was recorded. Extracts were administered continuously for 7 days. TL recorded on the 1st day and 7th day. Retention or retrieval memory without extracts and drugs were recorded 24 hrs later (8th day). The mean ± standard error of mean (SEM) was calculated and the values pasted on tables and graphically represented. Results analyzed by one-way ANOVAs followed by Dunnett's test.

Aluminum-induced amnesia

Rats were randomly distributed into 6 groups each containing 6 animals. Group I served as control and received only 2% gum acacia suspension, Group II was treated only with aluminum chloride (Alcl3), Group III received Alcl3 along with piracetam 200 mg/kg serves as standard, and Groups IV, V, and VI received CPPME 100 mg/kg, 200 mg/kg, and 400 mg/kg body weight, respectively, along with Alcl3.

Rats were administered aluminum chloride dissolved in distilled water (40 mg/kg) administered once daily orally for a period of 40-day. From day 21 of aluminum treatment, the drugs were administered once daily to different groups. Plant extracts administered orally to all the groups.

Rats were subjected to elevated plus maze on the 40th day and 24 hrs later 41st day. The mean ± SEM was calculated, and values are placed on tables and graphically represented too as on acquisition and retrieval memory. Results were analyzed using one-way ANOVA followed by Dunnett's test.

Spatial memory in Morris water maze task

Rats were randomly distributed in 6 groups as follows.
Group I: Control (vehicle used 2% gum acacia suspension)
Group II: SCP (0.5 mg/kg)
Group III: SCP (0.5 mg/kg) + piracetam (200 mg/kg)
Group IV: SCP (0.5 mg/kg) + CPPME (100 mg/kg)
Group V: SCP (0.5 mg/kg) + CPPME (200 mg/kg)
Group VI: SCP (0.5 mg/kg) + CPPME (400 mg/kg).

Apparatus

The Morris water maze consists of the large circular tank made of black opaque PVC or hardboard coated with fiberglass and resin and then surface painted white (1.8-2.0 m in diameter and 0.4-0.6 m height). The pool is filled with water (20-22°C) to a depth of 0.3-0.4 m and rendered opaque by the addition of small quantity of milk or non-toxic white. The pool is fixed with filling and draining facilities and mounted on a frame so that the water is at waist level.

The floor of the circular tank is marked off into four equal quadrants arbitrarily designed north, south, east, or west. In addition, the platform is made of plexiglass with a 13 cm^2 platform attached to a 34 cm long clear plexiglass cylindrical pedestal (3 cm. diameter) mounted on a 1 m^2 (5 mm thick) plexiglass base. The top of the platform is covered with a coarse material that provides a good grip for the rat when climbing on a platform. For the hidden platform task, water is added to the circular tank to a level 2 cm above the top of the platform. Water maze represents a versatile tool in which a number of distinct tasks can be measured. The simplest measure of performance is the latency to escape from the water onto the hidden platform.

The platform remains fixed in the position during the training session. Each animal is subjected to four consecutive trials for 4 days during which they are allowed to escape onto the hidden platform and allowed to remain there for 20 seconds. Escape latency time (ELT) to locate the hidden platform in water maze is noted as an index of acquisition or learning. In case the animal is unable to locate the hidden platform within 20 seconds, it is gently guided by hand to the platform and allowed to remain there for 20 seconds. After the trial session, SCP and extracts were administered with 30 minutes of difference and subjected to the task. The task was continued for every day up to 7 days. On the 8th day without administration of drugs and extracts, the platform is removed and time spent by each animal in target quadrant searching for the hidden platform is noted as an index of retrieval and measured [20].

Estimation of brain AChE

Rats were randomly distributed in 6 groups and each group of 6 rats for the estimation of AChE and percentage of inhibition of AChE.
Group I: Control (vehicle used 2% gum acacia suspension)
Group II: Piracetam (200 mg/kg) - standard
Group III: Mentat (herbal formulation) (200 mg/kg) - standard
Group IV: CPPME (100 mg/kg)
Group V: CPPME (200 mg/kg)
Group VI: CPPME (400 mg/kg).

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 dithiobisnitro benzoate ion.

The reaction is acetylthiocholine → thiocholine + acetate

Thiocholine + dithiobisnitrobenzoate → yellow

The initial reaction is performed in the presence of AChE enzyme.

The drugs and extracts treatment is continued for selected groups for 7 days.

On the 8th day, animals were euthanized by cervical dislocation carefully to avoid any injury to tissues. The whole brain AChE activity was measured using the Ellman's method. Ellman's reagent 5, 5-dithiobis (2-nitrobenzoate) is commonly known as DTNB. The end point was the formation of the yellow because of the reaction of thiocholine with dithiobisnitrobenzoate ions. The rate of formation of thiocholine from acetylcholine iodide in the presence of tissue cholinesterase was measured using a spectrophotometer. The resulting yellow is due to the reduction of DTNB by certain substances in the brain homogenate and due to non-enzymatic hydrolysis of substrate. After having calibrated the instrument, change in absorbance per min of the sample was read at 420 nm [21].

$$\text{Rate} = \frac{\text{Change in the absorbance/ min}}{\text{Co}} \times (5.74 \times 10 - 4)$$

Where,
Rate = Moles substrate hydrolyzed per min per gram of tissue
C_0 = Original concentration of brain tissue (mg/ml)

Procedure

In-vivo determination of Acetylcholinesterase quantity performed by homogentation of the rat brain. Before sacrificing the animals extracts treated about 7 days. The whole brain taken out on the 8th day and homogenized in the tissued homogenizer (Approximately 20 mg of tissue per ml of phosphate buffer at PH 7.2). A 0.4 ml of this homogenate was added to a cuvette containing 2.6 ml of phosphate buffer. To this 100 µl of Ellman's reagent added and then substrate (Acetylthiocholine iodide) added and absorbance measured at 412 nm.

RESULTS

TL in SCP-induced amnesia on elevates plus maze

Results were presented in Table 1 and Fig. 1. In this study, cholinergic antagonist SCP significantly increased the TL on the 1st (101.33±3.3 seconds) and 7th day (108±2.8 seconds), when compared to the control group but on the 8th day, SCP-induced TL was drastically decreased (61.33 seconds) when compared to the 1st day. This clearly indicates the learning behavior of rats on the 7th day. However, the nootropic agent, piracetam showed a significant reversal of SCP-induced deficits. CPPME significantly and dose-dependently decreased the TL on the 7th day. But even on the 8th day, extracts has shown the same degree of effect (decreased) on TL on elevated plus maze. On the 8th day, the effect of extract with two different doses was almost equal with the effect of the standard drug (Piracetam).

Aluminum-induced cognitive deficits in rats on elevated plus maze

Results were presented in Table 2 and Fig. 2. Aluminum chloride produced notably increased the transfer latency on the 40th day, but on the 41st day, aluminum chloride-induced transfer latency was slightly increased. This indicates no learning behavior of rats with aluminum chloride-induced cognitive deficits on the 41th day. However, the nootropic agent piracetam showed a significant reversal of Alcl3 -induced deficits. CPPME significantly ($p<0.05$) and dose-dependently reduced the TL on the 40th day. Effect of extract dose of 100 mg/kg, 200 mg/kg, and 400 mg/kg was similar with the effect of the standard drug. But even on the 41st day, the extract has shown more degree of effect on transfer latency on elevated plus maze when compared to the 40th day effect.

Morris water maze task

In the Morris water maze task, ELT was measured to assess spatial memory, and data was shown in Table 3 and Fig. 3. Before treatment session, the test was carried out on the day 1, and it shows that there was no significant difference in the ELT in all groups. But on day 5 CPPME treated group increase the spatial memory in a dose-dependent manner, with ELT at 100 mg/kg ($p<0.01$), 200 mg/kg ($p<0.01$), and 400 mg/kg ($p<0.01$) as compared to SCP rats. On the 8th day, CPPME treated groups also significantly reduced the ELT at 100 mg/kg ($p<0.01$), 200 mg/kg ($p<0.01$), and 400 mg/kg ($p<0.01$).

Estimation of acetylcholinesterase activity in rat brain

The control group had shown 10.48±0.22 µg/ml concentration of

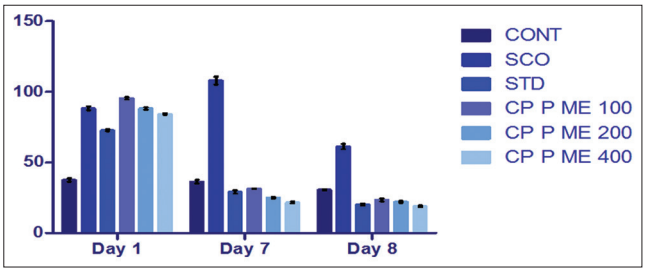

Fig. 1: Effect of *Celastrus paniculatus* wild, whole plant methanolic extract on transfer latency in scopolamine-induced amnesia on elevated plus maze

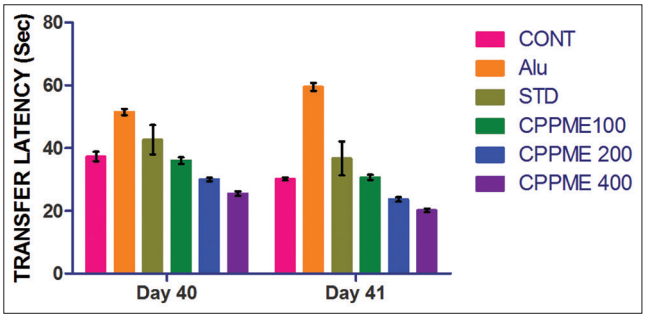

Fig. 2: Effect of *Celastrus paniculatus* wild, whole plant methanolic extract on transfer latency in aluminum-induced amnesia on elevated plus maze

Table 1: Effect of CPPME on TL in SCP -induced amnesia on elevated plus maze

Groups	Treatment	TL (seconds)		
		1st day	7th day	8th day
I	Control	37.66±1.2	36.33±1.3	30.66±0.42
II	SCP treated (0.5 mg/kg)	101.33±1.3	108.0±2.8	61.33±1.9
III	Standard (Piracetam) 200 mg/kg	32.83±0.7*	29.16±1.16**	22.33±0.66*
IV	CPPME 100 mg/kg	35.5±0.76ns	31.5±0.1ns	23.5±0.99ns
V	CPPME 200 mg/kg	28.33±0.8ns	25.0±0.5*	22.16±0.60*
VI	CPPME 400 mg/kg	26.23±0.78	21.23±0.6	20.2±0.53

SCP: Scopolamine, SEM: Standard error of mean, n=6 in each group. Data expressed in mean±SEM, statistical analysis by one-way ANOVA followed by Dunnett's test. Significance at *$p<0.05$, **$p<0.01$, ***$p<0.001$ and ns: Not significant versus SCP group and control group, CPPME: *Celastrus paniculatus* wild whole plant methanolic extract, TL: Transfer latency

AChE in the brain. Whereas piracetam 200 mg/kg, mentat 200 mg/kg, CPPME 100 mg/kg, CPPME 200 mg/kg, and CPPME 400 mg/kg showed decreased the AChE concentration as 8.72±0.229 µg/ml, 3.7±0.55 µg/ml, 10.51±0.46 µg/ml, 9.16±0.14 µg/ml, and 6.4±0.20 µg/ml, respectively.

There is increased in percentage of AChE inhibition with piracetam 200 mg/kg, mentat 200 mg/kg, CPPME 100 mg/kg, CPPME 200 mg/kg, and CPPME 400 mg/kg as 16.85%, 64.60%, 0.56%, 12.35%, and 50% with respect to control group.

DISCUSSION

In this study, we found the nootropic and neuroprotective effects of CPPME in SCP-induced amnesia model. Research findings obtained from the present work also elucidated the neurotrophic potential of flavonoids which will be advantageous particularly in neurodegenerative disorder like AD. Pre-treatment and treatment with CPPME demonstrated multifaceted effects such as decreasing AChE and enhanced neurotrophic activity and thus, ultimately improved spatial memory formation as compared to SCP group. Here, we speculated that therapeutic efficacy of CPPME is directly related to its action on cholinesterase activity. Nootropic, neuroprotective, and neurotrophic strategies would be a rational approach as it is not only delays the progression of neurodegeneration but also improves the disease condition.

Though several models for amnesia using pharmacological drugs are available, SCP-induced memory deficits and aluminum-induced memory deficits have been proposed to have symptomatological similarities with AD and related disorders. This research contemplates the nootropic effect of CPPME on SCP-induced memory deficit and Alcl3-induced cognitive deficits on elevated plus maze in rats.

Various studies describe that aluminum exposure is a risk factor for the development of AD in humans [22], and it has been detected in the senile plaques and neurofibrillary tangles of AD [23,24]. Neurotoxic effects of intra peritoneal administration of aluminum chloride to adult rats over a 40-day period and the treatment effects of methanolic extract of *C. paniculatus* wild whole plant on rats exposed to aluminum chloride (Alcl3).

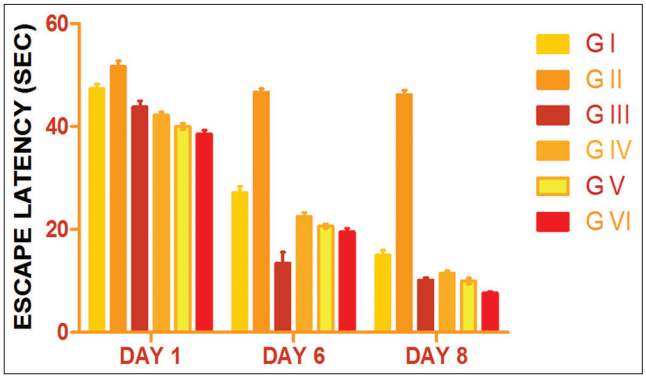

Fig. 3: Effect of *Celastrus paniculatus* wild, whole plant methanolic extract on spatial memory in Morris water maze task in rats

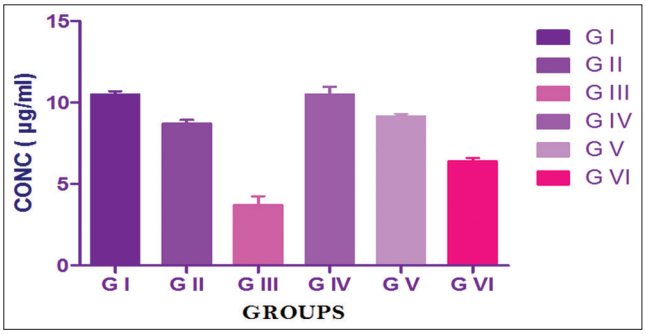

Fig. 4: Estimation of acetylcholinesterase in rat brain in *Celastrus paniculatus* wild whole plant methanolic extract [29]

Table 2: Effect of CPPME on TL in aluminum-induced amnesia on elevated plus maze

Groups	Treatment mg/kg	TL in second (mean±SEM)	
		40th day	41st day
I	Control	37.33±1.5	30.16±0.47
II	$AlCl_3$+vehicle	51.5±1.02	59.5±1.28
III	$AlCl_3$+STD	28.33±4.7*	29.0±5.4*
IV	$AlCl_3$+CPPME (100 mg/kg)	36±1.06	30.66±0.84
V	$AlCl_3$+CPPME (200 mg/kg)	30±0.57	23.66±0.71*
VI	$AlCl_3$+CPPME (400 mg/kg)	25.5±0.76**	20.16±0.54*

n=6 in each group. Data expressed in mean±SEM, statistical analysis by one-way ANOVA followed by Dunnett's test. Significance at *p<0.05, **p<0.01, ***p<0.001 and ns: Not significant versus control group, CPPME: Celastrus paniculatus wild whole plant methanolic extract, TL: Transfer latency, SEM: Standard error of mean

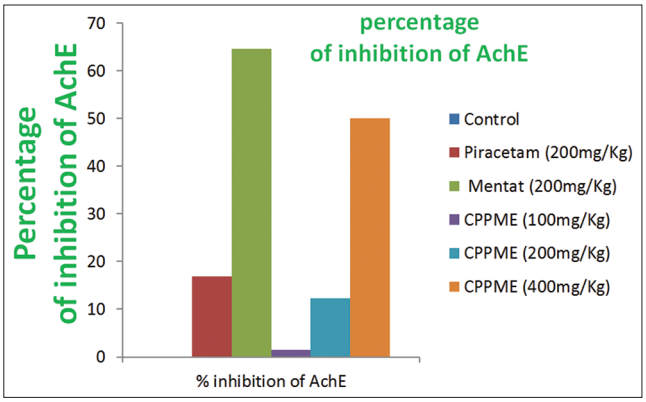

Fig. 5: Percentage of inhibition of acetylcholinesterase in rat brain in *Celastrus paniculatus* wild whole plant methanolic extract [29]

Table 3: Effect of CPPME on spatial memory in Morris water maze task in rats

Group	Treatment	Escape latency time (SEC) (mean±SEM)		
		Day 1	Day 6	Day 8
I	Control	47.33±0.88	27.16±1.16	15±0.96
II	SCP	51.66±1.08**	46.66±0.66**	46.16±0.87**
III	SCP+Piracetam 200 (mg/kg)	43.83±1.16**	13.42±2.14**	10.16±0.47**
IV	SCP+CPPME (100 mg/kg)	42.16±0.60**	22.5±0.76**	11.5±0.42**
V	SCP+CPPME (200 mg/kg)	40.0±0.57**	20.66±0.426**	10.0±0.55**
VI	SCP+CPPME (400 mg/kg)	38.5±0.76**	19.5±0.71**	7.66±0.31**

n=6 in each group. Data expressed in mean±SEM, statistical analysis by one-way ANOVA followed by Dunnett's test. Significance at *p<0.05, **p<0.01, ***p<0.001 and ns: Not significant versus SCP group and control group, CPPME: Celastrus paniculatus wild whole plant methanolic extract, TL: Transfer latency, SEM: Standard error of mean, SCP: Scopolamine

Table 4: Estimation of acetylcholinesterase in rat brain by CPPME [29].

Groups	Treatment	Concentration of AChE (µg/ml) mean±SEM	Percentage of inhibition of AChE (%)
I	Control	10.48±0.22	-
II	Piracetam (200 mg/kg)	8.72±0.229	16.85
III	Mentat (200 mg/kg)	3.7±0.55**	64.60
IV	CPPME (100 mg/kg)	10.51±0.46^{n}	0.56
V	CPPME (200 mg/kg)	9.16±0.14	12.35
VI	CPPME (400 mg/kg)	6.4±0.20**	50

n=6 in each group. Data expressed in mean±SEM, statistical analysis by one-way ANOVA followed by Dunnett's test. Significance at *p<0.05, **p<0.01, ***p<0.001 and ns: Not significant versus control group, CPPME: Celastrus paniculatus wild whole plant methanolic extract, TL: Transfer latency, SEM: Standard error of mean

In our study, we found the memory enhancing effect in rats treated with CPPME and it shows dose-dependently inhibited AChE enzyme in specific brain regions (prefrontal cortex, hippocampus, and hypothalamus). This clearly indicates that the mechanism involved in nootropic action of methanolic extract of *C. paniculatus* wild whole plant may be due to inhibition of AChE enzyme and hence elevation of acetylcholine levels which maintains the normal cognitive function in the brain.

Moreover, the Morris water maze is a behavioral procedure mostly used with rodents. It is widely used in behavioral neuroscience to study spatial learning memory [25]. The task is also used as a tool to study drug-abuse, neural systems, neurotransmitters, and brain development. This provides evidence that methanolic extract of the whole plant of *Celastrus paniculata* Willd enhanced the nootropic effect in rats.

In elevated plus maze, decrease in transfer latency time indicates the improvement of memory and *vice versa*. In Morris water maze, a decrease in escape latency during retrieval indicated an improvement of learning and memory, respectively. Thus, the memory enhancing the effect of *Celastrus paniculata* Willd whole plant of the methanolic extract is specific and not false positive.

Out of the three effective doses of methanolic extract of *Celastrus paniculata* Willd whole plant (100, 200 and 400 mg/kg, *oral.*) all doses produced better memory enhancing effect in rats ($p<0.01$) as compared to control group in both the behavioral models employed, hence the higher doses (200 mg/kg and 400 mg/kg) was employed for elucidating the probable mechanisms of memory enhancing activity.

Central cholinergic system plays a major role in the regulation of cognitive function [26]. Drugs that reduce cholinergic function such as muscarinic receptor antagonist SCP and neurotoxic substance like Alcl3 produce amnesia in laboratory animals. In the present study, SCP and aluminium significantly impaired memory of rats. Methanolic extract of *C. paniculatus* whole plant (200 mg/kg and 400 mg/kg) significantly reduced brain AChE concentration in rats as compared to the control group. This suggests that the memory enhancing the effect of CPPME might be due to inhibition of AChE, leading to increase in brain levels of acetylcholine. Acetylcholine is considered to be one of the important neurotransmitter involved in the regulation of cognitive functions. Cognitive dysfunction has been shown to be associated with impaired cholinergic transmission and the facilitation of central cholinergic transmission resulting in improved memory. Moreover, selective loss of cholinergic neurons in certain brain parts appeared to be a characteristic feature of senile dementia [27]. The degeneration and dysfunction of cortical cholinergic neurons are closely associated with cognitive deficits of AD [28]. Thus, the drugs which enhance cholinergic function can be used for the treatment of dementia closely related to AD. Whole plant methanolic extract of *C. paniculatus* wild showed memory enhancing activity in rat probably by inhibiting brain AChE activity.

CONCLUSION

It was concluded that whole plant methanolic extract of *Celastrus paniculatus* wild promising herb for the patients of AD and other cognitive deficit states.

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