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Anti-Radical and Neuroprotective Potential of *Ficus infectoria* in Scopolamine Induced Memory Impairment in Mice

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Abstract

Ficus infectoria has a wide distribution in Bangladesh, Nepal, Pakistan, Sri Lanka, Southwest China and Indochina and is an enrich source of phytochemicals thereby possess antibacterial, antifungal and hyperglycaemic activities. In this study, we attempted to examine the cognitive ability of methanolic and ethanolic extract of *F. infectoria* fruit extract in scopolamine induced memory impairment in mice by using preliminary phytochemical and antioxidant tests, and the cognitive ability of the methanolic and ethanolic fruit extract of *F. infectoria*. Fruit extract was analyzed in scopolamine amnesia mice using passive avoidance approach. Piracetam was used as a reference drug (200 mg/Kg). Further confirmation was provided by means of mice brain homogenate biochemical tests. Maximum phytochemical, antioxidant activity and nootropic ability were observed in the ethanolic fruit extract of *F. infectoria*. Plant extract was used at three doses *i.e.* 75 mg/Kg, 150 mg/Kg and 300 mg/Kg and exhibited nootropic abilities in all tests used. Enhanced SDL value *i.e.* (**291.2 ± 0.33$^{+++###}$**) was observed by the administration of plant extract at all dose range in comparison to reference drug *i.e.* piracetam (**252.8 ± 1.60$^{###}$**) used in the study. The plant extract utilization has showed increase in total protein (**25.08 ± 0.26$^{+++###}$** mg/g of tissue) and reduced glutathione content (**33.0 ± 0.46$^{+++###}$** nmoles/mg of protein) and vice versa while low malondialehyde (MDA) (**9.18 ± 0.17$^{+++###}$** nmoles/mg of protein) and AChE activity (**0.067 ± 0.009$^{+++###}$** M/min/g protein). However, opposite situation was observed in the scopolamine amnesia mice. Hence it was concluded the plant extract possessed neuroprotective activity in the scopolamine induced cognitive decline in mice thereby used as cost effective natural medicines in near future.

Keywords

Antioxidant, Malondialdehyde, Reduced Glutathione, Acetylcholinestrase, Scopolamine Hydrobromide, Neuroprotective, Antioxidant, *Ficus infectoria*

1. Introduction

Over accumulation of free radicals lead to Oxidative stress which is responsible for all the cognitive disorders like Dementia and Alzheimer disease (AD) [1]. AD reflects about 70% of all the dementia cases which are quite common in the people of elder age groups [2]. Moreover more than 115 million people will be affected by this disease by 2050 as reported by literature survey [3].

Till now no sufficient data was available for the treatment of AD and the drugs currently available in the market have impose serious health issues so there is a dire need to look for the medicinal plants that possessed a significant role in curing cognitive disorders which occur as a result of free radicals accumulation [4] [5].

According to the clear verifiable scientific reference it was observed that *Ficus* was a relatively ancient genus being at least 60 million years old and possibly as old as 80 million years [6]. Ethnobotanical studies have shown that *Ficus* species are the immense source of drugs as documented in traditional knowledge, and many important drugs of modern day are derived directly or indirectly from medicinal plants [7] [8] [9].

F. infectoria known as White Fig/Philkan is a medicinally important plant of Family Moraceae. This plant is distributed throughout Bangladesh, Nepal, Pakistan, Sri Lanka, South west China and Indochina. *F. infectoria* is an ethnomedicinal important plant and has a multiple benefits like antibacterial, antifungal and hyperglycaemic activities [10]. The plant under study is the rich source of flavonoids and phenolics which correspond to the antioxidant potential. All the antioxidant and phytochemical rich plants are responsible for the prevention of neurological disorders which are also reflected by the work of different scientists [11] [12].

The aim of the present study was to analyse the phytochemical screening, total phenolic, total flavonoid, antioxidant potential and memory enhancing ability of fruit extract of *F. infectoria* in scopolamine which induced cognitive decline. The obtained outcomes clearly illustrate the fact that secondary metabolites present in them allow for the antioxidant potential of this plant, and thereby it allows their use in treating all the cognitive disorders linked with oxidative stress. Hence, it is concluded that the pharmacological effects of this plant enable its use in a scopolamine-induced memory impairment model of disease in near future.

2. Materials and Methods

2.1. Materials

F. infectoria fruits were collected from Jinnah Garden, Lahore, Pakistan in the

months of Feb-May (2016). Identified by Prof. Dr. Mir Ajab Ali Khan, Department of Biological Sciences, Quaid-i-Azam University, Islamabad and respective specimen were deposited in the Prem Madan Herbarium of Lahore College for Women University, Lahore, Pakistan (*F. infectoria* Voucher No: LCWU-15-103).

2.2. Preparation of Plant Extract

Double maceration technique was used for the extraction of fruit extract of *F. infectoria* via two polar solvents *i.e.* 70% methanol and 70% ethanol for 3 - 4 days. The obtained filtered was dried by rotary evaporator at 45˚C and was stored at 4˚C for further use [13].

2.3. Phytochemical Screening

2.3.1. Qualitative Assay for the Detection of Alkaloids, Phenolics, Flavonoids, Terpenoids and Tannins

Phytochemical constituents: Different tests were conducted to identify the presence and absence of diverse phytochemicals such as terpenoids [14], alkaloids [15] [16], tannins [17], phenolics [18] and flavonoids [19].

Terpenoids: Presence or absence of terpenoids in extracts was detected by Salkowski test. Taking quantify amount of tested material along with chloroform plus concentrated H_2SO_4, reddish brown coloration was formed at the junction which indicated the presence of terpenoids [14].

Alkaloids: Different reagents were used for the detection of Alkaloids. In case of Mayers reagent creamish precipitate was formed, Dragondroff's reagent gave orange precipitate while brown precipitate appearance was reflected with Wagner's reagent [15] [16].

Tannins: In the $FeCl_3$ test transformation of blue or greenish-black color to olive green color on progressive addition of $FeCl_3$ which represented the presence of tannins in the compound under observation. Blue, green or even red color was the indication of phenolics [17].

Flavonoids: Alkaline Reagent test was used for the detection of flavonoids. Addition of 10% NaOH solution, 1% KOH, aluminium chloride to the tested compound resulted in the formation of yellow color indicating the presence of flavonoids [19].

Phenolics: 2 mL of fresh fruit extract when mixed with 5% $FeCl_3$ gave blue coloration which was the clear indication of the presence of phenolics [18].

2.3.2. Quantitative Detection of Total Phenolics and Flavonoids Content

Total phenolic contents (TPC) in the methanolic and ethanolic *F. infectoria* fruit extract were determined by Folin Ciocalteu reagent assay using Gallic acid as a standard [20] [21]. Aluminum chloride method was used for the detection of total flavonoid content using quercetin as a standard. After incubation at room temperature O.D values of samples were measured at 510 nm and expressed as mg quercetin equivalents (QE)/g fresh weight [22] [23].

2.3.3. DPPH Free Radical Scavenging Activity

Antiradical activity of selected plant extract was determined by means of DPPH assay via two polar solvents at four different concentrations (0.125, 0.25, 0.5 and 1 mg/mg/mL). Ascorbic acid (AA), Quercetin, Vitamin E and Butylated Hydroxytoulene (BHT) was used as reference positive control. The IC50 represents the concentration of fractions that means 50% inhibition was determined for each fraction [24].

2.4. Experimental Models

About Nighty six (96) albino mice (male only) (20 - 30 g) were procured from I.V.R. Lahore. They were acclimatized under standard temperature (23˚C ± 2˚C) and humidity (50% ± 5%) conditions in LCWU with 12 h photoperiod. Before carrying out experiments animals were habituated to environment for seven days. Institutional Animal Ethical Committee gave approval for performing experiments on animals Government of Pakistan according to Specified guidelines as well are according to the EEC Directive of 1986. All study was performed between 9:00 am - 5:00 pm.

2.5. Acute Toxicity Study of Plant Leaves Extract

Acute oral toxicity analysis was done via OECD-423 guidelines. Mice were kept in overnight fasting condition with only free access of water. Methanolic and Ethanolic fruit extract (5 mg/Kg p.o) was administered to one group of mice (n = 6). Mortality, skin, fur and behaviour changes were observed for 14 days. In absence of any mortality, acute toxicity study was performed with doses of 75 mg/Kg, 150 mg/Kg and 300 mg/Kg. Toxic symptoms were observed in animals for 72 hours like skin, fur, behavioural changes and mortality (OECD guidelines-423).

2.6. Vehicle

Dissolution of plant extract was done in distilled water while normal saline was used for the preparation of Scopolamine hydrobromide and piracetam stock solution.

2.7. Experimental Plan

The memory enhancing ability of fruit extract of *F. infectoria* was assessed by means of positive avoidance approach. The experimental plan was divided into seven groups on the basis of treatments. For conducting the whole experiment the mice were divided into seven groups on the basis of treatment they were provided with. Group I and Group II were considered as a control group. In Group I (n = 6) distilled water (1 ml/100 g) was administered p.o to mice while Group II was administered with Normal Saline i.p for 21 days. After 90 min of administration on 21st day, SDL was recorded during both the sessions of training. Retention of learned task was examined after 24 h. Group III mice (n = 6) was administered with Scopolamine hydrobromide (0.4 mg/Kg) intraperitoneally for three week. Group IV was treated with methanolic and ethanolic plant

extracts alone (75 mg/Kg, 150 mg/Kg, and 300 mg/Kg). SDL was recorded after 90 min of administration on 21th day and after 24 h. Group V (n = 6): animals were treated with methanolic and ethanolic plant extract along with scopolamine hydrobromide. Group VII this group mice (n = 6) were pre-treated with Piracetam (200 mg/Kg) alone. Group VII Piracetam plus Scopolamine hydrobromide (0.4 mg/Kg) was treated group. SDL was recorded after 90 min of administration on 21st day.

2.8. Preparation of Brain Homogenate for Biochemical Estimation

After completion of the behavioural studies on day 21st, rats were sacrificed by cervical dislocation. Brain was removed from each rat, kept on an ice-cold plate. The brains were washed and homogenized 10 times with ice-cold 0.1 M phosphate buffer (pH 7.4) and used to measure total protein, MDA, GSH, and AChE activity [25] [26] [27].

2.9. Statistical Analysis

Results were statistically analysed. Expression of results was done by Mean and Standard deviation capital and one way analysis of variance followed by Post-hoc Tukey test and Bonferonni test was used for the analysis of data. Graphical and statistical representation was done with the help of IBM SPSS Statistic Data Editor and Microsoft Excel 2010. Data were considered statistically significant at $p < 0.05$ in comparison to the control groups [4] [26] [28].

3. Results

3.1. Phytochemical Analysis

Quantitative Phytochemical screening showed the presence of terpenoids, phenolics, flavonoids, alkaloids and tannins in both methanolic and ethanolic fruit extract of *F. infectoria*. The presence of phytochemicals is in turn responsible for the antioxidant potential which is responsible for their capability in preventing the scopolamine induced amnesia in mice.

3.2. Quantitative Analysis

Standard protocols were used for the detection of total phenolic and flavonoid content.

Quantitative Estimation of Total Phenolic and Total Flavonoid Content

Highest phenolic content was reflected in the ethanol extract of *F. infectoria* (fruit) which was 4.277 ± 0.06 mg GAE/g dry plant extract however lowest phenolic content in methanolic extract 3.537 ± 0.13 GAE/dry plant extract. Maximum flavonoid content was estimated to be in the plant extract 3.637 ± 0.06 while ethanolic plant extract showed TFC *i.e.* 2.866 ± 0.01. Results were given in **Figure 1** and **Figure 2**.

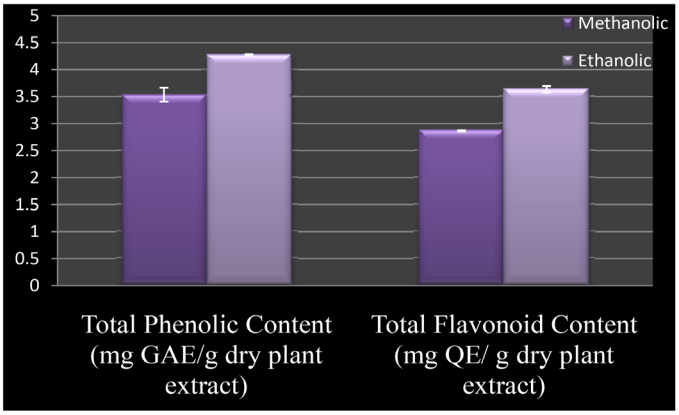
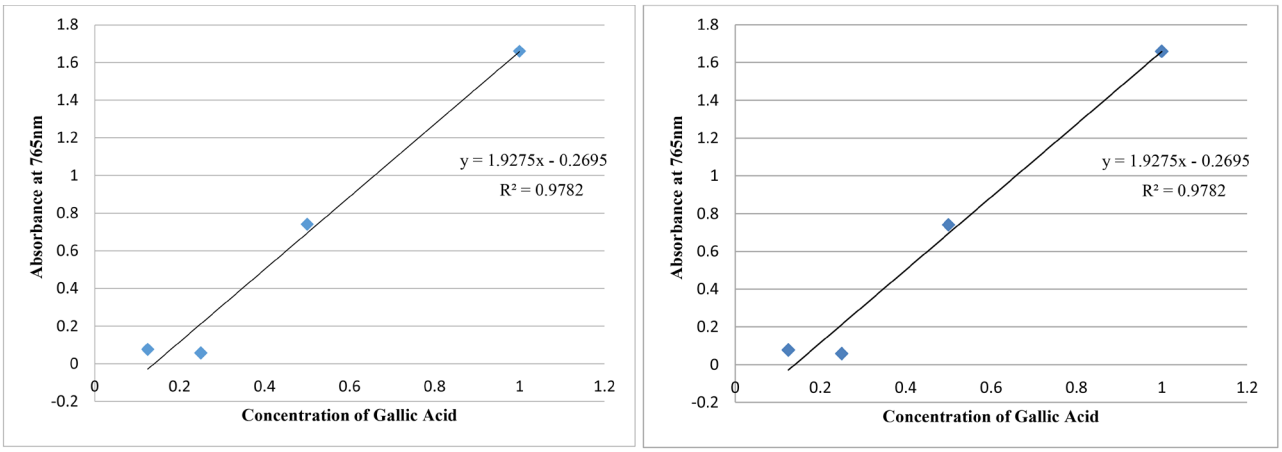


Figure 1. Total phenolic (mg Gallic acid/g dry plant extract) and Flavonoid content (mg Quercetin/g dry plant extract) in Methanolic/Ethanolic extracts of *F. infectoria* fruit extract.



(a) (b)

Figure 2. (a) Caliberation curve of gallic acid (mg/ml); (b) Caliberation curve of quercetin (mg/ml).

3.3. Antioxidant Activity

One of the reliable, quick and easy approach to analyse the radical scavenging potential in any compound is a DPPH assay [29]. Results showed that the *F. infectoria* Fruit extract possessed % age inhibition ranging between 60% - 96%. However, maximum % age of antioxidant activity *i.e.*, 96.77% ± 0.21% with ethanol and 96.77 ± 0.21 with methanol respectively at the 1st dilution (**Figure 3**). The results of % age inhibition was compared with ascorbic acid (AA), Quercetin, Vitamin E, and Butylated Hydroxytoulene (BHT) which was used as standards with 92.05% ± 0.27%, 91.72% ± 0.42%, 88.54% ± 0.50% and 79.42% ± 0.51% inhibition at 1st inhibition. The IC50 was also calculated by means of Graphpad prism software 5.04. Results obtained were illustrated in the **Table 1**.

3.4. Neuroprotective Potential of *F. infectoria* Fruit Extract

The results of the present study revealed a strong neuroprotective potential of fruit extract of *F. infectoria*.

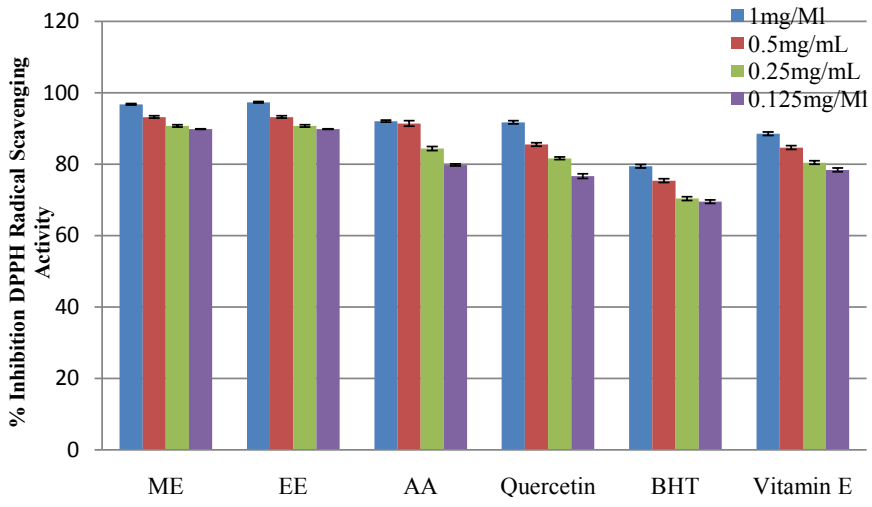


Figure 3. % inhibition of *F. infectoria* Fruit extract using Methanol and Ethanol via DPPH assay (ME methanolic extract, EE ethanolic extract).

Table 1. IC50 value of methanolic and ethanolic fruit extract of *F. infectoria*.

Sr No.	Name of Compound	IC50 (Methanol) (Mean ± S.D)	IC50 (Ethanol) (Mean ± S.D)
1	*Ficus infectoria* (Fruit)	0.111 ± 0.001	0.191 ± 0.001
2.	Ascorbic acid	0.106 ± 0.01	0.103 ± 0.01
3.	Quercetin	0.5632 ± 0.01	0.224 ± 0.01
4.	Butylated Hydroxytoulene	0.875 ± 0.01	0.771 ± 0.01
5.	Vitamin E	0.320 ± 0.005	0.299 ± 0.01

3.4.1. Acute Toxicity Test Results of Fruit Extract of *F. infectoria*

Methanolic and Ethanolic extract of fruit extract of *F. infectoria* did not produce any mortality, no changes in skin and fur and behaviour in any mice was observed even at maximum doses 2000 mg/Kg. Therefore experiment carried out further safely with three doses 75 mg/Kg, 150 mg/Kg & 300 mg/Kg (it is expressed in Table 2).

3.4.2. Behavioral Analysis

Both the methanolic and ethanolic plant extracts exhibit significant neuroprotective properties. However, maximum activity was observed in the ethanolic plant extracts. Increased step down latency was observed by the administration of methanolic and ethanolic fruit extract at all three dose range *i.e.* (75 mg/Kg, 150 mg/Kg and 300 mg/Kg). Plant extract administered at high dose range for 21 days significantly increased SDL ($291.2 \pm 0.33^{+++###}$) in comparison to control group (DW: 247.3 ± 0.76; NS: 241 ± 1.80), Scopolamine hydrobromide treated group (113.17 ± 1.60) as well as standard drug *i.e.* Piracetam treated group ($252.75 \pm 1.60^{###}$). Results were illustrated in Figure 4. Data is presented as Mean ± SEM (n = 6); One way ANOVA followed by Tukey Post Hoc test and

Table 2. Acute toxicity test results of plant fruit extract.

Plant Extracts	Changes in skin and Fur	Alertness	Mortality
F. infectoria (75 mg/Kg)	−ve	+ve	Survived
F. infectoria (150 mg/Kg)	−ve	+ve	Survived
F. infectoria (300 mg/Kg)	−ve	+ve	Survived
F. infectoria (2000 mg/Kg)	−ve	+ve	Survived

−ve sign indicates absence of any change in skin and fur. +ve sign indicates alertness remain present.

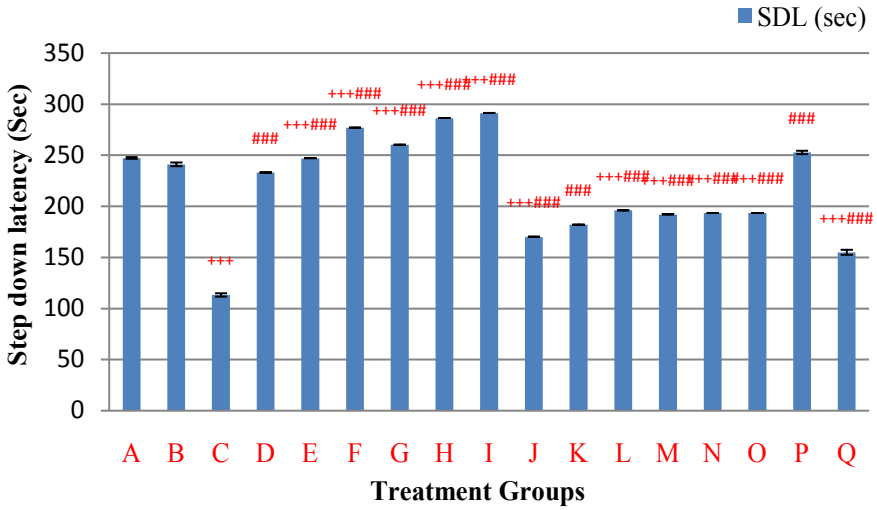


Figure 4. Effect of *Ficus infectoria* methanolic and ethanolic fruit extract on step down latency of mice using passive avoidance approach. A. Control (DW) p.o (10 mL), B. Control (Normal Saline) i.p (10 mL), C. Scopolamine HBR i.p (0.4 mg/Kg), D. *F. infectoria* (M) Fruit extract (75 mg/Kg), E. *F. infectoria* (M) Fruit extract (150 mg/Kg), F. *F. infectoria* (M) Fruit extract (300 mg/Kg), G. *F. infectoria* (E) Fruit extract (75 mg/Kg), H. *F. infectoria* (E) Fruit extract (150 mg/Kg), I. *F. infectoria* (E) Fruit extract (300 mg/Kg), J. *F. infectoria* (M) Fruit extract (75 mg/Kg) + Sco HBR (0.4 mg/Kg), K. *F. infectoria* (M) Fruit extract (150 mg/Kg) + Sco HBR (0.4 mg/Kg), L. *F. infectoria* (M) Fruit extract (300 mg/Kg) Sco HBR (0.4 mg/Kg), M. *F. infectoria* (E) Fruit extract (75 mg/Kg) + Sco HBR (0.4 mg/Kg), N. *F. infectoria*. (E) Fruit extract (150 mg/Kg) + Sco HBR (0.4 mg/Kg), O. *F. infectoria* (E) Fruit extract (300 mg/Kg) + Sco HBR (0.4 mg/Kg), P. Piracetam i.p (200 mg/Kg), Q. Piracetam (200 mg/Kg) + Scopolamine HBR (0.4 mg/Kg).

Bonferroni test. ***$p < 0.001$, **$p < 0.01$ and *$p < 0.05$ when compared to normal control; $^{###}p < 0.001$, $^{##}p < 0.01$ and $^{#}p < 0.05$ when compared to negative control.

3.4.3. Biochemical Investigation

At the end of 21st day brain homogenate of each mice group was subjected to Chemical Evaluation of Total protein (mg/g of tissue), MDA (nmoles /mg of protein), GSH (nmoles /mg of protein) & AChE (M/min/g protein). There was a significant increase in the total protein and reduced glutathione content while

reduction in the malondialdehyde and acetylcholinesterase activity. So reduction in MDA and AchE activity illustrates the nootropic ability of fruit extract of *F. infectoria*. Graphical representation gave a more clear view of the obtained results by conducting the following research. The mice brain biochemical parameters Total protein, Malondialdehyde levels, GSH and AChE activity were expressed as Mean ± SEM values (n = 6/group); One way ANOVA followed by Tukey Post hoc test & Bonferroni test $^{+}P < 0.05$, $^{++}P < 0.01$, $^{+++}P < 0.001$ significant difference from the disease control group. $^{\#}P < 0.05$, $^{\#\#}P < 0.01$, $^{\#\#\#}P < 0.001$ significant difference from the control group (**Figures 5-8**).

4. Discussion

Cognitive decline in the people of elder age groups are the clear evidence of severe disorders *i.e.* Dementia & Alzheimer disease. Suitable way for the treatment of such disorders are still unknown however one of the major symptoms shown in the patients suffering from this disease is the formation of Acetylcholine tangles because Acetylcholinestrase activity is at peak in the patients suffering from Cognitive disorders so there is a need to look for natural AchE inhibitors which have the potential in preventing the brain from loss of intellectual properties.

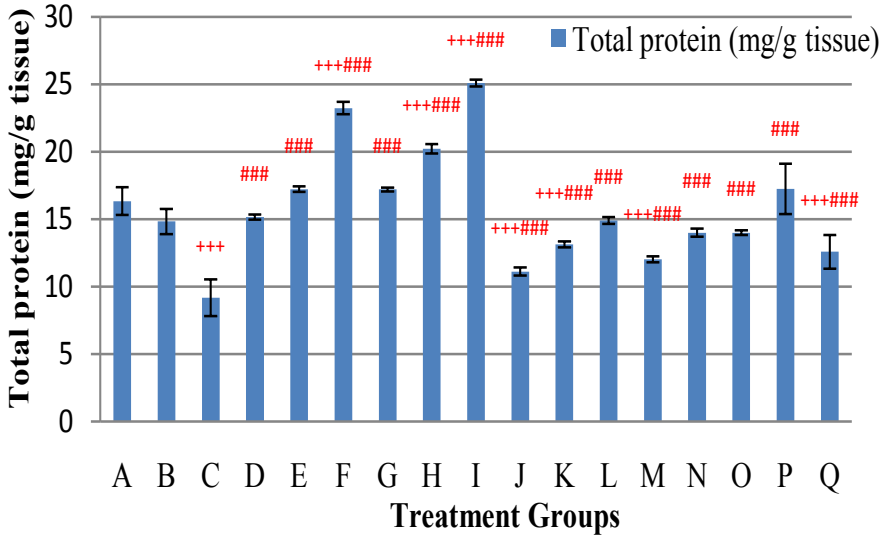


Figure 5. Nootropic ability of methanolic and ethanolic *Ficus infectoria* (Fruit extract) on Total protein (mg/g of tissue). A. Control (DW) p.o (10 mL), B. Control (Normal Saline) i.p (10 mL), C. Scopolamine HBR i.p (0.4 mg/Kg), D. *F. infectoria* (M) Fruit extract (75 mg/Kg), E. *F. infectoria* (M) Fruit extract (150 mg/Kg), F. *F. infectoria* (M) Fruit extract (300 mg/Kg), G. *F. infectoria* (E) Fruit extract (75 mg/Kg), H. *F. infectoria* (E) Fruit extract (150 mg/Kg), I. *F. infectoria* (E) Fruit extract (300 mg/Kg), J. *F. infectoria* (M) Fruit extract (75 mg/Kg) + Sco HBR (0.4 mg/Kg), K. *F. infectoria* (M) Fruit extract (150 mg/Kg) + Sco HBR (0.4 mg/Kg), L. *F. infectoria* (M) Fruit extract (300 mg/Kg) Sco HBR (0.4 mg/Kg), M. *F. infectoria* (E) Fruit extract (75 mg/Kg) + Sco HBR (0.4 mg/Kg), N. *F. infectoria* (E) Fruit extract (150 mg/Kg) + Sco HBR (0.4 mg/Kg), O. *F. infectoria* (E) Fruit extract (300 mg/Kg) + Sco HBR (0.4 mg/Kg), P. Piracetam i.p (200 mg/Kg), Q. Piracetam (200 mg/Kg) + Scopolamine HBR (0.4 mg/Kg).

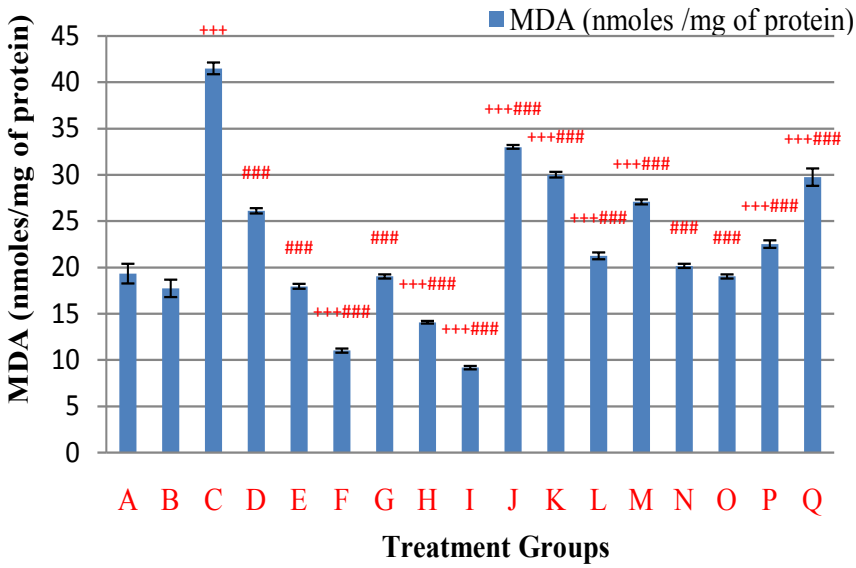


Figure 6. Nootropic ability of methanolic and ethanolic *Ficus infectoria* (Fruit extract) on Malondialdehyde Level (nmoles/mg of protein) A. Control (DW) p.o (10 mL), B. Control (Normal Saline) i.p (10 mL), C. Scopolamine HBR i.p (0.4 mg/Kg), D. *F. infectoria* (M) Fruit extract (75 mg/Kg), E. *F. infectoria* (M) Fruit extract (150 mg/Kg), F. *F. infectoria* (M) Fruit extract (300 mg/Kg), G. *F. infectoria* (E) Fruit extract (75 mg/Kg), H. *F. infectoria* (E) Fruit extract (150 mg/Kg), I. *F. infectoria* (E) Fruit extract (300 mg/Kg), J. *F. infectoria* (M) Fruit extract (75 mg/Kg) + Sco HBR (0.4 mg/Kg), K. *F. infectoria*. (M) Fruit extract (150 mg/Kg) + Sco HBR (0.4 mg/Kg), L. *F. infectoria* (M) Fruit extract (300 mg/Kg) Sco HBR (0.4 mg/Kg), M.*F. infectoria* (E) Fruit extract (75 mg/Kg) + Sco HBR (0.4 mg/Kg), N. *F. infectoria* (E) Fruit extract (150 mg/Kg) + Sco HBR (0.4 mg/Kg), O. *F. infectoria* (E) Fruit extract (300 mg/Kg) + Sco HBR (0.4 mg/Kg), P. Piracetam i.p (200 mg/Kg), Q. Piracetam (200 mg/Kg) + Scopolamine HBR (0.4 mg/Kg).

Medicinal plants are the rich source of secondary metabolites which was responsible for the antiradical properties and these properties enable them to prevent neurological disorders and to be used as alternatives to the drug available in the market which impose serious side effects on human health.

The current research was undertaken to analyse the nootropic potential of fruit extract of *F. infectoria* in scopolamine induced amnesia in mice. Qualitative and Quantitative analysis of Phytochemicals have showed the presence of all phytochemicals in both methanolic and ethanolic fruit extract of *F. infectoria* However among both the solvents used Ethanol proved to be an excellent solvent in extracting the phytochemicals *i.e.* phenolics and flavonoids which ultimately lead to the antiradical properties of *F. infectoria*. Ethanol is always considered as a best solvent in all biological activities [30]. Results showed the maximum total phenolic and flavonoid content *Ficus infectoria*, (Ethanol Fruit Extract) which was 4.677 ± 0.06 mg GAE/g dry weight and 4.637 ± 0.06 mg QE/g (E) (**Figure 1**, **Figure 2**).

This is correlated by the work of different scientist that plant which are enrich source of phytochemicals possessed strong radical scavenging activity [31] [32] [33]. Same results were shown by the research undertaken; concentration

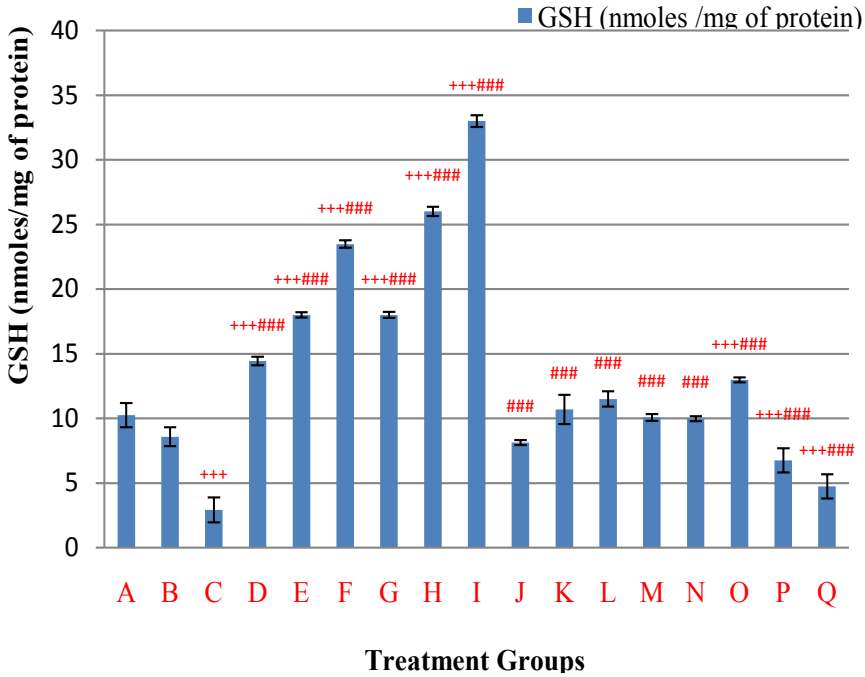


Figure 7. Nootropic ability of methanolic and ethanolic *Ficus infectoria* (Fruit extract) on GSH (nmoles/mg of protein). A. Control (DW) p.o (10 mL), B. Control (Normal Saline) i.p (10 mL), C. Scopolamine HBR i.p (0.4 mg/Kg), D. *F. infectoria* (M) Fruit extract (75 mg/Kg), E. *F. infectoria* (M) Fruit extract (150 mg/Kg), F. *F. infectoria*. (M) Fruit extract (300 mg/Kg), G. *F. infectoria* (E) Fruit extract (75 mg/Kg), H. *F. infectoria* (E) Fruit extract (150 mg/Kg), I. *F. infectoria* (E) Fruit extract (300 mg/Kg), J. *F. infectoria* (M) Fruit extract (75 mg/Kg) + Sco HBR (0.4 mg/Kg), K. *F. infectoria* (M) Fruit extract (150 mg/Kg) + Sco HBR (0.4 mg/Kg), L. *F. infectoria* (M) Fruit extract (300 mg/Kg) Sco HBR (0.4 mg/Kg), M.*F. infectoria* (E) Fruit extract (75 mg/Kg) + Sco HBR (0.4 mg/Kg), N. *F. infectoria* (E) Fruit extract (150 mg/Kg) + Sco HBR (0.4 mg/Kg), O. *F. infectoria* (E) Fruit extract (300 mg/Kg) + Sco HBR (0.4 mg/Kg), P. Piracetam i. p (200 mg/Kg), Q. Piracetam (200 mg/Kg) + Scopolamine HBR (0.4 mg/Kg).

dependent response was obtained which showed increase % DPPH radical scavenging activity with every rise in concentration. Similar trend was reflected by the work of different workers [34] [35].

Graph pad prism 5.04 software was used for assessing the IC50 value of *Ficus infectoria* fruit extract (E) which was found to be 0.091. Results were correlated by the work of different researchers as the plants with low IC50 value exhibit high antioxidant activity and vice versa [36] [37]. A strong correlation was observed between phenolics, flavonoids and radical scavenging activity [38].

Effect of fruit extract of *F. infectoria* in scopolamine induced memory impairment in mice was determined by means of behavioural model *i.e.* passive avoidance approach. This approach is useful in analysing memory deficit and is the indicator of long term memory [39]. Scopolamine is an anti-cholinesterase inhibitor which is involved in the cognitive impairment also supported by the previous literature reported [39]. Even at high concentration piracetam remains non-toxicated and its role is documented in multiple disorders which include

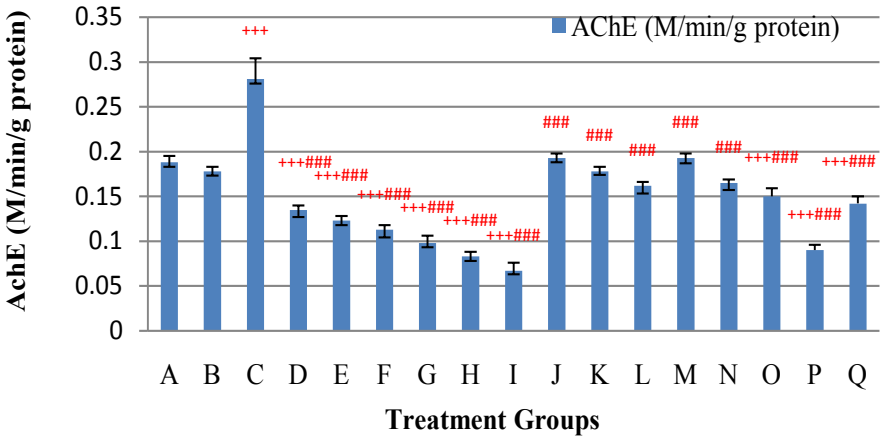


Figure 8. Nootropic ability of methanolic and ethanolic *Ficus infectoria* (Fruit extract) on Acetylcholinestrase Activity (M/min/g protein) Control (DW) p.o (10 mL), B. Control (Normal Saline) i.p (10 mL), C. Scopolamine HBR i.p (0.4 mg/Kg), D. *F. infectoria* (M) Fruit extract (75 mg/Kg), E. *F. infectoria* (M) Fruit extract (150 mg/Kg), F. *F. infectoria* (M) Fruit extract (300 mg/Kg), G. *F. infectoria* (E) Fruit extract (75 mg/Kg), H. *F. infectoria* (E) Fruit extract (150 mg/Kg), I. *F. infectoria* (E) Fruit extract (300 mg/Kg), J. *F. infectoria* (M) Fruit extract (75 mg/Kg) + Sco HBR (0.4 mg/Kg), K. *F. infectoria* (M) Fruit extract (150 mg/Kg) + Sco HBR (0.4 mg/Kg), L. *F. infectoria* (M) Fruit extract (300mg/Kg) Sco HBR (0.4 mg/Kg), M. *F. infectoria* (E) Fruit extract (75 mg/Kg) + Sco HBR (0.4 mg/Kg), N. *F. infectoria* (E) Fruit extract (150 mg/Kg) + Sco HBR (0.4 mg/Kg), O. *F. infectoria* (E) Fruit extract (300 mg/Kg) + Sco HBR (0.4 mg/Kg), P. Piracetam i.p (200 mg/Kg), Q. Piracetam (200 mg/Kg) + Scopolamine HBR (0.4 mg/Kg).

cognitive disorders and dementia, vertigo, cortical myoclonus, dyslexia, and sickle cell anemia [40].

Phytochemical and high radical scavenging potential of plants extract played a significant role in the prevention of neurodegenerative diseases *i.e.* Dementia and Alzheimer disease which was strongly correlated by the work of different researchers. Kubinova *et al.* (2016) estimated the antioxidant potential of five *Agrimonia* species (Rosaceae) and results obtained showed that the antioxidant rich plant species like *Agrimonia* species had the capability in the inhibition of cholinesterase which showed that these plant species helped in the prevention of multiple cognitive disorders of which Alzheimer disease is considered as one of them. Nutraceuticals enrich plants (curcumin, apigenin, docosa hexaenoic acid etc.) have also shown significant potential in the prevention and treatment of AD [12].

Cognitive abilities of plants extract was analyzed via biochemical estimations in which total protein, Level of Malondialdehyde, Reduced Glutathione Level and acetylcholinesterase activity was assessed. The plants with neuroprotective potential have showed high level of protein content in brain, lower malondialdehyde levels, increase GSH level and inhibition in acetylcholinesterase activity was observed even at low dose range *i.e.* (150 mg/Kg) in comparison to the commercially available drug that even at high dose not showed significant results as plants extract at low dose range.

According to the work of Uddin *et al.* (2016) decrease of brain antioxidant enzymes such as CAT, SOD, GSH was observed in scopolamine amnesia mice which imparted a significant role in the proper functioning of brain. However, the effect was reversed by the administration of *Phyllanthus acidus* L. Moreover the scientist observed that the restoration of Acetylcholine by the treatment of patients with *Persicaria flaccida* plant extract because this is the integral in agent in controlling the brain intellectual properties so this plant could be used for the treatment of neurological disorder [4].

5. Conclusion

According to the research, the results suggest that *F. infectoria* (fruit) possessed significant cognitive abilities in scopolamine induced memory impairment in mice in comparison to the standard drug *i.e.* piracetam. Thereby current research is of high significance as it leads to the formulation of drug which is cost effective and eco-friendly in nature and could be used on commercial scale in near future for the treatment of multiple health disorders.

Disclosure Statement

No potential conflict of interest was reported by the authors.

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