



## Evaluation of Anti-Diarrheal and Central Nervous System Depressant Effect of *Flacourtia indica* in Swiss Albino Mice

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### ABSTRACT

*Flacourtia indica* (FI) has been used in traditional system of medicines to treat several diseases like snakebite, cancer, diabetes and hepatic disorders. This study evaluated the anti-diarrheal and central nervous system (CNS) effect of ethanolic extract of FI in mice. Anti-diarrheal activity was evaluated using castor oil and MgSO<sub>4</sub> induced diarrhea tests in mice. GI motility was estimated using BaSO<sub>4</sub> milk. CNS effect was investigated using hole board, hole cross and elevated plus maze test. Extract was used at doses of 500 mg and 1000 mg/kg body weight. Loperamide (10 mg/kg p.o) and diazepam (4 mg/kg) were used as standard drug. The FI extract showed statistically significant anti-diarrheal effect in the total number of feces and episodes of diarrheal feces. Treatment with FI at both doses reduced diarrhea very highly significantly ( $p < 0.001$ ) in castor oil and highly significantly ( $p < 0.01$ ) in MgSO<sub>4</sub> induced diarrhea test. FI at 500 mg/kg and 1000 mg/kg doses caused a reduction in the diarrheal stools by 70% and 77.50% in castor oil induced diarrhea. In MgSO<sub>4</sub> induced diarrhea, the plant extract lowered diarrhea by 39.54% ( $p < 0.05$ ) and 48.84% ( $p < 0.01$ ) respectively. FI reduced GI motility very highly significantly ( $p < 0.001$ ) at both the doses after 30 minutes of BaSO<sub>4</sub> administration. Standard drug loperamide (10 mg/kg) had very highly significant ( $p < 0.001$ ) antidiarrheal effect. The extract resulted significant CNS depressant effect ( $p < 0.001$ ) in hole board, hole cross and elevated plus maze test. The overall results depicted that the FI extract had significant antidiarrheal and CNS depressant properties.

**Keywords:** *Flacourtia indica*, Antidiarrheal properties, Castor oil induced diarrhea, MgSO<sub>4</sub> induced diarrhea, BaSO<sub>4</sub> induced GI motility, CNS effect.

### INTRODUCTION

Diarrhea and constipation affects 70% of the population worldwide [1]. Diarrhea is responsible for the death of millions of people, accounted as the second leading causes of death of children less than five years in developing country [2,3]. Medicinal plants being the effective sources of both traditional and modern medicines are genuinely for primary health care. According to an estimate of the World Health Organization (WHO), about 80% of the world population still uses herbs, plants and other traditional

medicines for their primary health care [4]. Medicinal plants are a promising source of anti-diarrheal drugs because they contain multiple constituents with effect-enhancing or side effect-neutralizing potential [5-7]. The flora of Bangladesh is very rich, and several native Bangladeshi medicinal plant species have a long tradition of use with great phytotherapeutic potential [8]. So, research in medicinal plants is a vital sector for the discovery of promising drugs in Bangladesh [9]. *Flacourtia indica* (Burm. f.) Merr. Is an important and rare nutraceuticals plant belonging to the family Flacourtiaceae.

Several phytochemical investigations showed the presence of alkaloids, flavonoids, tannins, terpenoids, glycosides etc. in the plant [4]. Its medicinal properties for the remedy of various diseases like scabies, jaundice, enlarged spleen, fever, poisonous snake bites, skin diseases, nephropathy, psychopathy, nephritic colic, cholera, rheumatic pain, malaria and diabetes have been reported in Ayurveda [4-13]. Various findings suggested that the plant has very good pharmacological properties like antimicrobial, antioxidant, antimalarial, antiasthmatic, anticancerous, and hepatoprotective [10,11].

However, the safety and therapeutic potentials of the medicinal plants used in traditional medicine have not been validated. Therefore, in order to determine the potential use and side effects of herbal medicine, it is important to emphasize the study of medicinal plant that was found in folklore. No available medicinal claims about antidiarrheal activity and central nervous system effects of the extract of *F. indica* were found. With these backgrounds, the experiments were conducted to assess the antidiarrheal and central nervous system effects of ethanolic extract of *F. indica*.

## MATERIALS AND METHODS

### Plant collection and extraction

*Flacourtia indica* was collected, identified and authenticated by the department of Botany, Jahangirnagar University, Savar, Dhaka. The collected materials were thoroughly washed in water, cut into smaller parts and shed dried at 35-40°C for a week and pulverized in electric grinder to get coarse powder. Then powders were extracted with ethanol. Finally a solid mass was obtained and preserved at a petridish in the refrigerator for further analysis.

### Experimental animals

The experiments were performed after the approval by the Biosafety, Biosecurity and Ethical Committee of Jahangirnagar University, Bangladesh {Ref No: BBEC, JU/M 2018 (11)2}. For the experiment Swiss albino mice, 6-7 weeks of age, weighing between 20-30 g, were collected from the animal research lab in the Department of Pharmacy, Jahangirnagar University, Savar, Dhaka.

Animals were maintained under standard environmental conditions (temperature:  $27.0 \pm 1.0^\circ\text{C}$ , relative humidity: 55-65% and 12 h light/12 h dark cycle) and had free access to feed and water ad libitum. The animals were acclimatized to laboratory condition for one week prior to experiments. All protocols for animal experiment were approved by the institutional animal ethical committee.

### Toxicity studies

Toxicity studies of the extracts were carried out in Swiss albino mice of either sex weighing between 20 and 25 g. No mortality was found till 5000 mg/kg per oral (p.o.) [14].

### Evaluation of anti-diarrheal activity

#### *Castor oil induced diarrhea in mice*

Mice of either sex fasted for 12 h were allocated in four groups of six animals each. Group I (received DW at 10 ml/kg p.o.) served as control group, Group II (received loperamide 10 mg/kg, p.o.) served as standard, Group III and IV received extract of *F. indica* at the doses of 500 and 1000 mg/kg, body weight (b.w.) p.o., respectively. One hour after administration, mice were fed castor oil orally at a dose of 0.5 ml per mouse to induce diarrhea. The total number of both dry and wet feces excreted by the animals was counted every hour for a period of 4 hours. The activity of each group was expressed as percent inhibition of defecation and percent inhibition of diarrhea [2, 15].

#### *Magnesium sulfate induced diarrhea*

Mice fasted for 12 hours were divided into four groups of 6 mice each. Group I (received DW at a dose of 10 ml/kg p.o.) served as control group, Group II (received loperamide 10 mg/kg, p.o.) served as standard, Group III and IV received *F. indica* at the doses of 500 and 1000 mg/kg, b.w. respectively. All treatments were given orally. After 1 hour, each mouse received  $\text{MgSO}_4$  (2 g/kg b.w) by oral route to induce diarrhea. The animals were placed individually in cages over white filter paper [16]. The activity of each group was expressed as inhibition (%) of defecation and inhibition (%) of diarrhea.

#### *Gastrointestinal motility test with barium sulfate milk*

Mice of either sex fasted for 12 hours were divided into four groups (n=6). Group I, II, III & IV, received DW (10 ml/kg p.o.) and served as control group, received loperamide (10

mg/kg, p.o.) and served as standard, *F. indica* 500 and 1000 mg/kg, b.w. respectively. All treatments were given orally. After 30 minutes, each mouse was administered 15% barium sulphate milk by oral route. After 30 minutes of administration of barium sulphate milk, mice were sacrificed. The distance traversed by barium Sulphate milk was measured and expressed as a percentage of the total length of small intestine (from pylorus to the ileocecal junction). The percentage of inhibition of GI motility compared with the control group was determined [17].

#### **Evaluation of CNS activity**

##### ***Hole board test***

A total of 16 holes, each 3 cm in diameter, were presented to the mouse in a flat space of 25 square centimeters. Each of the animal was transferred carefully to one corner of the field and the number of ambulation (expressed as the number of holes passed), head dipping and number of fecal boluses excretion was recorded for a period of 2 minutes at pre-30 minutes and post 30, 60, 120, 180 and 240 minutes intervals of administration of *F. indica* and were compared with the control animals administered with distilled water [18].

##### **Hole cross test**

In a box having dimension of 30 × 20 × 14 cm, a hole of 3 cm in diameter at a height of 4.5 cm from the floor was constructed on the dividing wall. Spontaneous movement of the animals through the hole from one chamber to the other was counted for a period of 2 minutes. The observation was conducted at 0, 30, 60, 120, 180 and 240 minutes after oral administration of plant extract and was compared with control animal administered with normal saline [19].

##### **Elevated plus maze test**

The elevated plus-maze consisted of two open arms (30 × 5 × 0.5 cm) and two closed arms (30 × 5 × 15 cm) with an

open roof, arranged so that two pairs of identical arms were opposite to each other. Arms emerged from a central platform (5 × 5 cm), and the entire apparatus was raised to a height of 50 cm above floor level. Mice were administered the test extract and placed individually in the center of the maze, facing one of the open arms. The number of entries into both the open or enclosed arms and the amount of time spent in the open arms was recorded. Each test lasted for 5 min and each mouse was tested only once. The apparatus was cleaned between each test. The test compounds were administered orally at 500 and 1000 mg/kg body weight. All tests were conducted at 0, 30, 60, 120, 180- and 240-minutes interval [20].

#### **Statistical analysis**

Statistical analysis for animal experiments was carried out by one-way ANOVA following Dunnett's post hoc test using SPSS 23.0. Data were presented as Mean ± SEM. The results obtained were compared with the control group.  $p < 0.05$ ,  $p < 0.01$  and  $p < 0.001$  were considered to be statistically significant, highly significant and very highly significant, respectively.

## **RESULTS**

#### **Anti-diarrheal activity**

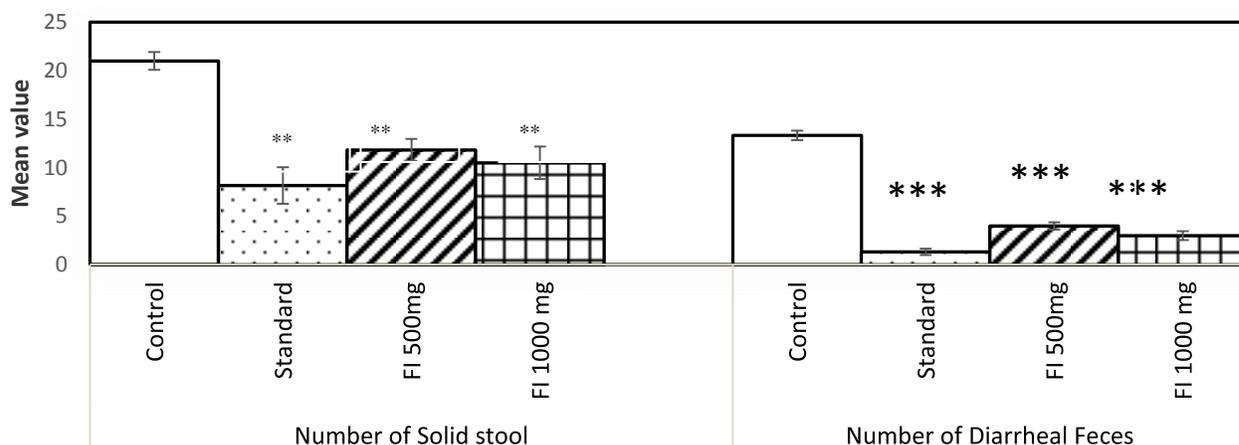
The results of castor oil induced diarrhea test showed that there has been a statistically significant reduction in the incident and severity of diarrhea with higher dose of the crude extract of FI in experimental animals. The crude extract of FI at dose of 500 mg/kg reduced the total fecal content highly significantly ( $p < 0.01$ ) and at 1000 mg/kg it was very highly significant ( $p < 0.001$ ). FI also reduced the diarrheal episode very highly significantly ( $p < 0.001$ ) at both the doses in diarrhea induced by castor oil as compared to the control group. The reduction of fecal content by 500 mg/kg and 1000 mg/kg doses were 43.65% and 50.0%, respectively and the inhibition of the diarrheal episodes was 70.0% and 77.50%, respectively (Table 1 and Figure 1).

**Table 1:** Effect of standard (loperamide 10 mg/kg) and FI on the in castor oil induced diarrhea test in mice.

Group	Total number of feces (Mean $\pm$ SEM)	% inhibition of defecation	Total number of Diarrheal feces (Mean $\pm$ SEM)	% inhibition of diarrhea
Control	21 $\pm$ 0.93	00	13.33 $\pm$ 0.50	00
Standard	8.17 $\pm$ 1.89**	61.11	1.33 $\pm$ 0.33***	90.0
FI 500 mg	11.83 $\pm$ 1.14**	43.65	4.0 $\pm$ 0.37***	70.0
FI 1000 mg	10.50 $\pm$ 1.67**	50.00	3.0 $\pm$ 0.45***	77.50

Data were analyzed by one-way ANOVA following Dunnett's post hoc test. Values are expressed as Mean  $\pm$  SEM, n=6. \*(p< 0.05) = significant, \*\* (p< 0.01) = highly significant, \*\*\* (p< 0.001) = very highly significant compared to the control group.

### Castrol oil induced diarrhea



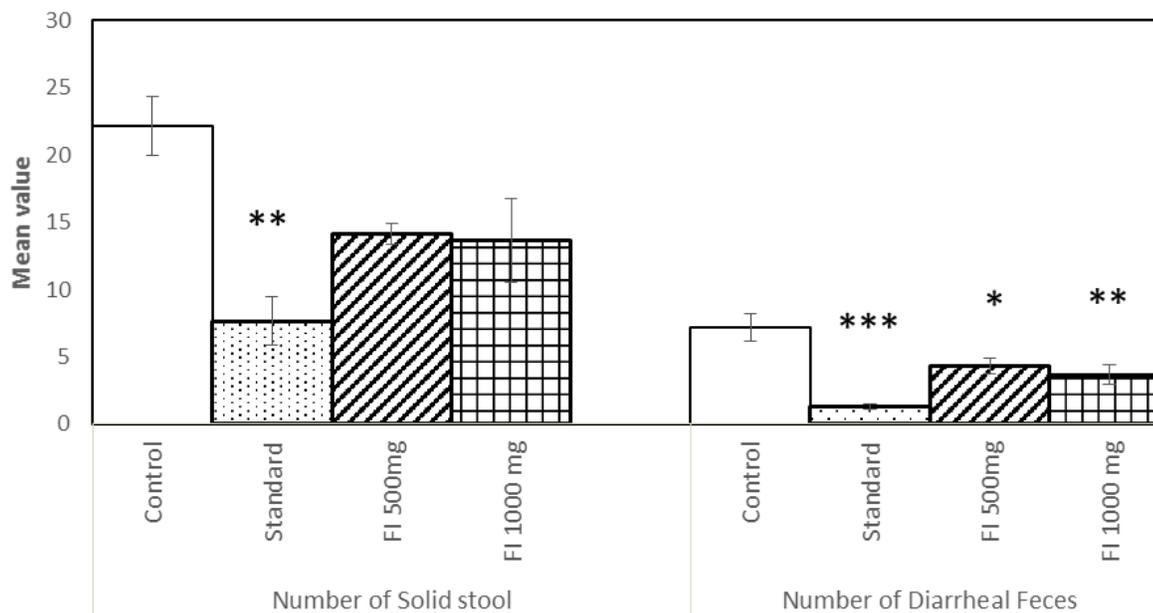
**Figure 1:** Effect of FI on the total number of feces in castor oil induced diarrhea test in mice. \*\* (p< 0.01) = highly significant, \*\*\* (p< 0.001) = very highly significant compared to the control group.

Table 2 and Figure 2 represented the effect of FI on MgSO<sub>4</sub> induced diarrhea. FI 500 mg/kg and 1000 mg/kg showed no significant effect on defecation.

**Table 2:** Effect of standard (loperamide 10 mg/kg) and FI in MgSO<sub>4</sub> induced diarrhea test in mice.

Group	Total number of feces (Mean $\pm$ SEM)	% inhibition of defecation	Total number of Diarrheal feces (Mean $\pm$ SEM)	% inhibition of diarrhea
Control	22.17 $\pm$ 2.21	00	7.17 $\pm$ 1.02	00
Standard	7.67 $\pm$ 1.84**	65.41	1.33 $\pm$ 0.21***	81.40
FI 500 mg	14.17 $\pm$ 0.79	36.09	4.33 $\pm$ 0.56*	39.54
FI 1000 mg	13.67 $\pm$ 3.09	38.35	3.67 $\pm$ 0.72**	48.84

Data were analyzed by one-way ANOVA following Dunnett's post hoc test. Values are expressed as Mean  $\pm$  SEM, n=6. \*(p< 0.05) = significant, \*\* (p< 0.01) = highly significant, \*\*\* (p< 0.001) = very highly significant compared to the control group.

**MgSO<sub>4</sub> induced diarrhoea**

**Figure 2:** Effect of standard and FI on the total number of feces in MgSO<sub>4</sub> induced diarrhea test in mice. \*\* (p<0.01) = highly significant, \*\*\* (p<0.001) = very highly significant compared to the control group.

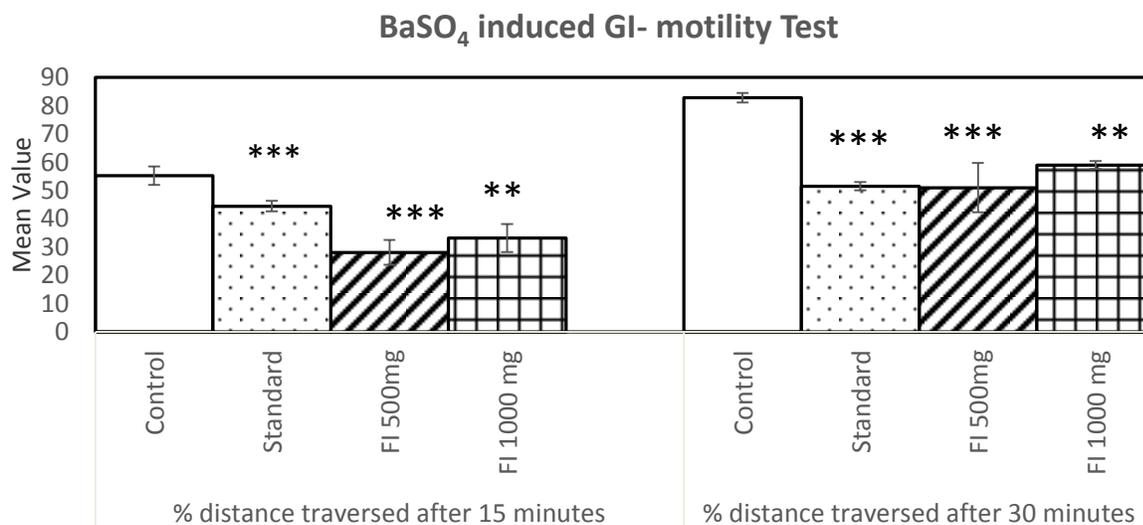
Whereas, FI at both the doses reduced the diarrheal episodes by 39.54% (p<0.05) and 48.84% (p<0.01), respectively when compared to the control group. The standard drug loperamide (10 mg/kg, p.o.) very highly significantly (p<0.001), inhibited both the fecal output (65.41%) and diarrhea (81.40%)

produced by MgSO<sub>4</sub>. In the GI motility test, *F. indica* at 500 mg/kg dose showed very highly significant (p<0.001) reduction of GI motility by 49.17% whereas highly significant (p<0.01) reduction at 1000 mg/kg by 39.91% after 15 minutes of barium sulfate administration (Table 3 and Figure 3).

**Table 3:** Effect of standard (loperamide 10 mg/kg) and FI on the gastrointestinal motility of barium sulphate milk in mice.

Group	After 15 minutes		After 30 minutes	
	% distance traversed by BaSO <sub>4</sub> (Mean ± SEM)	% inhibition of GI motility	% distance traversed by BaSO <sub>4</sub> (Mean ± SEM)	% inhibition of GI motility
Con	55.26 ± 3.29	0.00	82.79 ± 1.69	00
STD	44.46 ± 1.83	19.54	51.49 ± 1.46***	37.81
FI 500 mg	28.09 ± 4.35***	49.17	50.99 ± 8.75***	38.42
FI 1000 mg	33.21 ± 4.97**	39.91	59.01 ± 1.40**	28.73

Data were analyzed by one-way ANOVA following Dunnett's post hoc test. Values are expressed as Mean ± SEM, n=6. \*(p<0.05) = significant, \*\* (p<0.01) = highly significant, \*\*\* (p<0.001) = very highly significant compared to the control group.



**Figure 3:** Effect of standard and FI on the gastrointestinal motility (% distance traversed) of barium sulphate milk in mice. \*\* (p<0.01) = highly significant, \*\*\* (p<0.001) = very highly significant compared to the control group.

significant (p<0.001) as compared to the control group.

#### CNS activity

In the hole board test, the extract showed a decrease in locomotion, HD and defecation in the test animals as compared to the control group at both dose levels (500 and 1000 mg/kg b.w.). The depressant activity was significantly (p<0.001) decreased at the end of experiment from 120 to 240 minutes study periods (Table 4).

After 30 minutes of barium sulfate administration, FI at 500 mg/kg and 1000 mg/kg reduced GI motility very highly significantly (p<0.001) by 38.42% and highly significantly (p<0.01) by 28.73%, respectively. Loperamide (10 mg/kg) reduced GI motility by 37.81% which was very highly significant (p<0.001) as compared to the control group.

In the hole cross test, the extract showed a decrease in locomotion (number of cross) in the test animals at both dose levels (500 and 1000 mg/kg body weight) compared to control group. The results were also dose dependent and statistically significant (p<0.001). The travelling frequency

through the open arm and the closed arm with time stayed for mice fed with FI was observed and found significantly decreasing effect (p<0.001) as compared to the control group (Table 5).

The number of holes crossed from one chamber to another by mice of the control group was increased from 30 minutes to 240 minutes (Table 6).

**Table 4:** Effect of standard (Diazepam 4 mg/kg) and FI on the hole board test in mice.

Group	Number of areas travelled (Mean ± SEM)					
	Pre-30 min	+ 30 min	+60 min	+120 min	+180 min	+240 min
Control	23.33 ± 3.36	32.33 ± 4.93	14.67 ± 3.85	23.67 ± 1.71	22.67 ± 1.12	33 ± 5.48
Standard	31.83 ± 3.41	12 ± 1.61	21.83 ± 0.75	20.83 ± 1.17	35.83 ± 5.75	8.17 ± 0.83***
FI 500 mg	27.17 ± 1.72	19.67 ± 0.42***	19 ± 1.13***	36.83 ± 5.38	6.5 ± 0.67***	16.83 ± 0.48***
FI 1000 mg	26 ± 1.39	16 ± 1.24***	36.33 ± 4.34	4.67 ± 0.62***	15.33 ± 0.62***	11.33 ± 0.62***
<b>Number of HD (Mean ± SEM)</b>						
	Pre-30 min	+ 30 min	+60 min	+120 min	+180 min	+240 min
Control	12.17 ± 2.40	12.17 ± 1.47	8.333 ± 1.022*	11.667 ± 0.558	11.167 ± 0.654	17 ± 1.862
Standard	21 ± 2.49**	9.5 ± 1.12***	8.833 ± 0.401	9 ± 0.365***	17.333 ± 1.626	7.833 ± 1.014***
FI 500 mg	13.67 ± 1.12	7 ± 0.365***	8.167 ± 0.307	16.5 ± 1.432	6.833 ± 1.046***	6.167 ± 0.307***
FI 1000 mg	12.83 ± 0.70	6.333 ± 0.803***	17 ± 0.894	4.167 ± 0.749***	5 ± 0.365***	3.667 ± 0.333***
<b>Number of Stool (Mean ± SEM)</b>						
	Pre-30 min	+ 30 min	+60 min	+120 min	+180 min	+240 min
Control	1 ± 0.63	3 ± 0.577	0 ± 0***	1.333 ± 0.211**	1.333 ± 0.211**	1.667 ± 0.422
Standard	2.34 ± 0.72	0.333 ± 0.333**	0.333 ± 0.211**	0.333 ± 0.211**	2.167 ± 0.477	0 ± 0***
FI 500 mg	2 ± 0.26	0 ± 0***	0 ± 0***	1 ± 0.447	0 ± 0**	0 ± 0**
FI 1000 mg	2.17 ± 0.31	0 ± 0**	0.167 ± 0.167	0 ± 0	0 ± 0	0 ± 0

\*(p<0.05) = significant, \*\* (p<0.01) = highly significant, \*\*\* (p<0.001) = very highly significant compared to the control group.

**Table 5:** Effect of standard (Diazepam 4 mg/kg) and FI on the number of hole cross in mice.

Number of Hole cross (Mean ± SEM)						
Group	Pre-30 min	+ 30 min	+60 min	+120 min	+180 min	+240 min
CON	8.167 ± 0.477	9.333 ± 0.422	10.5 ± 0.619	11.667 ± 0.803	12.5 ± 0.342	12.167 ± 0.477
STD	10.167 ± 0.601	9.5 ± 0.342	5.1667 ± 0.601***	3.5 ± 0.671	0.833 ± 0.401***	0.167 ± 0.167***

FI 500 mg	12.167 ± 0.703	9.5 ± 0.429	9 ± 0.632	6.333 ± 0.494	3 ± 0.365***	0.833 ± 0.477***
FI 1000 mg	11.333 ± 0.760	10.333 ± 0.333	6.5 ± 0.428***	3 ± 0.578	0.833 ± 0.401***	0.167 ± 0.167***

\*(p < 0.05) = significant, \*\* (p < 0.01) = highly significant, \*\*\* (p < 0.001) = very highly significant compared to the control group.

**Table 6:** Effect of standard (Diazepam 4 mg/kg) and FI on elevated plus maze test in mice.

Group	Number of travelling in the open arm (Mean ± SEM)					
	Pre-30 min	+ 30 min	+60 min	+120 min	+180 min	+240 min
Control	2.667 ± 0.333	3 ± 0.365	2.5 ± 0.428	2 ± 0.258	2.5 ± 0.428	36.333 ± 4.341
Standard	1.833 ± 0.307	0.5 ± 0.224***	0 ± 0***	0.167 ± 0.167***	0 ± 0***	4.667 ± 0.615***
FI 500 mg	2.333 ± 0.422	1.667 ± 0.333*	1.167 ± 0.307**	0.333 ± 0.211***	0 ± 0***	15.333 ± 0.615***
FI 1000 mg	2.5 ± 0.428	1.5 ± 0.224**	0.667 ± 0.211***	0 ± 0***	0 ± 0***	11.333 ± 0.615***
Group	Number of travelling in the close arm (Mean ± SEM)					
	Pre-30 min	+ 30 min	+60 min	+120 min	+180 min	+240 min
Control	8.5 ± 0.428	1.694 ± 0.428	7.5 ± 0.428	8.167 ± 0.477	8.167 ± 0.307	17 ± 0.894
Standard	8.167 ± 0.601	8.5 ± 0.577***	2.5 ± 0.428***	1.667 ± 0.333***	1 ± 0***	4.167 ± 0.749***
FI 500 mg	8.5 ± 0.428	5 ± 0.577	5.167 ± 0.601***	4 ± 0.365***	1.833 ± 0.307***	5 ± 0.365***
FI 1000 mg	8 ± 0.577	7 ± 0.428***	3.167 ± 0.307***	2.167 ± 0.307***	1.333 ± 0.333***	3.667 ± 0.333***

\*(p < 0.05) = significant, \*\* (p < 0.01) = highly significant, \*\*\* (p < 0.001) = very highly significant compared to the control group.

Therefore, the result of neuropharmacological tests demonstrated profound CNS depressant activity by the test drug in mice.

## DISCUSSION

Diarrhea is one of the most prominent reasons of malnutrition and death among the children in the world, especially in the developing countries and it results from an absorptive and secretory imbalance in the intestinal tract, which is accompanied by an excess loss of fluid in the feces. In some types of diarrhea, the secretory component predominates, while other types of diarrhea are characterized by hyper motility. Castor oil causes diarrhea due to its active metabolite, ricilonic acid [21-23], which stimulates the peristaltic activity in the small intestine, leading to the changes in the electrolyte permeability of the intestinal

mucosa. Its action stimulates the release of endogenous prostaglandins (PGE2) [24]. The results of the study showed that there had been a statistically significant reduction in the incident and severity of diarrhea with the crude extract of *F. indica* in experimental animals. The FI extract at both the doses showed very highly significant and antidiarrheal effect in castor-oil induced diarrhea test in mice. It is evident that alcoholic extract of *Celosia argentea* leaves show anti diarrhoeal effects by inhibiting PGE2 [25]. The extract of *Maranta arundinacea* L. leaves showed considerable antidiarrheal effect in castrol oil induced diarrheal test [26]. Tannic acid and tannins are present in many plants and denature proteins by forming protein tannate complex. The complex formed coat over the intestinal mucosa and makes it more resistant and reduces secretion [27].

Magnesium sulfate stimulates gastrointestinal movement and acts as laxative. MgSO<sub>4</sub> may lead to intraluminal fluid and electrolyte accumulation & to increased intestinal motility [28]. The extract of FI at 500 and 1000 mg/kg showed very highly significant reduction effect in MgSO<sub>4</sub> induced diarrheal feces. Barium sulfate prevents the reabsorption of water in the intestine and increases the intestinal volume. Barium sulfate induced diarrhea is seemed to occur by osmotic properties and cholecystokinin production [24]. FI extract at 500 mg/kg showed highly significant effect and 1000 mg/kg showed very highly significant effect on the reduction of GI motility in BaSO<sub>4</sub> induced GI motility test which demonstrated the antidiarrheal activity of FI. It was reported that, flavonoids and polyphenols were responsible for the antidiarrheal activity and flavonoids have ability to inhibit intestinal motility and water and electrolytes secretion [29,30]. Tannin and flavonoid present in *F. indica* extracts may be responsible for the anti-diarrhoeal activity [4].

Decrease in locomotor activity is an observation of sedative effect. Different types of anxiolytic, muscle relaxant, sedative-hypnotic drugs are shown their action through GABA the major inhibitory neurotransmitter in the CNS. Thus, the extracts of FI may act by membrane hyperpolarization which potentiating GABA-ergic inhibition in the CNS that leads to either decrease in the firing rate of critical neurons in the brain or direct activation of GABA receptor by the extracts [31].

Behaviors such as open arm activity and head dipping are

considered a greater frequency of exploratory activities. Fear behaviors include closed arm activity, stretch attend posture, grooming frequency and duration, defecation and urination, a greater number of these measures implies a greater level of emotionality or fear [32]. These behaviors significantly demonstrate that higher the value in open arm, the less the anxiety level. On the other hand, open arm avoidance by rodents in the elevated plus maze gives a measure of anxiety [33]. So, the administration of FI is assumed to be by act as a CNS depressant agent in mice.

### CONCLUSION

The overall finding of this experimental evaluation indicates that the FI extract has inhibitory properties on diarrheal feces generation and GI motility showing significant anti-diarrheal activity. It also confirmed that the FI is associated with sedative effect in the neuropharmacological tests showing CNS depressant activities. Therefore, the FI extract can be used as an important therapeutic agent in the clinical management of diarrhea and CNS problems. It is also suggested that traditional medicine which contain FI extract should be used carefully for its antidiarrheal and CNS depressant effect. Further studies are required to find out the mechanism of these activities of the FI extract.

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