The Pharma Innovation Journal 2025; 14(7): 39-43

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
Impact Factor (RJIF): 6.34
TPI 2025; 14(7): 39-43

www.thepharmajournal.com
Received: 11-06-2025
Accepted: 08-07-2025

Kahou Bi Gohi Parfait
Laboratory of Agrovalization, Animal Physiology Phytotherapy and Pharmacology Specialty, Jean Lorougnon GUEDE University, Daloa, Ivory Coast

Irie Bi Jean Severin
Laboratory of Biology and Health; Animal Physiology, Phytotherapy and Pharmacology Specialty, Felix Houphouët Boigny University, Abidjan, Ivory Coast

Ekissi Yapi Hugues Romaric
Laboratory of Biological Sciences Animals, Animal Physiology, Phytotherapy and Pharmacology Specialty, Science and Technology Training and Research Unit, Alassane Ouattara University, Bouaké, Ivory Coast

Corresponding Author:
Kahou Bi Gohi Parfait
Laboratory of Agrovalization, Animal Physiology Phytotherapy and Pharmacology Specialty, Jean Lorougnon GUEDE University, Daloa, Ivory Coast

Antidiarrheal Properties of Aqueous Extract of *Tectona grandis* L.f. (Lamiaceae) in Wistar Rats

Kahou Bi Gohi Parfait, Irie Bi Jean Severin and Ekissi Yapi Hugues Romaric

DOI: https://www.doi.org/10.22271/tpi.2025.v14.i8a.26221

Abstract
Diarrhea is a real public health problem. Each year, more than half a million children die from this disease worldwide. The objective of this study was to evaluate the antidiarrheal properties of *Tectona grandis* aqueous extract (EATg) in rats. To conduct this study, the control group received distilled water. Rats in groups 2, 3, and 4 (test groups) were first treated with the extract at doses of 150, 300, and 900 mg/kg BW, respectively, and then orally administered castor oil. After diarrhea induction with castor oil, rats in groups 2, 3, and 4 (test groups) were treated with EATg at doses of 150, 300, and 900 mg/kg BW, respectively. In both sets of experiments, their diarrheal stools are counted. Their intestines are isolated and emptied to determine the volume of intestinal contents.
The duration of intestinal transit is also measured using activated charcoal as a marker. The results showed that doses of 150, 300 and 900 mg/kg BW dose-dependently reduced the occurrence and number of diarrheal stools and thus reduced the severity of diarrhea. EATg also led to a reduction in the volume of intestinal contents and a reduction in intestinal mobility compared to controls. This extract therefore has antidiarrheal properties, comparable to those of loperamide (reference antidiarrheal), and antispasmodic properties similar to those of atropine sulfate (reference antispasmodic).

Keywords: *Tectona grandis*, antidiarrheal, antispasmodic, loperamide, activated charcoal

Introduction
Diarrhea is defined by an increase in fecal output and/or excessive elimination of fluid through the anus, leading to dehydration of the body due to the loss of water and electrolytes (WHO, 2017) [1]. Diarrhea is a real public health problem. Indeed, each year, more than half a million children die from this disease worldwide (WHO, 2017; Aubry and Gaüzère, 2019) [1,2]. In children under five years of age, this endemic disease is the second leading cause of death (WHO, 2017) [1]. In Côte d'Ivoire, during an ethnobotanical survey, 63 medicinal plant species were identified, including *Tectona grandis* (Lamiaceae) for treating diarrhea (Ambé *et al.*, 2015) [3].
This study aims to demonstrate the potential antidiarrheal effects of *Tectona grandis* (Lamiaceae) in rats.

2. Materials and Methods
2.1. Materials
2.1.1. Plant Materials
The plant material used in this work consists of *Tectona grandis* (Lamiaceae) leaves, harvested in May 2024 at the Félix Houphouët-Boigny University (UFHB) in the commune of Cocody (Ivory Coast). After harvesting, the leaves were dried in the shade at room temperature.

2.1.2. Animal Materials
Pharmacological tests were performed on albino rats (males and females) of the Wistar strain of the species *Rattus norvegicus* (Murideae), weighing between 100 and 300 g. These animals are raised in the animal facility of the Biosciences Training and Research Unit (UFR) at the Félix Houphouët-Boigny University (UFHB).

2.2. Study Methods
2.2.1. Preparation of the aqueous extract of dried leaves of *Tectona grandis* (Lamiaceae)
Two (2) liters of distilled water added to 10 g of cut dry leaves of *Tectona grandis* are brought to a boil for 30 minutes. After cooling, the resulting decoction is filtered successively through

a white cloth, then through absorbent cotton, and then through Whatman No. 2 filter paper. The collected filtrate is dried in an oven at 40 °C for 72 hours. After drying, the aqueous extract of *Tectona grandis* appears as a water-soluble powder.

2.2.2 Pharmacological Studies

2.2.2.1 Evaluation of the Effects of EATg on Castor Oil-Induced Diarrhea in Rats

The induction of diarrhea by administering castor oil to rats was carried out according to the method described by Awouters *et al.* (1978) [4] and N'guessan (2019) [5].

The study was conducted on sixteen (16) rats (male and female) divided into four (4) groups of four (4) animals according to average weight. They were placed in plastic cages and fasted for 24 hours before the start of the experiment.

- Rats in group 1 (control group) received distilled water.
- Rats in groups 2, 3, and 4 (test groups) received two (2) ml of castor oil.

One hour later, the stools of the rats in each group were collected on non-absorbent paper and counted. Treatment of test batches with EATg at doses of 150, 300, and 900 mg/kg BW, respectively, began 1 hour after castor oil administration to rats that had become diarrheal. All solutions were administered orally, as a single dose, using a gastric cannula.

The rats were observed for 6 hours to assess the consistency, number, frequency, and severity of diarrheal stools.

2.2.2.2 Evaluation of the effects of EATg on the quantity of droppings in rats made diarrheal by castor oil administration

In this study, 20 rats (male and female) were divided into 5 groups of 4 animals each, based on average weight, and were fasted for 24 hours prior to the experiment.

- Rats in group 1 (healthy controls) received distilled water orally.
- Rats in groups 2, 3, and 5 received 150, 300, and 900 mg/kg BW of gEAT orally, respectively.
- Rats in group 6 (diarrheic controls) received loperamide orally at a dose of 5 mg/kg BW.
- One hour after treatment, each rat received 2 ml of castor oil orally. All solutions are administered orally, as a single dose, using a gastric cannula.
- One hour after castor oil administration, feces (normal and diarrheal) were collected, then analyzed and counted every hour for 6 hours (Awouters *et al.*, 1978; N'guessan, 2019) [4, 5].
- Rats in group 5, which received EATg orally at 900 mg/kg BW, continued to be treated daily for 5 days with the same dose of this extract, and their feces were observed daily. Also, the droppings of healthy control rats, as well as those of diarrheal control rats, continued to be observed for the 5 days.

The inhibition rate of the amount of diarrheal droppings was determined using the formula below, used by Awouters *et al.* (1978) [4].

$$T = \frac{Qt - Q}{Qt} \times 100$$

T: Inhibition rate
Qt: Quantity of diarrheal droppings in the control group
Q: Quantity of diarrheal droppings in the treated group

2.2.2.3 Evaluation of the effects of EATg on the gastrointestinal transit of rats rendered diarrheal by castor oil administration

Twenty (20) rats (male and female) used in this study were divided into 5 groups of 4 animals each based on average weight and were fasted for 24 hours prior to the experiment.

- Rats in group 1 (negative controls) received distilled water orally.
- Rats in group 2 (positive controls) received atropine sulfate orally at a dose of 5 mg/kg BW.
- Rats in groups 3, 4, and 5 received 150, 300, and 900 mg/kg BW of EATg orally, respectively.

One hour later, each rat received 2 ml of castor oil and 1 ml of activated charcoal solution by successive gavage. Thirty (30) minutes later, all animals were placed in a covered jar containing cotton soaked in ether for sacrifice and then the small intestine was removed from the pylorus to the cecum. For each rat, the distance (D) traveled by the charcoal from the pylorus as well as the total length (L) of the intestine were measured **(**Besra *et al.*, 2002) [6].

The percentage of coal transit is given by the ratio between the distance traveled by the coal and the total length of the intestine (Pazhani *et al.*, 2001; Méité *et al.*, 2009) [7, 8]. This is calculated according to the following formula:

$$P = \frac{D}{L} \times 100$$

P: Percentage of activated charcoal transit
D: Distance traveled by activated charcoal
L: Total length of the intestine

The percentage of inhibition is obtained from the average distance traveled by the activated carbon, according to the following formula (Pazhani *et al.*, 2001; Méité *et al.*, 2009) [7, 8]:

$$I = \frac{D1 - D2}{D1} \times 100$$

I: Percentage of inhibition
D1: Average distance traveled by the activated carbon for the control batch
D2: Average distance traveled by the activated carbon for the treated batch

2.3. Processing of Results

Statistical data analysis and graphical representations were performed using GraphPad Prism software (San Diego, CA, USA), version 9.5.1.

Values are expressed as the mean plus the standard error of the mean. Statistical differences between results were determined using analysis of variance (ANOVA), followed by the Tukey-Kramer multiple comparison test, with a significance level of $P < 0.05$. Thus, for:

- $p > 0.05$, the difference is not significant;
- $p < 0.05$, the difference is marginally significant (*);
- $p < 0.01$, the difference is significant (**);
- $p < 0.001$, the difference is highly significant (***).

3. Results and Discussion

3.1 Results

3.1.1 Effects of beaver oil on rat feces

Animals given distilled water only (control rats) produced solid, dark brown, almost black droppings. These rats' droppings remained unchanged throughout the experiment (6 hours) (Figure 1A). Once old, these droppings hardened further and turned completely black.

Castor oil administered at a volume of 2 ml/rat causes acute diarrhea in rats one hour later, characterized by the frequent emission of very soft, pasty or liquid droppings, yellowish in color. In these rats, the stools collected are practically all of the same appearance, which shows that these rats become diarrheal following the administration of castor oil (Figure 1B).

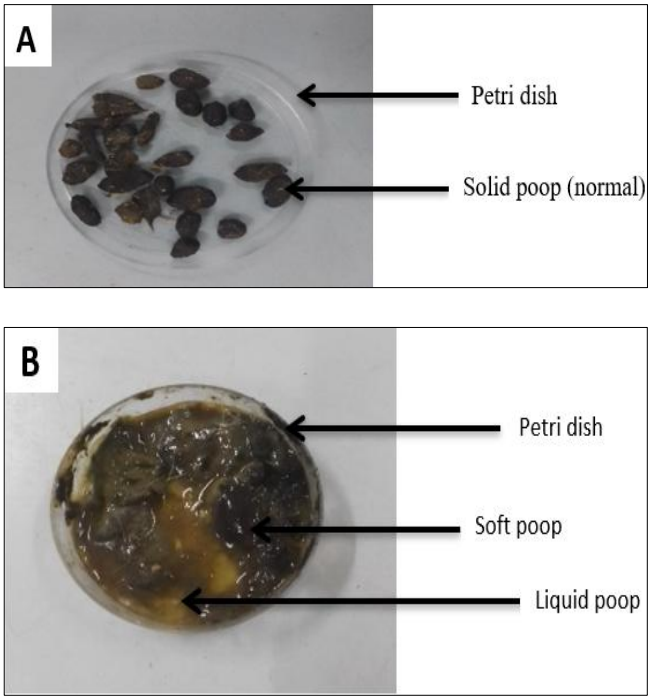
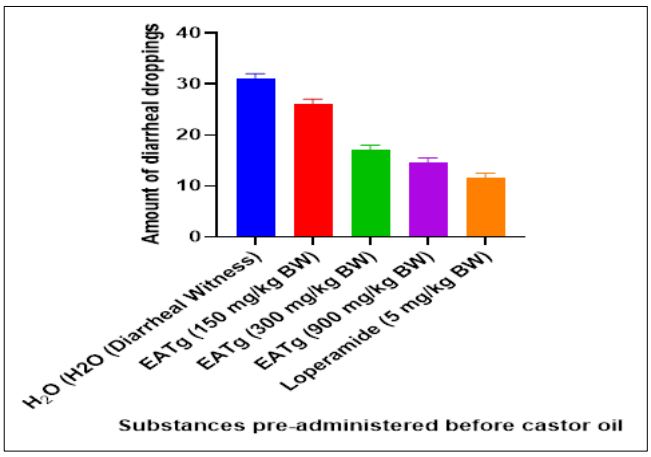


Fig 1: Normal (A) and diarrheal (B) rat droppings
A - Rat droppings given distilled water (normal droppings)
B - Rat droppings given castor oil (diarrheal droppings)



*n = 4; *: p < 0.05; **: p < 0.01; ***: p < 0.001 compared to the diarrheal control.*

Fig 2: Effects on the quantity of diarrheal droppings of pretreatment of rats with aqueous extract of *Tectona grandis* (EATg) or loperamide

3.1.2 Effects of pre-administered aqueous extract of *Tectona grandis* (EATg) and loperamide on the quantity of rat diarrheal droppings

Diarrheic control rats produced an average of 31 ± 2 diarrheal droppings 6 hours after treatment with castor oil.

The occurrence of diarrheal droppings in rats pretreated with EATg was reduced in a dose-dependent manner. Indeed, when rats received this extract at doses of 150, 300, and 900 mg/kg BW, followed one hour later by the administration of castor oil, 26 ± 1.10, 17 ± 1.05, and 14.5 ± 1.5 diarrheal droppings were produced, respectively; a decrease of 16.13 % ($p < 0.05$), 45.16 % ($p < 0.01$), and 53.22 % ($p < 0.001$) in the quantity of diarrheal droppings produced, compared to that of diarrheal control rats.

Pretreatment of rats with loperamide resulted in a greater reduction in the occurrence of diarrheal droppings in these animals. Indeed, the quantity of diarrheal droppings in rats pretreated with 5 mg/kg BW of loperamide, one hour before receiving castor oil, is 11.5 ± 0.5; or a 62.9 % reduction ($p < 0.001$) in the quantity of diarrheal droppings compared to that of diarrheal control rats (Figure 2).

3.1.3 Effects of *Tectona grandis* aqueous extract (EATg) on diarrhea in rats

The healthy control rats, given only distilled water, produced normal stools that remained unchanged throughout the experiment (5 days).

In the diarrheal control rats given only castor oil, 1 hour after this treatment, the stools became diarrheal. This diarrhea diminished over time but persisted for the five (5) days of observation.

In rats given castor oil followed, one hour later, by the aqueous extract of *Tectona grandis* at 900 mg/kg BW, there was frequent diarrheal stool at the beginning (day 1), but less than that of the diarrheal control rats. Subsequently, this diarrhea gradually diminished, with stools gradually becoming normal, over the days of daily treatment with EATg. Thus, after four (4) days of treatment with this extract, the droppings of these rats return to normal.

3.1.4. Effects of *Tectona grandis* aqueous extract (EATg) and atropine sulfate on gastrointestinal transit in diarrheal rats

In healthy control rats that received only activated charcoal (1 ml), 30 min after this treatment, the intestinal transit measured for activated charcoal was 25.4 ± 4.7 cm, for intestines measuring on average 98.9 ± 7.6 cm; or 25.68 % of the length of the intestine covered by activated charcoal (Table). On the other hand, 30 min after the administration by gavage of 2 mL of castor oil and the activated charcoal solution (1 mL) to rats (diarrheic controls), the intestinal transit measured for the activated charcoal is 93.75 ± 8.75 cm, for intestines measuring on average 101.3 ± 10.25 cm; or 92.55 % of the length of the intestine covered by the activated charcoal.

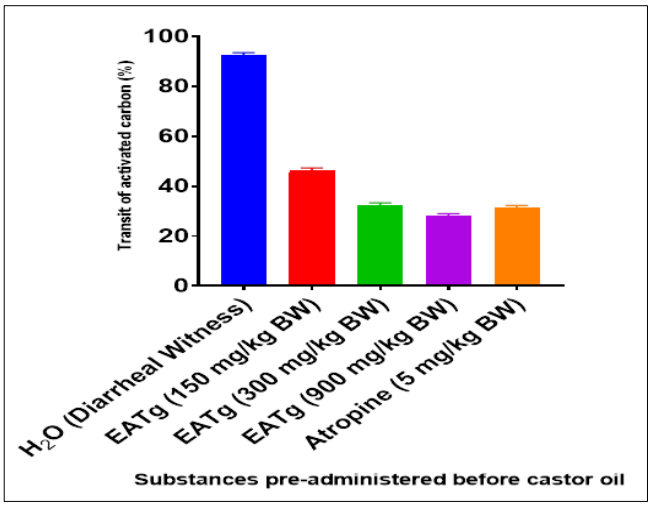
In rats receiving EATg at doses of 150, 300 and 900 mg/kg BW one hour before administration of castor oil and activated charcoal solution, the distances traveled by the charcoal 30 min later were 47 ± 2 cm, 31.5 ± 4.5 cm and 28.5 ± 5.5 cm for intestines measuring on average respectively 101.5 ± 1.5 cm, 97.5 ± 2.5 cm and 101.8 ± 6.25 cm; i.e. respectively 46.3 % ($p < 0.01$), 32.3 % ($p < 0.001$) and 28 % ($p < 0.001$) of the length of the intestine traveled in each case by the activated

charcoal. Thus, pretreatment of rats with EATg at doses of 150, 300 and 900 mg/kg BW reduced intestinal transit by 49.3 %, 65.1% and 69.75 % respectively, compared to that of diarrheic control rats. When castor oil and activated charcoal were administered to rats that had received atropine sulfate at 5 mg/kg BW one hour earlier, intestinal transit time measured 30 minutes later for activated charcoal was 29 ± 9 cm, for intestines measuring an average of 92.75 ± 9.75 cm; or 31.27 % ($P < 0.001$) of the intestinal length traveled by activated charcoal. Intestinal transit time was thus reduced by 66.21 % compared to that of diarrheal control rats.

Intestinal transit time was therefore reduced in a dose-dependent manner by the EATg pre-administered to rats that subsequently received castor oil. Furthermore, EATg at 900 mg/kg BW is more active than atropine sulfate (5 mg/kg BW) in reducing intestinal transit in diarrheal rats, without however bringing this transit back to normal, as in healthy control rats (Figure 3).

Table 1: Effects of aqueous extract of *Tectona grandis* (EATg) and atropine sulfate on gastrointestinal transit in diarrheic rats

Pre-administered substance	Total length of the intestine (cm)	Distance traveled by coal (cm)	Coal transit (%)	Reduction of transit (%)
H_2O (Healthy control)	98.9 ± 7.6	25.4 ± 4.7	25.68	0
H_2O (Diarrheic witness)	101.3 ± 10.25	93.75 ± 8.75	92.55	0
EATg (150 mg/kg BW)	101.5 ± 1.5	47 ± 2	46.3**	49.97
EATg (300 mg/kg BW)	97.5 ± 2.5	31.5 ± 4.5	32.3***	65.1
EATg (900 mg/kg BW)	101.8 ± 6.25	28.5 ± 5.5	28***	69.75
Atropine sulfate (5 mg/kg BW)	92.75 ± 9.75	29 ± 9	31.27***	66.21



*n = 4; **: P < 0.01; ***: P < 0.001 compared to the diarrheal control.*

Fig 3: Effects on gastrointestinal transit of pretreatment of diarrheal rats with aqueous extract of *Tectona grandis* (EATg) or atropine sulfate

4. Discussion

Oral administration of castor oil (2 mL/rat) induces severe secretory diarrhea in rats. Diarrhea results, in most cases, from an intestinal imbalance between absorption and secretion phenomena accompanied by accelerated motility, resulting in excess fluid in the stool and electrolytes in the intestinal lumen (Abdelrahim *et al.*, 2013) [9]. Castor oil is known to induce diarrhea through various mechanisms (Zahan *et al.*, 2012) [10] through the action of ricinoleic acid released by the hydrolysis of a triglyceride in the oil in the duodenum by pancreatic lipase (Pang *et al.*, 2013) [11]. This increases peristaltic activity and hypersecretion by promoting the exchange of electrolytes and water in the intestinal membrane (Mujumdar *et al.*, 2005) [12].

Pretreatment of animals with the aqueous extract of dried leaves of *Tectona grandis* significantly reduced castor oil-induced diarrhea within one hour of treatment. Indeed, EATg pre-administered at doses of 150, 300, and 900 mg/kg BW reduced the amount of diarrheal stool excreted in a dose-dependent manner. This diarrhea-reducing effect of EATg at a dose of 900 mg/kg BW was similar to that of loperamide, a reference antidiarrheal drug, at 5 mg/kg BW. Furthermore, continued treatment of rats made diarrheal with EATg at 900 mg/kg BW resulted in the disappearance of diarrhea after 4 days, whereas diarrhea remained when rats receiving castor oil were not treated with EATg. The significant inhibition by EATg of castor oil-induced diarrhea suggests that this extract has antisecretory and/or antispasmodic activity to oppose diarrhea (Zahan *et al.*, 2012) [10]. EATg could thus act just like loperamide on intestinal activity to oppose diarrhea. Loperamide acts relatively selectively on the intestine by stimulating the absorption of water and electrolytes at the enterocyte level and reducing peristalsis by inhibiting calmodulin, which increases the transit time of the contents of the digestive tract (Zahan *et al.*, 2012) [10].

These effects of EATg on castor oil-induced diarrhea are comparable to those obtained by some authors with other plant extracts. Indeed, the work carried out by Atta and Mouneir (2005) [13] and by Méité *et al.* (2009) [8] shows a significant reduction in the quantity of diarrheal droppings in rats pretreated respectively with ethyl acetate extracts of *Bidens bipinnata* (Euphorbiaceae) leaves at doses of 200 and 400 mg/kg BW and *Morinda morindoides* (Rubiaceae) leaves at doses of 500 and 1000 mg/kg BW.

EATg at doses of 150, 300 and 900 mg/kg BW significantly and dose-dependently reduced intestinal transit in rats made diarrheic by posterior administration of castor oil. This study shows that EATg at 900 mg/kg BW is more active than atropine sulfate (5 mg/kg BW) in inhibiting intestinal transit in diarrheic rats. The reduction of intestinal motility in the presence of EATg suggests that this extract has antidiarrheal properties comparable to those of atropine sulfate, a reference antispasmodic, which reduces gastric secretions (Florian *et al.*, 2008) [14]. and is used against functional gastrointestinal disorders.

5. Conclusion

The pharmacological study of EATg on diarrhea induced by oral administration of castor oil to rats shows that this extract has antidiarrheal properties comparable to those of loperamide (reference antidiarrheal), and antispasmodic properties similar to those of atropine sulfate (reference antispasmodic).

These results support the use of *Tectona grandis* (Lamiaceae)

in traditional medicine for the treatment of diarrhea.

6. References

1. WHO. Diarrheal diseases. Fact Sheet. 2017;330-334.
2. Aubry P, Gaüzère B. Infectious diarrhea. News. 2019;8.
3. Ambé ASA, Ouattara D, Tiebre MS, Vroh Bi TA, Zirihi G, N'guessan KE. Diversity of medicinal plants used in the traditional treatment of diarrhea in the markets of Abidjan (Côte d'Ivoire). Journal of Animal and Plant Sciences. 2015;26(2):4081-4096.
4. Awouters F, Niemegeers CJE, Lenaerts FM, Janseen PAJ. Delay of castor oil diarrhea in rats: a new way to evaluate inhibitors of prostaglandin biosynthesis. Journal of Pharmacology. 1978;30:41-45.
5. N'guessan KJ. Phytochemical toxicological study and the demonstration of the antidiarrheal potential of an aqueous extract of *Solanum torvum* (Solanaceae) in mammals. Doctoral Thesis from the Félix Houphouët-Boigny University. 2019;n° 1096/2019:168.
6. Besra SE, Gomes A, Chaudhury L, Vedasiromoni JR, Ganguly DK. Antidiarrhoeal activity of seed extract of *Albizzia lebbeck* Benth. Phytotherapy Research. 2002;16(6):529-533.
7. Pazhani GP, Subramanian N, Arunchalam G, Hemalatha S, Ravichandran V. Antidiarrheal potential of *Elephantopus scaber* Linn leaf extract. Indian Drugs Journal. 2001;38:269-271.
8. Méité S, N'guessan JD, Bahi C, Yapi HF, Djaman AJ, Guédé GF. Antidiarrheal activity of the ethyl acetate extract of *Morinda morindoides* in rats. Tropical Journal of Pharmaceutical Research. 2009;8:201-207.
9. Abdelrahim MY, Elamin BMA, Khalil DJ, El Badwi SMA. Antidiarrhoeal activity of ethanolic extract of *Adansonia digitata* fruit pulp in rats. Journal of Physiology and Pharmacology Advances. 2013;3:172-178.
10. Zahan R, Nahar L, Haque A, Mossaddik A, Fazal A, *et al*. Antidiarrhoeal and hypoglycemic effects of *Synedrella nodiflora*. Phytopharmacology. 2012;2:257-264.
11. Pang YL, Han XF, Bamikole MA, Gong ZH, Tang SX, Tan ZL, *et al*. Anti-diarrhea and anti-oxidant properties of Magnolol. Tropical Journal of Pharmaceutical Research. 2013;12:85-91.
12. Mujumdar A, Misar A, Upadhye A. Antidiarrhoeal activity of ethanol extract of the bark of *Dalbergia lanceolaria*. Journal of Ethnopharmacology. 2005;10:213-216.
13. Atta A, Mouneir A. Evaluation of medicinal plant extracts for antidiarrhoel activity. Phytotherapy Research. 2005;19:418-485.
14. Florian D, Sassot R, Stratmann M, Vogelsang W. Global analysis of helicity parton densities and their uncertainties. Physical Review Letters. 2008;101(7):072001.