

***In vivo* Antidiarrhoeal Activity of *Bryophyllum pinnatum* Leaf Extract on Castor Oil Induced Diarrhea in Albino Rat**

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Authors' contributions

This work was carried out in collaboration between both authors. Author EOD designed the study, wrote the protocol and wrote the first draft of the manuscript. Author FOO performed the statistical analysis, managed the literature searches and wrote the first draft of the manuscript. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JALSI/2018/43047

Editor(s):

(1) Dr. Hakan Inci, Assistant Professor, Department of Animal Science, Faculty of Agriculture, Bingol University, Bingol, Turkey.

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Complete Peer review History: <http://www.sciencedomain.org/review-history/27204>

Original Research Article

Received 29 June 2018
Accepted 22 September 2018
Published 14 November 2018

ABSTRACT

Aims: Diarrhoea is more common in rural area and in low-income countries like Nigeria, where children experience an average three episodes of diarrhoea every year. *Bryophyllum pinnatum* (Crassulaceae) is a widely used medicinal plant in a traditional system with a wide range of biological activities. Hence, *In vivo* antidiarrhoeal activity of *Bryophyllum pinnatum* leaf extract on castor oil induced diarrhoea extracts was evaluated.

Place and Duration of Study: Department of Microbiology, Federal University of Technology, Akure in 2017.

Methodology: Lethal dose (LD₅₀) of the ethanol extract was determined by Lorke's method, rats were grouped and diarrhoea was induced in the experimental Albino rat using castor oil and treated with 200, 300 and 500 mg/kg per body weight.

Results: The result showed that phytochemical compositions of the extract were: tannin (25%), flavonoids (20%), saponin (17.5%), phenols (13%), glycosides (7%), coumarin (6%), titerpenoids

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(6.5%) and alkaloids (5%). Diarrhoeic faecal droppings reduced significantly ($P \leq 0.05$) in treated groups, the reduction were dose dependent. However, the highest inhibition of 93.5% was observed in the group treated with 500 mg/kg of extract. The extract also inhibited the intestinal content by 46%, 62% and 67% in the group treated with 200, 300 and 500mg/kg respectively. Also, *B. pinnaatum* extract (300 and 500 mg/kg) significantly ($P \leq 0.05$) reduced the gastrointestinal distance travelled by the charcoal meal in rats compared to untreated group.

Conclusion: In evaluation of anti-diarrhoeal activity of *B. pinnaatum* in rat, there was an improvement in faecal consistency, therefore it could be considered suitable for the treatment of non-infectious diarrhoea. Further studies should be carried out on purification and the structural elucidation of the extracts to ascertain the main bioactive component of the extract responsible for anti-diarrhoeal activity.

Keywords: Phytochemical; castor oil; diarrhoea; faecal droppings.

1. INTRODUCTION

Diarrhoea is the condition of having at least three loose or watery bowel movements per day or more frequently than normal for an individual, it often last for few days and can result in dehydration due to fluid loss [1]. Diarrhoea are regarded as acute when the duration is less than 2 weeks, which results in varying degrees of dehydration, it is persistent, if the duration varies from 2 to 4 weeks, manifested by malabsorption, nutrient losses, wasting and bloody diarrhoea and chronic when it lasts more than 4 weeks and often presents diagnostic challenges which can be very difficult to manage while Infectious diarrhoea has a sign of the intestinal damage caused by infectious agent, drugs, habitual use of stimulant laxatives (e.g., Senna, cascara, castor oil), chronic ethanol consumption, ingestion of certain environmental toxins (e.g., arsenic), poisons (including bacterial toxins), or acute inflammatory reactions [2,3].

It was reported that diarrhoea is more common in rural area and in low-income countries, where children under three years old experience an average three episodes of diarrhoea every year, for examples in Asia and Africa [4]. The geographical distribution of diarrhoea disease and its associated death, however, is very unbalanced and the poorest countries are most affected. Estimates showed that diarrhoeal diseases account for 40% in Africa, and 39% in Asia of total death in the region, quite the opposite, mortality in the more developed countries has been reduced to very low levels, only 4% in Europe, and 5% in America [1].

As stated, patients with uncontrolled diarrhoea are at increased risk of dehydration, electrolyte imbalance, skin breakdown, and fatigue [5]. In many cases the treatments utilised are oral

rehydration therapy (ORT) and pharmacological intervention, including antibiotics and anti-diarrhoeal drugs, which cause a pronounced effect on gut motility, thus decreasing intestinal transit. Many patients with sudden onset of diarrhoea have a self-limited illness requiring no treatment or evaluation. However, in severe cases, dehydration and electrolyte imbalances are the principal risks, particularly in infants, children, and frail elderly patients, thus requiring both non-pharmacological and pharmacological treatment.

Medicinal plants are the main source of biologically active compounds that can be used for the treatment of diarrhoea [6]. Plant materials include juices, gums, fatty acid, and any other substances of this nature. Similarly, herbal medicine also known as botanical medicine as the use of plant leaves, barriers, bark, roots, nuts, or flower for medicinal purpose, it is the oldest and widely used system of medicine in the world today, used in all society and common to all cultures [7].

Bryophyllum pinnatum (Crassulaceae) is a widely used medicinal plant in traditional system with a wide range of biological activities. It is classified as a weed, and some of its common names are: "African never die", "Love plant", "Life plant", "Air plant", Zakhm-ehyat, Parnabija etc. The main criticism against herbal medicine is the absence of scientific information on the safety profile of herbal products, safety information on *Bryophyllum pinnatum* will be of great importance. In addition, some of the phytochemical constituents present in *Bryophyllum pinnatum* such as bufadienoides, steroids, cardenolides, terpenoids may possess cytotoxic properties which underscores the importance of studying the possible adverse effects of the extract [8]. Therefore, this is aim at

providing information on the antidiarrhoeal potential of *Bryophyllum pinnatum* in diarrhoea induced Albino rats.

2. MATERIALS AND METHODS

2.1 Collection and Identification of Plant Sample

The leaves of *Bryophyllum pinnatum* were collected from Ilesa West Local Government area [9], Ilesa, Osun State, Nigeria and was identified at the herbarium in the Department of Crop and Soil Management, Federal University of Technology, Akure, Nigeria.

2.2 Processing and Extraction of Bioactive Constituents of *Bryophyllum pinnatum*

The leaves were destalked, washed and sun-dried by constantly exposing the leaves to sunlight for 2 weeks, the leaves were turned periodically during the course of drying, to help prevent fungal growth and ease its pulverisation into a dry powder using Malex electric blender. Four hundred gram (400 g) of the powdered plant material was subjected to maceration process with 1.0 litre of 70% ethanol at room temperature for 72 h while the solution was stirred occasionally. The extract was decanted and filtered using cotton wool in Euchard funnel and filtered using Whatman No. 1 filter paper. The filtrate was remacerated twice using the same volume of solvent to exhaustively extract the leaves. The ethanol was then removed from the extract by evaporation under reduced

pressure using a Rotary evaporator (BUCHI Rotavapour R-200, Switzerland) at 55°C to a constant volume. The extract was then dried in a hot air oven at 50°C to obtain a crystal extract. The resulting dried extract was weighed and stored in the refrigerator at 4°C until used [10].

2.3 Phytochemical Screening of Ethanolic Leave Extract of *B. pinnatum*

The phytochemical analysis was carried out according to the standard procedures described to determine the bioactive constituents of ethanolic extract of *Bryophyllum pinnatum* [11]. The phytochemicals assayed were alkaloids, saponin, flavonoids, terpenoids, cardiac glycoside, tannin and phenol, they were quantified qualitatively and quantitatively.

2.4 Care and Acclimatization of Rat

Adult Albino rat of both sexes (120-180 g) used in this study was acquired from the Animal house, Department of Pharmacy, Obafemi Awolowo University, Ile-Ife, Osun state, Nigeria. All the animals were housed in a clean and well-ventilated plastic cage under temperature $23 \pm 1^\circ\text{C}$; photoperiod (the interval in a 24 h period during which an organism is exposed to light), 12 h natural light and 12 h dark; humidity: 45 to 50%. They were also allowed free access to Balanced Trusty Chunks (Sai Durga Foods Ltd, Bangalore) and tap water. The cleaning of the cages was done daily. The rats were allowed to acclimatize for two weeks before the commencement of the experiments.



Fig. 1. A photograph showing the leaves and stem of *Bryophyllum pinnatum* plant
Source: [9]

2.5 Determination of LD₅₀ of the Extract

The Median lethal dose (LD₅₀) of the ethanol extract was determined by Lorke's method [12, 13]. Six groups of three adult albino-rats each weighing between 120-180 g were used for this experiment. The experiment was divided into two phases. Phase one comprises groups 1-3 were administered with 10, 100 and 1000 mg/kg body weight of extract respectively while phase two comprises groups 4-6 and were administered 1600, 2900 and 5000 mg/kg body weight of the extract respectively. The extract was prepared by dissolving 0.1 g, 0.5 g, 5.0 g, 8.0 g, 15 g and 25 g into 5 ml volume of distilled water separately to produce concentrations of (10, 100, 1000, 1600, 2900, 5000 mg/ml) mg/ml respectively which was administered orally to each rat in the groups using oral Cannula. The rats were observed for 24 h and the number of deaths was recorded. The LD₅₀ was calculated. Based on this test, three safe dose levels of ethanolic leave extract were selected for the evaluation of antidiarrhoeal activity in rats.

$$LD_{50} = \sqrt{XY}$$

Where,

X= Highest dose without death,
Y= lowest dose with death.

2.6 Castor Oil Preparation

Castor oil used in this study was produced by Vasco drug Laboratory, Agra and was obtained from Chemistry Laboratory, Federal University of Technology, Akure.

2.7 Grouping of Experimental Rats

The experimental rats were grouped according to the method described by Sharma et al. [14]. They were randomly assigned into 5 groups each consisting of 5 rats (weighing 120-180 g) and were fasted for 24 h.

Group A; Negative control were treated with normal saline 2 ml/kg per body weight,

Group B; Positive control were treated with standard drug, (morphine 3 mg/kg per body weight was used as a standard).

Group C, D, and E were treated with three doses of *Bryophyllum pinnatum*; by dissolving 1 g, 1.5 g, and 3 g to produce concentration of 200, 300 and 500 mg/ml based on their body weight.

2.8 Antidiarrhoeal Activity Test

Castor oil induced diarrhoea test, castor oil induced enteropooling test and charcoal meal test or normal gastrointestinal transit test was carried out using the method described by Sharma et al. [14], as indicated below:

2.9 Castor oil-Induced Diarrhoea in Rats

Healthy albino rats were treated as described in the method of Sharma et al. [14]. In experimental rat, diarrhoea was induced by administration of 1 ml of castor oil orally to each rat after 1 h of drug and extract treatment (standard drug; Loperamide 5 mg/kg and extract; 200, 300, 500 mg/kg). The rats were then housed individually in transparent plastic cages, the bottom of the cage was lined with white sheet of paper for observation of the number and consistency of faecal droppings. The papers were changed every h to make the faecal droppings visible for counting and to check stool consistency. During the observation period of 4 h, the onset of diarrhoea, the number of both dry and wet stools excreted by the animals were recorded and compared with the control for assessing the antidiarrhoeal activity. The onset was measured as the time interval in minutes between the administration of castor oil and the appearance of the first diarrhoeal stool. The total number of diarrhoeal faeces of the control group was considered 100%.

Percentage inhibition (PI) was calculated as follows; [14].

$$PI = \left[\frac{\text{Mean number of wet stools of (control group-treated group)}}{\text{Mean number of wet stools of the control group}} \right] \times 100$$

2.10 Castor Oil-Induced Enterpooling

Intraluminal fluid accumulation was determined by castor oil induced enter pooling in rats fasted for 18 h and are divided into 5 groups of five animals each, Group 1 received 2 ml/kg of normal saline, group 2, 3, and 4 received 200, 300 and 500 mg/kg body weight of the extract and group 5 received 3 mg/kg of Atropine. After one h of administration of drugs, diarrhoea was induced by administering 1 ml of castor oil orally. Two hours (2 h) later, rats were sacrificed through cervical dislocation, the small intestine was ligated at both the pyloric sphincter and the ileocaecal junction and dissected. The small intestine was weighed and its contents were

collected by milking into a graduated tube allowing the volume to be measured. The intestine was reweighed and the differences between full and empty intestines were calculated [14].

2.11 Castor oil Induced Gastrointestinal Transit (Motility) in Rats

Rats were divided into five groups of five animals each to determine the effect of *B. pinnatum* in normal transit. Group 1 received 5ml/kg of distilled water, extract, and Atropine. 1 h after the administration of distilled water, extract or standard drug, Castor oil of 1ml per rats was given and one h after administration of castor oil each rat was given 1 ml of charcoal meal (3% activated charcoal in 2% aq. gum acacia) orally. The rats were then sacrificed through cervical dislocation one h after the administration of the charcoal meal, the abdomen were opened and the small intestine was immediately isolated. The length of the intestine from pylorus to the caecum (LSI) and the distance travelled by the charcoal (LM) were measured. The peristaltic index (PI) for each rat was calculated, expressed as percentage of the distance traveled by the charcoal meal relative to the total length of the small intestine. The percentage inhibition relative to the control was also calculated as Sharma et al. [14]. Standard ethical guidelines for the experimental animal was adhered to during this study as described by the Association for the Study of Animal Behaviour [15].

$$PI = LM/LSI \times 100\%$$

Where;

PI = Peristaltic Index

LM = Length of Charcoal Meal;

LSI = Length of Small Intestine

% Inhibition = $\left[\frac{\text{Mean of distance travelled by marker of (Control - Test) group}}{\text{Mean of distance travelled by marker of Control group}} \right] \times 100$.

2.12 Statistical Analysis

Mean values of replicates were reported with their standard deviations using a statistical package of the social science 22.0 (SPSS). One way Analyses of Variance (ANOVA) were done to calculate significant differences in the treatment means, and the mean separations were achieved by Duncan's Multiple Range Test ($P \leq 0.05$).

3. RESULTS AND DISCUSSION

3.1 RESULTS

3.1.1 Qualitative phytochemical screening of ethanolic *Bryophyllum pinnatum* leave extract

The result showed in Table 1 revealed that flavonoids, tannins, alkaloid, saponin, titerpenoids, glycosides and phenol were present in *Bryophyllum pinnatum* ethanoic leave extract while reducing sugar was absent.

3.1.2 Quantitative phytochemical screening of ethanolic *Bryophyllum pinnatum* leave extract

As shown in Fig. 2, percentage of phytochemical compositions were; tannin 25%, flavonoids; 20%, saponin; 17.5%, phenols; 13%, glycosides; 7%, coumarin; 6%, titerpenoids; 6.5%, while alkaloids was least present 5%. There was no significant ($p < 0.05$) difference in the values of glycosides, coumarin, titerpenoids and alkaloids.

3.1.3 Acute toxicity (LD_{50}) test of *Bryophyllum pinnatum* Leaf Extract

The results presented in Table 2 shows that the acute toxicity test (LD_{50}) of the ethanol extract was indeterminable as there was no death recorded and no obvious toxicological signs at a dose of 5g/kg body weight.

3.1.4 Effect of ethanolic extract of *Bryophyllum pinnatum* on castor oil induced rats

As shown in Table 3, diarrhoea was apparent in all the rats and the control group. Diarrhoeic faecal droppings were significantly reduced ($P \leq 0.05$) in treatment groups, the reduction were dose dependent, however, the highest inhibition of 93.5% was observed in the group treated with 500 mg/kg followed by standard drug (loperamide) 87.1%, 300 mg/kg (80.6%) and the least, 200 mg/kg (77.4%).

3.1.5 Effect of *Bryophyllum pinnatum* leaves extract on castor oil induced enter polling in experimental rats

Table 4 showed the effect of *B. pinnatum* leaves extract on castor oil induced enter polling in experimental rats. The result showed that there

was no significant ($P \leq 0.05$) different between the weights of intestinal contents in the standard (5 ml/kg of atropine) and group treated with 500 mg/kg of extract. The result also revealed that the extract inhibited the intestinal content by 46%, 62% and 67% in the group treated with 200, 300 and 500 mg/kg respectively.

Table 1. Qualitative phytochemical screening of ethanolic *Bryophyllum pinnatum* leave extract

Bioactive components	Inferences
Flavonoids	+
Tannin	+
Alkaloids	+
Saponin	+
Titerpernoids	+
Reducing sugars	-
Glycosides	+
Phenols	+
Coumarin	+

Key=+ = positive
- = negative

Furthermore, the result revealed that percentage inhibition of intestinal volume increased with increase in extract dose. There was significant ($P \leq 0.05$) difference between the intestinal volume of standard (5ml/kg of atropine) and groups treated with extracts. *B. pinnatum* extract 200, 300, and 500mg/kg doses inhibited the intestinal fluid accumulation by 31%, 42%, and

57% respectively in rat compared with control (untreated group), the standard drug atropine (5ml/kg) also inhibited the intestinal fluid accumulation by 60%.

Table 2. Phase: I and II of the acute toxicity (LD_{50}) test of ethanoloic *Bryophyllum pinnatum* leaf extract

Experimental rats	Dosage (mg/kg)	Mortality
Phase 1	10	0/3
	100	0/3
	1000	0/3
Phase 2	1600	0/3
	2900	0/3
	5000	0/3

3.1.6 Effect of Ethanolic Extract of *Bryophyllum pinnatum* on castor oil induced gastrointestinal transit in Albino rat

Effect of ethanolic extract of *B. pinnatum* on castor oil induced gastrointestinal transit in albino rat is shown in Table 5. The result revealed that the length of small intestine ranged from 11.67 ± 0.33 (group treated with 200 mg/kg) to 10.10 ± 0.33 cm (group treated with 300 mg/kg), however, there were no significant ($P \leq 0.05$) different between the lengths of small intestine in the untreated group and group treated with 3 mg/kg of morphine (standard).

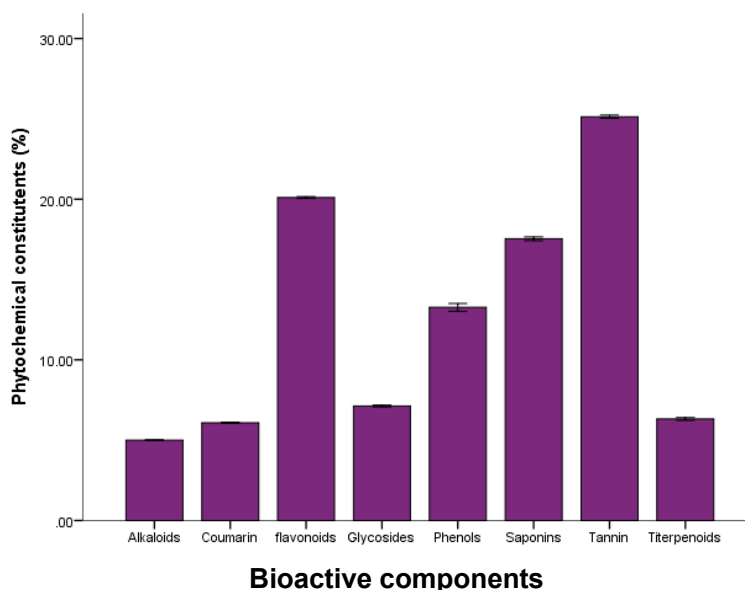


Fig. 2. Quantitative phytochemical screening of ethanolic leave extract of *Bryophyllum pinnatum*

Table 3. The effect of ethanolic extract of *Bryophyllum pinnatum* on castor oil induced Albino rats

Treatments	No of wet faecal droppings after 4 h	% Inhibition
Control (2 ml/kg)	12.67±1.76 ^a	-
BPE (200 mg/kg)	3.00±0.58 ^b	77.4
BPE (300 mg/kg)	2.00±0.58 ^c	80.6
BPE (500 mg/kg)	1.33±0.33 ^e	93.5
Standard (5 mg/kg)	1.67±0.33 ^d	87.1

Data are presented as Mean±S.E (n=5). Values with the same superscript letter(s) along the same column are not significantly different (P<0.05).

Legend; BPE = *Bryophyllum pinnatum* Extract, Control = Normal saline, Standard = Loperamide

Bryophyllum pinnatum extract (300 and 500 mg/kg) significantly (P≤0.05) reduced the gastrointestinal distance travelled by the charcoal meal in rats compared to control. Morphine (3 mg/kg) caused an intestinal inhibition of 47.90% which was significantly (P≤0.05) higher than what was observed in the group treated with 500 mg/kg of extract (41.57%).

3.2 DISCUSSION

Findings from this study revealed that the qualitative phytochemical screening of the ethanolic leave extract of *Bryophyllum pinnatum* contain secondary metabolites, this is in agreement with other findings that stated that

extract of *B. pinnatum* contain secondary metabolites which are; alkaloids, tannins, saponins, phenols, and flavonoids [16,17]. Quantitative phytochemical screening revealed high contents of flavonoids, saponin, tannins, phenols and alkaloids this corroborates the findings of Akacha et al. [18]. Flavonoids and other important constituents of plant were known as free radical scavengers, capable of preventing oxidative damage and reducing oxidative stress while high terpenoids and saponin could be toxic to cellular component [16]. Tannin is known to produce a protein complex (protein tennate) that denatures protein in the intestinal mucosa which makes it more resistant to chemical alteration and reduces secretion. Alkaloids inhibit the

Table 4. Effect of *Bryophyllum pinnatum* leaves extract on castor oil induced enterpooling in experimental rats

Treatment	Wt. of intestinal content (g)	% inhibition	Vol. of intestinal (ml)	% inhibition
Control (2 ml/kg)	2.57±0.12 ^a	-	1.57±0.03 ^a	-
Standard (5 ml/kg)	0.83±0.02 ^d	67	0.60±0.02 ^d	60
BPE (200 mg/kg)	1.33±0.33 ^b	46	0.90±0.06 ^b	31
BPE (300 mg/kg)	0.92±0.04 ^c	62	0.87±0.03 ^b	42
BPE (500 mg/kg)	0.83±0.02 ^d	67	0.67±0.03 ^c	57

Data are presented as Mean±S.E (n=5). Values with the same superscript letter(s) along the same column are not significantly different (P<0.05).

Legend; Control = Normal saline, BPE = *Bryophyllum pinnatum* Extract, Standard = Atropine, % = Percentage, Vol. = Volume

Table 5. Effect of ethanoic extract of *Bryophyllum pinnatum* on castor oil induced gastrointestinal transit in Albino rat

Treatment	LSI (cm)	LM (cm)	Peristaltic index (%)	% inhibition
Control	11.20±1.00 ^b	3.66±0.33 ^a	78.66	-
BPE (200 mg/kg)	11.67±0.33 ^a	2.96±0.07 ^b	26.41	19.21
BPE (300 mg/kg)	10.10±0.33 ^c	2.18±0.10 ^c	21.72	35.58
BPE (500 mg/kg)	10.60±0.88 ^c	2.00±0.00 ^d	19.90	41.57
Standard (3 mg/kg)	11.10±0.17 ^b	1.89±0.07 ^e	17.27	47.90

Data are presented as Mean±S.E (n=5). Values with the same superscript letter(s) along the same column are not significantly different (P<0.05).

Legend; LSI = Total Length of small intestine, LM = Length of charcoal meal, % = Percentage, BPE = *Bryophyllum pinnatum* Extract, Standard = Morphine Control = Normal saline

release of autocoid and prostaglandin released by castor oil and terpenoids are known as derivatives that inhibit the release of autocoids and prostaglandin thereby inhibiting the motility and secretion induced by castor oil.

In the acute toxicity test, *B. pinnatum* ethanolic leaf extract produced neither overt toxicity nor death during the 14 days observation period following oral administration of 10,100,1000 mg/kg at the first phase and the second phase of 1800, 2600 and 5000 mg/kg. The absence of mortality and signs of overt toxicity suggested that *B. pinnatum* has a wider safety margin and LD₅₀ value greater than 2000 mg/kg in rats. This is in agreement with Amabe et al. [8], who recorded no toxicological effects in acute toxicity study of *B. pinnatum* even at a higher dose of 5 g/kg and Ozolua et al. [19], who reported no death at maximum acute dose of 5 g/kg body weight, and subacute treatment was found not to alter animal weights, animal weight and fluids intake. This is an indication that the leave extract is relatively safe for animal use.

Significant diarrhoea observed in castor oil induced rat could be as a result of increase in the volume of intestinal contents, by preventing the re-absorption of water, the liberation of ricinoleic acid that results in irritation and inflammation of intestinal mucosa leading to release of prostaglandin, this has also been reported by Shamkuwar and Shahi [20]. Leaf extract of *B. pinnatum* produced statistically significant protection against diarrhoea and was found to have higher percentage inhibition compared to loperamide; a drug widely employed against diarrhoea disorders which effectively antagonizes diarrhoea induced by castor oil, prostaglandin, infection and cholera toxin. The pharmacological effect of loperamide is due to its antimotility and antisecretory properties while the antidiarrhoeal activities of medicinal plants could be due to the presence of bioactive agents such as tannins, alkaloids, saponins, flavonoids, steroids and terpenoids as reported in the finding of Sharma et al. [14] while the flavonoids are known to inhibit intestinal motility and hydroelectrolytic secretion. The result observed in castor oil induced diarrhoea is in support of previous claims in respect of antidiarrhoeal herbs [6,21,22]. A medicinal plant is said to be considered as an antidiarrhoeal once it can reduce the amount of fluid loss, frequency and consistency of the stool [14].

The extract significantly reduced both the weight and volume of intestinal content in enterpooling,

this also corroborates with the report [23]. This is expected, because the extract might have exerted its antidiarrhoeal action by antisecretory mechanism as the effect of the extract was partly similar to loperamide. The plant extract also inhibited normal gastric emptying; this effect may be linked to the reduction in gastrointestinal propulsion observed in the rats. Decrease in intestinal transit time by morphine and atropine is linked to a delay in gastric emptying as it was earlier reported by Sharma et al. [14]. This suggests that the plant may have morphine-like action in exerting its antidiarrhoeal activity this result is in agreement with Bakare et al. [6], Pandey et al. [23]. The pronounced inhibition of castor oil induced intestinal fluid accumulation (enterpooling) and the weight of the intestinal content could possibly be linked to the presence of terpenoids and flavonoids that increase the reabsorption of electrolytes and water by hindering castor oil mediated Nitric Oxide synthesis. However, the antidiarrhoeal effect of flavonoids has been ascribed to their ability to inhibit intestinal motility. Flavonoids are also able to inhibit the intestinal secretory response induced by prostaglandin [24].

Evaluation of intestinal transit, demonstrated a significant reduction in the intestinal propulsive movement of charcoal meal in the rat in comparison to the positive control at all the test dosage (200,300 and 500 mg/kg body weight). Besides, the extract showed a similar effect in experimental rats as compared to standard drugs. This is comparable to other studies, in which the extract significantly inhibited the distance travelled by charcoal meal [6,14]. Alkaloids and terpenoids have been demonstrated to have an inhibitory effect on gastrointestinal motility [24]. Although the phytochemical constituents responsible for the antidiarrhoeal effect are yet to be identified, the amount of phytochemical constituents that are responsible for impeding gastrointestinal motility such as tannins and alkaloids appear to increase with dose. This could possibly be the reason why the significant anti-motility effect was observed at the higher dose of the ethanolic leave extract, this corresponds to the findings of Sharma et al. [14] where higher dosage of *B. pinnatum* inhibited diarrhoea significantly compared to the lower dosage.

4. CONCLUSION

The global increase in antibiotics resistance and a side effect of over the counter antidiarrhoeal drugs is a major concern and

requires innovative strategies to control diarrhoea. In the evaluation of antidiarrhoeal activity in clinical cases of rats, *Bryophyllum pinnatum* showed improvement in faecal consistency, therefore it could be considered suitable for the treatment of infectious and non-infectious diarrhoea. Further studies should be carried out on purification and the structural elucidation of the extracts to ascertain the main bioactive component of the extract responsible for the antidiarrhoeal activity.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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