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Preliminary toxicity and gastroprotective potential of flavonoid-rich fractions of leaves from *Opilia celtidifolia* (Guill. & Perr.) Endl. ex Walp (Opiliaceae)

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ABSTRACT

Objective: In Burkina Faso as in other developing countries, the diarrheal diseases constitute a serious problem of public health. To treat diarrhea, most Burkina Faso people living in the rural areas do rely on medicinal plants. To evaluate the traditional use of *Opilia celtidifolia*, scientific validation is needed.

Methods: The collected plant materials were dried, pulverized, and aqueous acetone extracts were prepared. The serially diluted fractions of the extracts and finally reach the flavonoid-rich fractions which assayed for antibacterial activities against selected enteropathogens by agar well diffusion method, minimum inhibitory concentration and minimal bactericidal concentration respectively. The anti-diarrheal activity was evaluated using castor oil induced diarrhea, magnesium sulphate-induced diarrhea and gastrointestinal transit test examined in animal models respectively.

Results: Flavonoid-rich fractions has positive effects in a dose dependent manner against diarrhoea induced by castor oil, magnesium sulphate-induced diarrhea and gastrointestinal transit test examined in animal models. The bioactive fraction also showed good antimicrobial activity against all bacteria strains and compared to the ciprofloxacin.

Conclusions: These findings indicate that the flavonoid-rich fraction possesses antidiarrheal property in rats and confirm the ethnomedicinal use of *Opilia celtidifolia* a valuable natural remedy for the treatment, management and/or control of diarrhea. The results provided some insight into the gastroprotective potential of this plant traditionally used by the people of Burkina Faso to treat diarrhea.

Keywords: Flavonoid-rich fractions, Leaves, *Opilia celtidifolia*, Gastroprotective potential

Introduction

Diarrhea is a gastrointestinal tract (GIT) dysfunction, which is considered as a common symptom of infection and one of the causes of intestinal motility disorder.[1] It causes loss of water and important nutrients from GIT in addition to increasing intestinal motility.[2]

Gastrointestinal disorders are significant health concerns in Burkina Faso and other least developed countries which substantially affect worldwide morbidity and mortality rates. Diarrhea in particular, is a leading killer of children, accounting for 9% of all deaths among children under age 5 worldwide in 2015, with over 1400 young children dying each day, or about 526 000 children per year.[3,4] It is a common cause of death in developing countries including Burkina Faso and the second most common cause of infant deaths worldwide.[5] In addition, many rural populations leave very far away from health centers, thus limiting their access to medication. In these conditions, medicinal plants appear as an alternative and available health care solution. Hence, some African medicinal plants have been reported for their efficiency in the treatment of diarrhea, thanks to the contribution of many researchers.[6] In Burkina Faso, traditional medicine is mainly based on the use of medicinal plants.[7] There are many medicinal plants that possess gastro protective effects activity with lesser side effects than the conventional drugs. Therefore, a search for plants with antidiarrhoeal and antimicrobial activities that could be used against any type of diarrhoeal disease is of high interest.

Opilia celtidifolia (Guill. & Perr.) Endl. Ex Walp (Opiliaceae) which is widely distributed throughout tropical Africa enjoys a number of ethnomedical uses in Burkina Faso. It is a native tosub-Saharan Africa and is essentially tropical in origin. In the western part of Burkina Faso, the leaves of this plant are used to treat cardiovascular diseases. It possesses hypotensive, hypolipidemic-delite, antioxidant, antibacterial and anti-inflammatory properties.[8] In traditional medicine, *Opilia celtidifolia* (Guill. &Perr.) Endl. ex Walp (Opiliaceae) is used to treat various diseases like diarrhea, abdominal tumours, asthma, epilepsy, eye infections, fever, inflammation, leprosy, oedema, paralysis, rheumatic pain, skin diseases, urinary disorders, ulceration and vomiting, anthelmintic, antihypertensive, aphrodisiac, diuretic, remedy against poisons and tonic to the brain, liver and spleen.[8] This plant is well known for these properties pharmacological in particularly these properties anti-diarrheal. Thus, the present study sought to evaluate the possible gastro protective effects of flavonoid-rich fractions from the leaves of this plant in models using rats, as well as its acute toxicity.

Materials and Methods

Plants material

The vegetable materials (Fresh leaves) of *Opilia celtidifolia* (Guill. & Perr.) Endl. ex Walp (Opiliaceae) were collected in August 2014 in Dedougou, 230 km West of Ouagadougou, capital of Burkina Faso. This plant was botanically identified by Dr. Traoré Lassina from the plants Biology Department of University Nobert Zongo from Koudougou.

Bacterial strains and antibiotic

Microorganisms used in this study were isolated from clinical samples at Laboratory of the General Hospital of Ouagadougou in Burkina Faso. Commercially available antibiotic diffusion discs (10 µg/disc) were purchased from Alkom Laboratories LTD. Clinical isolates were: *Shigella dysenteriae*, *Shigella boydii*, *Shigella flexneri*, *Salmonella thyphi*, *Klebsiella pneumonia*, *Klebsiella arogenes*, *Escherichia coli*, *Proteus mirabilis* and *Staphylococcus aureus*. The following microorganisms were all identified by the use of their biochemical profiles as recommended by the manual "Bactériologie Medical".[9]

Preparation of aqueous acetone extract for acute toxicity study

The field grown fresh samples were washed with tap water followed by distilled water to remove the adhering dust particles. After blotting, samples were air dried in shade. The dried plant materials were ground to fine powder and stored

in clean air tight containers. A sample of 50 g of leaves was placed in the soxhlet and run by using 80% aqueous acetone (500 ml) in 1/10 ratio (w/v) for 24 h under mechanic agitation at room temperature. After filtration all the extracts were dried in vacuum rotary evaporator at 40°C under reduced pressure. Extracts were weighed and stored at 4°C for further analysis.

Flavonoid-rich fractions extraction

The fresh harvested plant materials (100 grams of leaves) were dried in the laboratory at room temperature (20–25°C); afterwards samples were ground to pass a sieve of 0.3 mm. Flavonoid-rich fractions were extracted with aqueous acetone (80%, v/v). The extracts were then washed with hexane to remove chlorophyll and other low molecular weight compounds. Acetone was evaporated and then the aqueous extract with ethyl acetate is used to separate by sequential liquid-liquid extraction. The flavonoid-rich fractions were lyophilized and stored at 22°C prior to biological tests. For the tests, lyophilized sample was dissolved with 10% DMSO in water at the desired concentration.

Antimicrobial profile of flavonoid-rich fractions

Preparation of inocula

The susceptibility tests were performed by Mueller Hinton agar-well diffusion method[10]. The bacterial strains grown on nutrient agar at 37°C for 18 h were suspended in a saline solution (0.9%, w/v) NaCl and adjusted to a turbidity of 0.5 Mac Farland standard (10^8 CFU/ml). To obtain the inocula, these suspensions were diluted 100 times in Muller Hinton broth to give 10^6 colony forming units (CFU)/ml.[11]

Preparation of discs

The stock solutions of phenol acid-rich fractions of roots from *Opilia celtidifolia* L, was dissolved in 10% dimethylsulfoxide (DMSO) in water[12] at a final concentration of 100 µg/ml after a serial two-fold dilution. Each stock solution of flavonoid-rich fractions was sterilized by filtration through 0.22 µm sterilizing Millipore express filter. The sterile discs (6 mm) were impregnated with 10 µL of the sterile flavonoid-rich fractions. Negative controls were prepared using discs impregnated with 10% DMSO in water and commercially available antibiotic diffusion discs (Ciprofloxacin) from Alkom Laboratories Ltd) were used as positive reference standards (10 µg/disc) for all bacterial strains.

Agar well diffusion method

Petri plates (9 cm) were prepared with 20 ml of a base layer of molten Mueller Hinton agar (DIFCO, Becton Dickinson, USA). Each Petri plate was inoculated with 15 µl of each bacterial suspension (10^6 CFU/ml). After drying in a sterile hood, 6 mm diameter discs soaked with 10 µl of the different flavonoid-rich fractions dilutions were placed on the agar.

Discs containing Ciprofloxacin (10 µg/disc) were used as positive controls and 10% DMSO was used as a negative control. The plates were incubated for 24 h at 37°C and at 44°C for *Escherichia coli* because this bacterium is thermoresistant. The diameters of the inhibition zones were evaluated in millimeters. The flavonoid-rich fractions inducing inhibition zone ≥ 3 mm around disc were considered as antibacterial. All tests were performed in triplicate and the bacterial activity was expressed as the mean of inhibition diameters (mm) produced.[13]

Micro-well dilution assay

Minimum inhibitory concentration (MIC) was determined by the microdilution method in culture broth as recommended by.[14] Eight serial two-fold dilutions of flavonoid-rich fractions were prepared as described before, to obtain final concentration range of 400 to 3.125 µg/ml. The 96-well micro-plates (NUNC, Denmark) containing 100 µL of Mueller Hinton (MH) broth were used. For each bacteria strain, three columns of eight wells to the micro-plate were used. Each well has getting: the culture medium + flavonoid-rich fractions + inoculum (10 µl of inocula) and INT (50 µl; 0.2 mg/ml). The plates were covered and incubated at 37°C and at 44°C

for *Escherichia coli* for 24 h. All tests were performed in triplicate and the bacterial activity was expressed as the mean of inhibitions produced. Inhibition of bacterial growth was judged by rose or yellow colour. The MIC was defined as the lowest concentration of extract or fraction of extract at which no colony was observed after incubation. So, the MIC was defined as the lowest concentration at which no visible growth was observed.

Minimal bactericidal concentration

Minimum bactericidal concentration (MBC) was recorded as a lowest flavonoid-rich fractions concentration killing 99.9% of the bacterial inocula after 24 h incubation at 37°C. Each experiment was repeated at least three times. MBC values were determined by removing 100 µl of bacterial suspension from subculture demonstrating no visible growth and inoculating nutrient agar plates. Plates were incubated at 37°C for a total period of 24 h. The MBC is determined with the wells whose the concentrations are ≥ MIC.[13,15] The MBC were determined in Mueller Hinton (MH) agar (DIFCO, Becton Dickinson, USA) medium.

Evaluation of bactericidal and bacteriostatic capacity

The action of an antibacterial on the bacterial strains can be characterized with two parameters such as Minimum inhibitory concentration (MIC) and Minimum bactericidal concentration (MBC). According to the ratio MBC/MIC, we appreciated antibacterial activity. If the ratio MBC/MIC = 1 or 2, the effect was considered as bactericidal but if the ratio MBC/MIC = 4 or 16, the effect was defined as bacteriostatic.[16]

Antidiarrheal activity test

Animals handling

Swiss NMRI mice (25–30 g) of both sexes were used for acute toxicity and Wister albino rats (180–240 g) of both sexes were used for antidiarrhea and antipyretic activities. All animals were housed in cages under controlled conditions of 12 h light/and 12 h without light and 25°C.They received pellets of food enriched with 20% protein and water ad libitum. They were deprived of food for 15 h (but with access to drinking water) and weighed before the experiments. Experiments on the animals were performed according to the protocols already approved by the Institute of Health Sciences Research/University of Ouagadougou (Burkina Faso) and met the international standards for animal study.[17]

Acute toxicity study in mice of aqueous acetone extract

Healthy male and female Swiss mice (25-30g) were randomly divided into 7 groups (1 control group and 6 treated assay groups) of 6 animals (3 male and 3 female). The control group received water containing 10% dimethylsulfoxide (DMSO) administered intra-peritoneally. The water/acetone of extract of leaves from *Opilia celtidifolia*, suspended in 10% DMSO was administered respectively intra-peritoneally at doses of 1; 2; 2.5; 3; 4; 5 and 6g/kg. The general behaviour of the mice was observed for 120 min after the treatment. The animals were observed for morbidity and mortality once a day for 14 days. The number of survivors after the 14 days period was noted. The toxicological effect was assessed on the basis of mortality for 14 days, which was expressed as the median lethal dose (LD50) (Lethal Dose 50) was estimated from the regression of log-probit mortality rate.[18]

Antidiarrhoeal activity

Castor oil induced diarrhea

The method described by, was followed for this study with slight modification.[19] The animals were all screened initially by giving 0.5 mL of castor oil one week before the actual experiment. Only those showing diarrhoea were selected for the final experiment. Twenty five mice fasted for 24 h were randomly allocated to five groups of five animals each. Group I (received 1% tween 80 at a dose of 10 ml/kg) served as control group, Group II received the standard drug loperamide 3 mg/kg *p.o*, Group III, IV and V received flavonoid rich-fractions of *Opilia celtidifolia* at the doses of 100, 200 and 300 mg/kg *p.o*, respectively. One hour after

administration, all animals received 0.5 ml of castor oil and then they were individually placed in cages, the floor of which was lined with transparent paper. During an observation period of 4 h, the time of onset of diarrhoea, the total number of faecal output (frequency of defecation) and weight of faeces excreted by the animals were recorded.

Magnesium sulphate-induced diarrhea

A similar procedure as for castor oil induced diarrhea was maintained for magnesium sulphate induced diarrheal model. The tested samples including loperamide (5 mg/kg) as standard, 0.9% normal saline (2 ml/kg) as control and plant fraction at the doses of 100, 200, and 300 mg/kg body weight were given orally to the rats and 30 min later of pre-treatments, magnesium sulphate (2 g/kg) was administered orally to the animals. Then they were placed in cages lined with adsorbent papers and observed for 4h for the presence of characteristic diarrheal droppings.

100% was considered as the total number of feces of control group the activity was expressed as% inhibition of diarrhea.

The percent (%) inhibition of defecation was measured.[20]

The percent (%) inhibition of defecation was measured using the following formula:

Percent (%) inhibition of defecation = $[(A - B)/A] \times 100$,

Where A is mean number of defecation time caused by castor oil and B is mean number of defecation time caused by drug or fraction.

Gastrointestinal transit test

The method was adopted for the determination of the effect of flavonoid rich-fractions from *Opilia celtidifolia* on gastrointestinal transit in the rats.[21] The test animals were fasted (without food, but water) for 18 h prior to the commencement of the experiment. The selected rats for castor oil-induced diarrheal test were divided into five groups (n=10). Animals in the positive control groups received loperamide (5 mg/kg) body weight and control group received 0.9% normal saline (2 ml/kg) orally while those in the test groups received flavonoid-rich fractions at the doses of 100, 200, and 300 mg/kg body weight of the fraction. After 30min, all the animals were again administered orally with 1ml of charcoal meal (10% charcoal suspension in 5% gum acacia). At half an hour post administration of the charcoal meal, all animals were sacrificed and the distance covered by the charcoal meal in the intestine, from the pylorus to the caecum, was measured and expressed as percentage of distance moved.[25] The percentage of the length of the small intestine according to the following expression:

Intestinal transit (%) = (Distance travelled by charcoal meal/Length of small intestine) (cm) x 100

Statistical analyses

Data were expressed as mean±standard deviation (SD) of six experiments (n = 6). Results were analyzed by one-way ANOVA followed by Dunnett's t-test using Prism 4 software. The level of significance was considered at $p \leq 0.05$.

Results and Discussion

Antimicrobial profile

In this study, nine bacteria strains (gram-negative and grampositive bacteria) were used. The antibacterial assays were performed by the agar-well diffusion and the broth micro dilution methods so that they could be qualified and quantified by inhibition zone diameters, MIC, MMC or MBC. We noticed that the susceptibility of the bacteria to flavonoid-rich fractions on the basis of inhibition zone diameters varied according to the microorganism and bacteria strains were more sensitive to flavonoid-rich fractions than reference compound (ciprofloxacin); the results are reported in Table 1. There is a significant variation in the diameters of inhibition zone values of flavonoid-rich fractions (Table 1). As for the micro-well dilution assay (MIC) and MBC of flavonoid-rich fractions, result varied according to microorganism (Table 2). The MIC

Table 1: Inhibition zone diameters (mm) recorder in agar well diffusion assay using flavonoid-rich fractions from *Opilia celtidifolia* leaves and ciprofloxacin (10 µg/disc).

Microorganisms	Ciprofloxacin (10 µg)	Flavonoid-rich fractions
Staphylococcus aureus	13.00±1.20	28.33±0.54
Proteus mirabilis	21.66±0.58	26.66±0.58
Shigella dysenteria	22.00±1.00	25.00±1.00
Shigella boydii	22.66±0.58	24.33±1.10
Shigella flexneri	nd	26.66±1.63
Salmonella thyphi	23.66±0.58	27.00±1.00
Klebsiella pneumonia	20.66±0.54	26.00±1.00
Klebsiella arogenes	19.66±0.58	22.00±1.20
Escherichia coli	18.00±0.58	21.66±0.58

The results are the means of number of the colonies±standard deviations. nd: no detected activity.

Table 2: Bacteriostatic (-) and bactericidal (+) effects of flavonoid-rich fractions from *Opilia celtidifolia* leaves.

Microorganismes	MIC (µg/ml)	MBC (µg/ml)	Effects
Staphylococcus aureus	12.5±0.00	25±0.00	+
Proteus mirabilis	25±0.00	50±0.00	+
Shigella dysenteria	50±00	100±0.00	+
Shigella boydii	50±0.00	100±0.00	+
Shigella flexneri	25±0.00	50±0.00	+
Salmonella thyphi	25±0.00	50±0.00	+
Klebsiella pneumonia	100±0.00	50±0.00	+
Klebsiella arogenes	100±0.00	400±0.00	-
Escherichia coli	100±0.00	400±0.00	-

The results are the means of number of the colonies±standard deviations. **+:** bactericidal effect, **- :** bacteriostatic effect.

Table 3: Effect of flavonoid-rich fractions from *Opilia celtidifolia* leaves on castor oil induced diarrhea in rats.

Treatment	Dose (mg/kg, *p.o.*)	Time of onset of diarrhea (min)	Total number of faeces in 4 h (frequency of defecation)	% inhibition of defecation	Weight of stool (g)
Group I		88.2±1.0	8.1±1.2	-	0.71±0.10
Group II	**3**	227.4±1.1***	1.4±0.1***	82.72	0.06±0.05***
Group III	**100**	152.6±0.1*	4.7±0.2*	41.78	0.36±0.04***
Group IV	**200**	197.2±0.5***	3.7±0.4**	54.32	0.21±0.01***
Group V	**300**	214.4±0.1***	1.8±0.1**	77.78	0.02±0.05***

Results are mean±SEM and significantly different when compared withthat of the control at *p<0.05, **p<0.01, ***p<0.001.

values were ranged from 12.5 to 100 µg/mL and the MBC values were ranged from 25 to 400 µg/mL. The bactericidal and bacteriostatic effect was determined using the ratio MBC/MIC (Table 2).

Antidiarrhoeal effects

Acute toxicity study of the plant extract

The acute toxicity of extract was evaluated in mice. The effect of intraperitoneal treatment of

aqueous acetone extract from *Opilia celtidifolia* on mortality and LD50 value were determined. The value of LD50 is 636.2 mg/kg body weight for intraperitoneal administration and the various observations showed normal behavior of the treated mice.

Castor oil induced diarrhea

Flavonoid-rich fractions from *Opilia celtidifolia* were found to be effective in a dose dependent manner against castor oil induced diarrhoea in Rats. At the dose of 300 mg/kg body weight, the fraction produced a significant decrease in the severity of diarrhoea in terms of the rate of defecation and consistency of faeces in Rats. Flavonoid-rich fractions at the doses of 100, 200, and 300 mg/kg, exerted statistically significantly ($p<0.001$) decreased and dose-dependent inhibition of the total number of diarrheal feces compared with the control groups (Table 3).

Magnesium sulphate-induced diarrhea

In Magnesium sulphate-induced diarrheal model, flavonoid-rich fractions from *Opilia celtidifolia* at the doses of 100, 200 and 300 mg/kg showed statistically significantly ($p<0.001$) and dose-dependent prevention the total number of diarrheal feces compared with the control groups (Table 4).

Gastrointestinal transit test

The administration of castor oil resulted in intestinal fluid volumes and weights of the intestinal contents of the rats (from the pylorus to the caecum) were statistically significantly ($p<0.001$) and dose- dependently reduced by both flavonoid-rich fractions from *Opilia celtidifolia* at the doses of 200, and 300 mg/kg compared to the control group (Table 5).

The results of acute toxicity showed that the plant extract did not cause any death at the end

Table 4: The antidiarrheal effect of flavonoid-rich fractions from *Opilia celtidifolia* leaves on magnesium sulphate-induced diarrhea models in rats.

Treatment	Dose (mg/kg)	Total number of feces	% of inhibition	Total number of diarrheal feces	% of inhibition
Control	2 ml/kg	18.46±1.64	-	12.54±0.54	-
Loperamide	5	7.62±0.11***	58.72	4.96±0.37***	60.45
Flavonoid-rich fractions	100	13.71±0.10*	25.73	8.92±0.10*	28.87
	200	10.43±0.37***	43.50	6.78±1.63***	45.93
	300	8.46±0.54***	54.17	5.40±0.11***	56.94

Each value is presented as the mean±SEM (n=10), flavonoid-rich fractions from *Opilia celtidifolia* leaves: ***p<0.001 compared with the control group (Dunnett's Test); **p<0.01 compared with the control group (Dunnett's Test); *p<0.05 compared with the control group (Dunnett's Test).

Table 5: The anti-motility effect of flavonoid-rich fractions from *Opilia celtidifolia* leaves on gastrointestinal transit test in rats.

Treatment	Dose (mg/kg)	Total length of intestine (cm)	Distance travel by charcoal (cm)	% of inhibition
Control	2 ml/kg	108.60±1.07	104.60±0.73	-
Loperamide	5	106.00±1.67	52.00±0.60***	50.29
Flavonoid-rich fractions	100	108.40±1.07	58.40±1.10***	44.17
	200	106.60±1.67	54.40±0.60***	47.99
	300	105.00±1.07	47.20±1.63***	54.88

Each value is presented as the mean±SEM (n=10). ***p<0.001 compared with the control group (Dunnett's Test). **p<0.01 compared with the control group (Dunnett's Test). *p<0.05 compared with the control group (Dunnett's Test).

of the 7 days of experimentation. Moreover, some behavioral modifications that were observed after administration of extract at higher doses, returned to normal after 48 h. According to any product with LD_{50} higher than 5 g/kg is regarded as non toxic supporting the hypothesis that the extract might not be toxic.[22] The drop in sensitivity and social interaction could be related to a depressive effect caused at the level of the central nervous system as previously mentioned by.[23]

Concerning the potential antimicrobial, one could say that leaves from *Opilia celtidifolia* exhibited broad spectrum of antibacterial activity. It was observed in the present study that flavonoid-rich fractions from *Opilia celtidifolia* inhibited the growth of all pathogenic bacteria tested. Our extract for study constitutes essentially total flavonoids. The antimicrobial activity could be due to the presence of these phytoconstituents. This antibacterial activity might be due to the presence of chemical compounds such as tannins, phenolic compounds, polyphenols and flavonoids.[24] Then, about antibacterial activity, we remark that fraction showed relatively the best inhibitory activity against the Gram-positive bacteria comparatively to the Gram negative bacteria. This difference could be due the nature of each bacterial strain. Gram-negative bacteria possess an outer membrane and unique periplasme space not found in Gram-positive bacteria.[25]

In our present study the flavonoid-rich fractions from *Opilia celtidifolia* was evaluated for its antidiarrheal potential against castor oil induced diarrhea and Magnesium sulphate-induced diarrheal model in rats. In respect to demonstrate the probable mechanisms, the anti-motility effect was also tested using gastrointestinal transit test in rats. Loperamide, the standard drug, generally produces rapid and sustained inhibition of peristaltic reflex through depression of longitudinal and circular muscle activity. It is well known to reduce the daily fecal volume and decreases intestinal fluid and electrolyte loss. The antidiarrheal activity of the plant extract was comparable to the standard drug, loperamide, which at present is one of the most efficacious and widely employed antidiarrheal drug. In our investigation, loperamide proved the claims by causing effectively antagonizes diarrheal activity induced by castor oil. Loperamide, apart from regulating the gastrointestinal tract, is also reported to slow down transit in the intestine, reduce colon flow rates and consequently any effect on colonic motility. It also decrease the number of diarrheal feces. It is widely known that Ricinoleic acid, the active component of castor oil, is responsible for its diarrhea-inducing property.[26] It stimulates peristaltic activity in the small intestine, leading to changes in the electrolyte permeability of the intestine mucosa. Its action also stimulates the release of endogenous prostaglandins, which in turn stimulate motility and secretion.[27] Medicinal plants are a promising source of antidiarrheal drugs.[28] The present study showed that the flavonoid-rich fractions exhibited a significant inhibition of castor oil-induced diarrhea in experimental mice. Phytoconstituents present in plants are responsible for antidiarrheal activity.[28] The above constituents may be present in the studied extracts. Further studies are needed to isolate the active substances from fraction of plant for a clear understanding of the mechanisms of their actions.

Conclusions

These findings indicate that the flavonoid-rich fraction possesses antidiarrheal property in rats and confirm the ethnomedicinal use of *Opilia celtidifolia* a valuable natural remedy for the treatment, management and/or control of diarrhea. The results provided some insight into the gastro protective potential of this plant traditionally used by the people of Burkina Faso to treat diarrhea.

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