INTRODUCTION

Diarrhoea can be defined as an alteration in the normal bowel movement, characterized by at least three loose or liquid bowel movements each day and adult daily stools exceed 300 g and contains 60-95 % water. It can result in dehydration due to fluid loss and can lead to death. The common reason for causing diarrhoea is gastrointestinal infection by various types of bacteria, virus, and parasites. According to WHO, after pneumonia it is second most common cause of infant mortality in developing countries, and it is responsible for the death of about 2-4 million children every year, especially in Africa and it is still a big public health problem in developing countries. Due to unhygienic livelihood condition especially in rural areas, peoples are prone to diarrhoea and several other diseases. This infection can be spread out through food, drinking water, and unhygienic environment. Furthermore rural populations live very far away from health centers, so there is lack of availability of proper medical facilities. There are many antibiotics available that are used as anti-diarrhoeal drug, but these drugs sometimes show some adverse effects and microorganisms are tend to develop resistance against them. In these conditions, medicinal plants appear as an alternative health care solution in the management of diarrhoea. The roles of plants in maintaining human health are well documented. Many plant species have been screened for substances with therapeutic activity. For the treatment of diarrhoea, medicinal plants are a potential source of antidiarrhoeal drugs. Bombax buonopozense P. Beauv. (Bombacaceae) is a tropical tree that grows up to 40 meters in height with large buttress roots that can spread six meters. It is native primarily in West Africa where it is found in rainforests of Sierra Leone in the northwest, east Gabon. It has common vernacular names in different languages such as Vabga (Dagbani) and Kurya (Hausa) and different parts are used for different purposes. The bark of younger trees is covered with spine and shedding the spines with age to some degree and large deep pink to-red flowers emerge while the tree is leafless. The leaves are compound and have 5 to 9 leaflets and 15 to 25 secondary veins. The individual leaflets have entire margins and are large. The undersides of the leaflet may be glabrous or
The conspicuous flowers emerge while the tree is leafless and are either solitary or arranged in small auxiliary cymes. There is limited scientific evidence supporting the potential use of leaves of *Bombax buonopozense* as an antidiarrhoeal agent. Present study therefore investigated the scientific basis for the efficacy of its antidiarrhoeal properties.

**MATERIALS AND METHODS**

**Plant collection**
The leaves of *Bombax buonopozense* were collected from Suleja, Niger State by an experienced, identified and authenticated. The plant material was air-dried at room temperature and pulverized into a dry powder, then macerated with 70% methanol in water for 72 hrs with constant shaking. The resultant mixture was filtered using Whatman (No 1) filter paper and the filtrate was concentrated using a rotary evaporator and dried on a water bath to give a yield 7.7% (w/w). The extract was reconstituted in normal saline at appropriate concentrations for the various experiments conducted.

**Animals used**
Albino wistar rats (150-230g) of either sex were selected for the study. The animals were maintained in a well-ventilated room with 12:12 hour light/dark cycle in polypropylene cages. The animals were used in accordance with the NIH Guide for the care and use of laboratory animals.

**Determination of antidiarrhoeal activity**

**Castor oil-induced diarrhoea**
Animals were fasted for 24 h but allowed free access to water. One hour after administration, all animals were given 0.5 ml of castor oil orally and individually placed in cages in which the floor was lined with transparent paper and changed every hour. The rats were divided into four groups of six animals each, diarrhoea was induced by administering of any treatment, 2 ml of castor oil orally to rats. Group I treated as control (2 ml/kg, p.o. saline), group II received Loperamide (5 mg/kg p.o) served as standard and group III and IV received extract (200 and 400 mg/kg, p.o) 1 hr before castor oil administration. Then observed for consistency of faecal matter and frequency of defaecation for 4 hrs.

\[
\text{\% of inhibition} = \frac{\text{Average no of WFC} - \text{Average no of WFT}}{\text{Average no of WFC}} \times 100
\]

here, WFC=average number of wet feces in control group and WFT=average number of wet feces in test group.

**Small intestinal transit**
Albino rats of either sex (200-250g) were randomly divided into five groups of six rats each. Rats were fasted for 24 hr divided into four groups of six animals each, Group I received 2ml normal saline orally, group II received atropine sulphate (5 mg/kg, i.p.), group III and IV received extract 200 and 400 mg/kg p.o respectively, 1 hr before administration of castor oil. One ml of marker (10% charcoal suspension in 5% gum acacia) was administered orally 1 hr after castor oil treatment. The rats were sacrificed after 1h and the distance travelled by charcoal meal from the pylorus was measured and expressed as percentage of the total length of the intestine from the pylorus to caecum.

**RESULTS**

**Castor oil-induced diarrhoea**
As shown in Table 1, it was observed that administration of methanol extract of *Bombax buonopozense*, induced insignificant decrease in the total number of feces and number of diarrhoeal feces and percent inhibition of diarrhoea.

| Group | Treatment | Number of wet feces in 4 hrs | % Inhibition |
|-------|-----------|-------------------------------|-------------|
| I     | Castor oil + Saline (2 ml/Kg p.o) | 13.3±0.43 | -- |
|       | Castor oil + Loperamide (5 mg/Kg i.p) | 9.20±0.37 | 66.43 |
| II    | Castor oil + Extract (200 mg/Kg i.p) | 13.00±0.89 | 52.62 |
|       | Castor oil + Extract (400 mg/Kg i.p) | 10.20±0.58 | 56.31 |

After 30 min administration of castor oil the diarrhoea was clinically apparent in all the animals of control group, for the next 4 h. This was markedly reduced by loperamide (2.5 mg/kg p.o) (75%). Marked reduction in the number of defecations over four hours was achieved with *Bombax buonopozense* at the doses of 200 and 400 mg/kg p.o.

**Small intestinal transit**
The percent intestinal transit was increased with control, but it was reduced in both doses of extract, and much more markedly by Loperamide (5 mg/kg i.p). Methanol extract of *Bombax buonopozense* 200 mg/kg, p.o dose of extract produced 42.58 % intestinal transit induced by castor oil respectively. Whereas, 400 mg/kg, p.o dose produced 53.68 % of castor oil induced charcoal meal transit (Table 2 and Figure 2).

**Statistical analysis**
All analyses were carried out in triplicates. Data were presented as mean±SEM. The significance of difference between the control and treated groups was determined using two way analysis of variance (ANOVA), followed by Student’s t-test. *P* value of 0.05 or 0.01 was considered as significant.
DISCUSSION
Diarrhoea is due to imbalance between the absorptive and secretory mechanisms in the intestinal tract, associated with excess loss of fluid in the faeces. Castor oil produces diarrhoeal effect due to its active component of recinoleic acid, inhibition of intestinal Na⁺, K⁺-ATP ase activity to reduce normal fluid absorption, activation of adenylyl cyclase, stimulation of prostaglandin formation, platelet-activating factor and recently nitric oxide was contribute to the diarrhoeal effect of castor oil. Since the alcoholic extract successfully inhibits the castor oil induced diarrhoea, the action might be via anti-secretary mechanism. Loperamide at present is one of the most efficacious and widely employed anti diarrhoeal agents and effectively antagonizes the action of castor oil due to its antimitotility and antisecretory property.

![Figure 2: Percentage of distance travelled by charcoal meal (cm) in albino rats.](image)

Table 2: Effect of methanolic extract of *Bombax buonopozense* on small intestinal transit in mice

| Group | Treatment | Total length of intestine (cm) | Distance travelled by charcoal (cm) | % Inhibition |
|-------|-----------|-------------------------------|------------------------------------|-------------|
| I     | Castor oil + Saline (2 mL/kg p.o) | 56.09±0.85 | 39.83±0.34 | --          |
| II    | Castor oil + Loperamide (5 mg/kg i.p) | 54.16±0.93 | 15.21±0.63 | 74.27       |
| III   | Castor oil + Extract (200 mg/kg i.p) | 48.20±0.66 | 26.72±0.63 | 42.58       |
| IV    | Castor oil + Extract (400 mg/kg i.p) | 51.06±0.83 | 23.81±0.84 | 53.68       |

At doses of 200 and 400 mg/kg, the methanol extracts of *Bombax buonopozense* showed significant antidiarrhoeal activity against castor oil-induced diarrhoea as compared with the control group. It significantly (P<0.01) reduced the frequency of diarrhoea and consistency of defecations. It also showed a dose related decrease in castor oil-induced diarrhoea. It was observed that, the administration of the extract of *Bombax buonopozense* in rats caused a significant reduction in the progression of charcoal meal and in the intestinal transit time.

CONCLUSION
Diarrhoea is a result of altered motility and fluid accumulation within the intestinal tract. Plants play a vital role in the maintenance of human health. Results conclude that the leaves extract of *Bombax buonopozense* contains bioactive natural substances with antidiarrhoeal properties thus justifying its widespread use by the local population for these purposes. Present study concluded that *Bombax buonopozense* contains pharmacologically active substances that are effective for management of diarrhoea. However, further in-vivo studies are required to fully investigate the mechanisms responsible for this observed antidiarrhoeal activity.

CONFLICT OF INTEREST
The author has declared that there is no conflict of interest related to this paper.

AUTHOR’S CONTRIBUTION
The manuscript was carried out, written, and approved in collaboration with all authors.

REFERENCES
1. Guerrant RL, Van Gilder T, Steiner TS, Theilman MN, Slutsker L. Practice guidelines for the management of infectious diarrhea. J Infect Dis 2001; 182: 331-351. https://doi.org/10.1093/cid/cix669
2. Abdullahi AL, Agho MO, Amos S, Gamaniel KS, Watanabe C. Antidiarrhoeal activity of the aqueous extract of Terminalia avicennoides roots. Phytother Res 2001; 15: 431-434. https://doi.org/10.1002/ptr.860
3. Valentine NN, Achidi EA, Gonsu HK, Lyonga EE, Mathew DE, Krsitiani B, Obama AMT. Epidemiology of rotavirus diarrhea in children under 5 years in Northern Cameroon. Pan Afr Med J 2012; 11: 73-75. PMID: 22655107
4. Wansi SL, Nguelefack TB, Watcho P, Ndam A, Kamanyi A. Effets spasmodigènes des extraits aqueux et au mélange methanol/ chlorure de méthylène (1:1) des feuilles de *Gmelina arborea* (Verbénacée) sur la motricité intestinale de rat. Cam J Exp Biol 2007; 2: 31-38. https://doi.org/10.4314/tjpr.v13i6.15
5. Synder JD, Merson MH. The magnitude of the global problem of acute diarrhoea disease. A review of active
surveillance data. Bull WHO 1982; 60:605-13. PMID: 6982783
6. Akuodor GC, Idris Usman M, Ibrahim JA, et al. Antinociceptive, anti-inflammatory and antipyretic effect of the methanolic extract of *Bombax buonopozense* leaves in rats and mice. Afr J Biotechnology 2011; 10: 3191-3196. https://doi.org/10.1007/s11418-007-0167-2
7. Mann A, Salawu FB, Abdulrauf I. Antimicrobial activity of *Bombax buonopozense*. Beav. (Bombacaceae) edible floral extracts. Eur J Sci Res 2011; 48(4):627-630.
8. Iroka Finian Chisom, Okereke Chukwu N, Okeke CU. Comparative phytochemical and proximate analyses on *Ceiba pentandra* (L) Gaertn. and *Bombax buonopozense* (P) Beauv.: Int J of Herbal Med 2014; 2(2): 162-167.
9. Watson WC, Gordon R. Studies on digestion absorption and metabolism of castor oil. Biochem Pharmacol 1962; 11:229-236. https://doi.org/10.1016/0006-2952(62)90078-3
10. Rouf ASS, Insam MS, Rahman MT. Evaluation of antidiarrhoeal activity of *Rumex maritimus* root. J Ethnopharmacol 2003; 84: 307-310. https://doi.org/10.1016/S0378-8741(02)00326-4
11. Atta AH, Mouneir SM. Antidiarrhoeal activity of some Egyptian medicinal plant extracts. J Ethnopharmacol 2004; 92:303-9. https://doi.org/10.1016/j.jep.2004.03.017
12. Longanga OA, Vercruysse A, Foriers A. Contribution to the ethnobotanical, phytochemical and pharmacological studies of traditionally used medicinal plant in the treatment of dysentery and diarrhoea in Lomela area, Democratic Republic of Congo (DCR). J Ethno Pharmacol 2000; 71:411-3. https://doi.org/10.1016/S0378-8741(00)00167-7
13. Beentje H, Sara S. Plant systemic and phytogeography for the understanding of African Biodiversity. Systemics and Geography of plants 2001; 71: 284-6.