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Original Article

Antidiarrhoeal Activity of Ethanolic Extract of Adansonia digitata Fruit Pulp in Rats

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Abstract

The antidiarrhoeal activity of ethanolic extract of Adansonia digitata fruit pulp was evaluated in rats. Studies were investigated on castor oil –induced diarrhoea, castor oil induced fluid accumulation and electrolyte secretion. Adansonia digitata was orally administered to rats at dose rate of 250 and 500mg/kg and Loperamide was used at 3mg/kg as reference antidiarrhoeal drug.The extract produced a dose dependant and significantly protected rats against castor oil induced diarrhoea. The frequency of defecation as well as weight of the feces was significantly ($p>0.05$) reduced.A preliminary phytochemical screening of the ethanolic extract of A. digitata revealed the presence of, flavonoids, saponins, tannins triterpenes, alkaloids and glycosides.

Keywords: Adansonia digitata, antidiarrhoeal activity, castor oil.

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Introduction

African baobab is a very long-living tree, in the Sudan it was known locally as Tabaldi, the fruits are named Gunguleiz. Baobab leaves, bark, pulp and seeds are used as food and for multiple medicinal purposes in many parts of Africa (Diop et al., 2005).

The baobab fruit pulp can be considered a highly valuable source containing levels of vitamin C raging from 2.8-3 g/kg and this was six times more than the contents of an orange which was considered the best source of ascorbic acid. Higher levels of pro vitamin A were detected in the young leaves, especially when they are used as dried material (Sidibé, et al., 1996; El-Kamali, et al., 1999).

Diarrhoea is one of the main water-borne diseases, endemic in many regions of the world and considered to be the major health threats to the world populations, both in tropical and subtropical poor countries (Damiki and Siva, 2011).

People customarily using the plants or plant-derived preparations consider them to be efficacious against diarrhoeal disorders without any scientific basis to explain the action of such plants. WHO has encouraged studies for treatment and prevention of diarrhoeal diseases using traditional medicinal practices (Atta and Mouneir , 2004)

Diarrhoea is a common gastrointestinal disorder characterized by increased frequency of bowel, wet stool and abdominal pains (Ezekwesili et al., 2004; Farthings, 2002). Diarrhoea resulting from an imbalance between the screartory and absorptive forces in the intestine and it is an important symptom and complications of many disease of great public health importance .(Tijani et al., 2009) On the other hand, the WHO has contributed a Diarrhoeal Disease Control Programme including prevention, approach evaluations of health education and studies on traditional medicine uses for the management of the disease suggesting that the herbal treatment is still important (Synder and Merson, 1982).

The present study was aimed to verify the traditional claim that, *Adansonia digitata* possess antidiarrhoeal activity.

Materials and Methods

Plant Materials

The fruit pulp of *A. digitata* was purchased from a local Market in Khartoum, Sudan. The fruit pulps were made into powder, extracted at the Medicinal and Aromatic Plants Institute (MAPRI), the extract weight was 26.18 gm and its yield was 13.9%.

Phytochemical Screening

The freshly prepared extract was subjected to a standard phytochemical screening test for various constituents (Trease and Evans, 1993). The extract was screened for the presence of flavonoids, alkaloids, saponins, tannins, cumarin, triterpenes and glycosides.

Animals

White Albino rats weighing 100-120 g were obtained from the Medicinal and Aromatic Plant, Research Institute, National Centre for Research, Khartoum, Sudan, where they were maintained in a room under standard environmental condition, controlled temperature (22±25°C), and relative humidity (60%) and maintained on standard animal pellets and free access to water. Food was withheld for 24 hrs prior to each experiment.

Effect of A. Digitata on Castor Oil – Induced Diarrhoea in Rats

The method described by (Sunil et al., 2001), was followed. Twenty four male and female rats were distributed and divided randomly to 4 groups each group containing

6 rats. Group 1 (control) received 1ml normal saline/rat orally. Group 2 and 3were treated orally with ethanolic extract of A. digitata at doses 250 and 500 mg/kg body weight/rat, respectively. Group 4 received Lopermide at 3mg/kg body weight /rat, it was used as standard antidiarrhoeal drug. After sixty minutes all groups were received castor oil 1ml/rat. Each rat was then housed separately in a cage over clean filter paper and diarrhoea episodes were observed for a period of 24 hours. First defecation time and frequency of defecation were also recorded. Total weight of the feces and inhibition percentage was recorded 4 and 6 hours after the last treatment.

Effect of A. Digitata on Castor Oil – Induced Fluid Accumulation and Electrolyte Secretion

Following the method of (Dicarlo et al., 1994), rats were divided into 5 groups of 6 rats each. Groups 1 and 2 received normal saline, 1 ml/rat, groups 3 and 4 received the ethanolic extract of A. digitata at 250 and 500 mg/kg respectively and group 5 received Lopermide at 3mg/kg. One hour after the last treatment castor oil was administered to all groups except group 1, at 1 ml/rat. Two hours later all rats were sacrified and the small intestines were removed from pylorus to the cecum after ligating the ends .Intestinal contents was collected into graduated cylinder and the volume was measured and reduction percentage was calculated.

Blood was collected from ocular plexus of rats immediately before sacrified and serum was separated for detection of electrolyte using flamephotomrter.

Statistical Analysis

All the results were expressed as mean ± S E. One way analysis of variance (ANOVA) was used for the statistical analysis of data. Duncan ś multiple range tests was used for determining the significance. A probability value of $p<0.05$ was considered as significant (Snedecor and Cochram, 1989).

Results

Phytochemical Screening

The percentage yield of the ethanol extract of A. digitata was13.901% the results of the phytochemical screening revealed the presence of flavonoids, saponin, alkaloid, triterpenes, tannins, cumarin and glycosides (Table 1).

Effect of A. Digitata on Castor Oil – Induced Diarrhoea in Rats at 4 Hrs

The effect of the fruit pulp extract of A. digitata on weight of feces, frequency, accumulation, and inhibition rate at 4 hrs, are presented on table (2).

The ethanolic extract of A.digitata administered at the dose of 250, and 500 mg/kg showed 30% and 68% reduction in total weight of the feces, respectively. The reduction in diarrheal episodes was also significant and maximum effect is observed at the dose of 500 mg/kg.

Effect of A. digitata on Castor Oil – Induced Diarrhoea in Rats at 6 Hrs

Total weight of the feces, frequency of diarrhea and inhibition percentage was shown in table 3.After 6 hrs of the last treatment A.digitata ethanolic extract produced 60% and 78% inhibition of diarrhea at the dose rate of 250 and 500 mg/kg respectively where as the standard drug Loperamide showed significant reduction in diarrheal weight and recorded 84%. Similarly there was dose dependant decrease in frequency of diarrhoea.

Effect of A. Digitata on Castor Oil – Induced Fluid Accumulation and Electrolyte Secretion

Table 4 and 5 summarized the effect of A. digitata on castor oil –induced fluid accumulation and electrolyte secretion. A.

digitata ethanolic extract at 250 and 500n mg/kg, was found to demonstrate a significant reduction (21% and 24% respectively) in intestinal fluid accumulation due to castor oil, when compared to control group 1, at the same time it produced significant reduction in weight of intestinal contents. Treatment of rats with castor oil reduced the serum concentration of Na+ and K+, significantly when compared to the control while the concentration of these electrolytes increased significantly in groups treated with. A. digitata and Loperamide.

Table 1: Phytochemical analysis of ethanolic extract of Adansonia digitata.

Reaction	Phytochemical constituents	Results
Dragendorff test	Alkaloids	+
Acetic anhydride, Chloroform and sulphuric acid	Sterols	-
Acetic anhydride, Chloroform and sulphuric acid	Triterpens	+
Aluminum chloride and Potassium hydroxide	Flavonoids	+++
Frothing test	Saponins	+++
Potassium hydroxide	Cumarins	+
Gelatin and Ferric chloride	Tannins	+
Sodium picrate	Glycoside	+

+++ High concentration; ++ Moderate concentration; + Trace; - Negative.

Table 2: Effect of A. digitata on castor oil induced diarrhoea in rats after 4hrs.

Groups	Total weight of feces (g)	Frequency of diarrhoea	%inhibition of diarrhoea
G1 (castor oil 1ml/rat)	0.58 ± 0.048^{a}	1.83 ± 0.30^{a}	0
G2(*A. digitata* 250mg/kg+1ml castor oil/rat)	0.42 ± 0.04^{b}	1.16 ± 0.17^{b}	30%
G3(*A. digitata* 500mg/kg+1ml castor oil/rat)	0.12 ± 0.08^{c}	0.33 ± 0.21^{c}	68%
G4(3mg/kg lopermide+1ml castor oil/rat)	0.04 ± 0.04^{c}	0.16 ± 0.16^{c}	78%

Table 3: Effect of A. digitata on castor oil induced diarrhoea in rats after 6hrs.

Groups	Total weight of feces (g)	Frequency of diarrhoea	%inhibition of diarrhoea
G1(castor oil 1ml/rat)	0.41 ± 0.026^{a}	1.66 ± 0.14^{a}	0
G2(*A. digitata* 250mg/kg+1ml castor oil/rat)	0.30 ± 0.067^{ab}	1.16 ± 0.30^{ab}	60%
G3(*A. digitata* 500mg/kg+1ml castor oil/rat)	0.10 ± 0.056^{b}	0.50 ± 0.22^{c}	78%
G4(3mg/kg lopermide+1ml castor oil/rat)	0.055 ± 0.037^{b}	0.33 ± 0.21^{c}	84%

Table 4: Effect of A. digitata on castor oil induced fluid accumulation in rats.

Groups	Weight of intestinal contents (g)	Volume of intestinal contents (ml)	%reduction on Wt of intestinal contents
G1(control	1.51±0.14[ab]	1.10±0.14a[b]	100%
G2(castor oil 1ml/rat)	1.83±0.16[a]	1.42±0.18[a]	0
G3(*A. digitata* 250mg/kg+1ml castor oil/rat)	1.43±0.17[ab]	1.10±0.19[ab]	21%
G4(*A. digitata* 500mg/kg+1ml castor oil/rat)	1.38±0.14[ab]	0.92±0.10[b]	24%
G5(3mg/kg lopermide+1ml castor oil/rat)	1.25±0.16[b]	0.94±0.14[b]	31%

Table 5: Concentration of serum electrolytes in rats treated with A. digitata on castor oil induced diarrhea.

Groups	Na^+ (mmol L^{-1})	K^+ (mmol L^{-1})
G1(control	143.16±1.22[a]	5.90±0.20[a]
G2(castor oil 1ml/rat)	111.91±1.7[4b]	2.70±0.28[b]
G3(*A. digitata* 250mg/kg+1ml castor oil/rat)	122.75±2.34[c]	3.90±0.23[b]
G4(*A. digitata* 500mg/kg+1ml castor oil/rat)	133.66±2.19[ab]	4.34±0.61[c]
G5(3mg/kg lopermide+1ml castor oil/rat)	140.00±1.11[a]	5.79±0.49[a]

Means in the same column with the same letter are not significantly different (p>0.05).

Discussion

The preliminary phytochemical screening of the extracts of *A. digitata* revealed the presence of flavonoids, triterpenoids, tannins, alkaloids and glycosides. The anti diarrhoeal activity of flavonoids has been ascribed to their ability to inhibit intestinal motility and hydro-electrolytic secretion , which are known to be altered in diarrhoea (Carlo et al., 1993; Rao et al., 1997). *In vitro* and *in vivo* experiments have shown that flavonoids are able to inhibit the intestinal secretory response, induced by PGE_2 (Sanchez et al., 1997). There are reports that flavonoids also modify mucosal permeability and inhibit intestinal peristalsis (Ghazouli and Holzer, 2004), hence helpful in controlling diarrhoea. The presence of tannins (phenolic glycosides) may also contribute to the anti diarrhoeal activity of ethanolic extracts, since tannins may precipitate the proteins of enterocytes, reduce peristaltic movement and intestinal secretions (Okudo et al., 1989) The ethanolic extract of *A.digitata* administered at the dose of 250 mg and 500 mg/kg showed 30% and 68% inhibition of defecation , respectively, after four hours. The maximum significant ($p < 0.05$) effect is observed at the dose of 500 mg/kg comparable to control group (castor oil group), and at 6 hours time, the maximum dose of extract (500 mg/kg) showed almost similar antidiarrhoeal activity as that of loperamide (3mg/kg) 78%and 84%respectively. Castor oil induced diarrhoea by increasing the volume of intestinal content by prevention of reabsorption of water. The release of ricinolic acid stimulate release of prostaglandins, which results in stimulaltion of secretion (Pierce et al., 1971).

Wickens and Lowe (2008), stated that, two main factors attributed to the antidiarrhoeic action of baobab are thought to include the astringent action of the tannins causing an inhibition of osmotic secretions in addition to the anti-inflammatory action of the boabab mucilage on the intestinal mucous membrane. Similarly Gruenwald and Galizia (2005), reported that, the presence of tannins, mucilage, cellulose and citric acid present in the baobab may also have a role to play in the effects of baobab fruit pulp against diarrhoea.

Treatment of rats with castor oil significantly decrease the serum concentration of Na^+ and K^+ compared to the control where as treatment of rats with the ethanolic extract of *A. digitata* significantly increase the concentration of Na^+ and K^+ in the serum by increasing reabsorption of electrolytes. (Rouf et al., 2003), reported that, castor oil causes motility and secretary diarrhoea and the mechanism involved has been associated with dual effects on gastrointestinal motility as well as on water and electrolyte transport that decreasing Na^+ and K^+ absorption across the intestinal mucosa.

The results of this investigation revealed that *A.digitata* contains pharmacologically active substances with antidiarrhoeal properties. These attributes may provide the rationale for the use of *A.digitata* in diarrheoa management by traditional healers.

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