In vivo anti-diarrhoeal effect of methanolic stem bark extract of *Faidherbia albida*

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The *In vivo* anti-diarrhoeal effect of methanolic stem bark extract of *Faidherbia albida* was investigated. Column chromatography of the crude methanolic extract eluted with benzene/methanol, acetic acid/methanol and ethyl acetate/methanol gave three fractions designated: I, II and III respectively. In our previous study on the separated fractions, fraction III of the crude methanolic stem bark extract of *F. albida* showed highest antimicrobial activity against *Salmonella typhi*, *E. coli* and *Shigella* species. The phytochemical analysis of the crude methanolic stem bark extract of *F. albida* and fraction III (the most active fraction of the crude extract) revealed the presence of secondary metabolites such as tannins, saponins and alkaloids. Different concentrations of the extract were used for the *In vivo* analysis and the result revealed that, it was at 500 mg/kg body weight of the crude methanolic stem bark extract of *F. albida* that was able to maintain maximal inhibition, while 250 and 500 mg/kg body weight of fraction III given to the rats were able to maintain maximal inhibition of diarrhoea throughout the period of the study. These results confirmed the basis of using the stem bark of *F. albida* by traditional healers for treating diseases like diarrhoea.

Key words: *Faidherbia albida*, *In vivo* anti-diarrhoeal effect, phytochemical analysis.

INTRODUCTION

A medicinal plant is any plant which contains substance that can be used for therapeutic purpose and in which one or more of its organs or substances are precursors for the synthesis of useful drugs (WHO, 1977). A plant becomes a medicinal plant only when its biological activity has been ethnobotanically reported or scientifically established (Elujoba, 1997).

*Faidherbia albida* belong to the family *Mimosaceae* and is widely used in folk medicine in Africa. The plant is a large tree, 8 - 15 m high in Senegal (Dalziel, 1937) and up to 25 m in Nigeria (Keay et al., 1964). The common names of the plant include winter thorn and apple-ring acacia. The Hausa people of Northern Nigeria call it “Gawo” while in Fulfulde it is called “Chaski”. Contrary to all other native “acacias”, albida sheds its leaves during rainy season and keeps them throughout the dry season.

Barks and roots of the plant, whether alone or mixed with other components are common ingredients of traditional medicinal preparation for external or internal usage. These preparations are prescribed for respiratory infections, sterility, digestive problems, dysentery, backache, malaria, fever, heart and circulatory problems, dental infections and deafness (Fagg and Barnes, 1990).

An infusion or decoction of the plant is made with other plants in Senegal to treat “diangaracayor”, an inclusive term covering many diseases (Tijani et al., 2008). In Tanganyika, South-Africa, a decoction of the plant is taken for diarrhoea and as anti-emetic in fever (Wickens, 1969). The bark in decoction is used to cleanse new wounds, having an action akin to that of potassium permanganate, in the treatment of kidney pains, and mixed with other drugs for madness (Tijani et al., 2008). In Nigeria, infusion (tea) of the plants is taken for fever, cough and to assist in child birth (Singha, 1965). The Fulanis in Northern Nigeria use it for treatment of chest pain (Jackson, 1973).

Diarrhoea is one of the main causes of high mortality rate in developing countries where over five million children under the age of five die annually from severe diarrhoeal diseases (WHO, 1996). Diarrhoea is mostly common in over populated areas couple with poor hygiene. It is a major contributor to malnutrition and causes rapid dehydration in infant and elderly people, which could lead to death if not treated (WHO, 1995).

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Traditional healers in most of the developing countries patronise medicinal plants in the treatment of diarrhoea and other ailments without any scientific understanding of their efficacy. This work was therefore, designed to evaluate the \textit{in vivo} anti-diarrhoeal effect of methanolic stem bark extract of \textit{F. albida} in order to scientifically appraise the traditional uses of the plant.

\section*{MATERIALS AND METHODS}

\subsection*{Plant material}

The stem bark of \textit{F. albida} was collected around Yolde Pate Ward in Yola South Local Government Adamawa State, in June 2012. It was identified and authenticated at the Department of Plant Sciences, Modibbo Adama University of Technology, Yola, Adamawa State.

\subsection*{Experimental animals}

Forty (40) apparently healthy white albino rats of both sexes were used for the study. The rats were obtained from National Veterinary Research Institute Vom, Jos, Plateau State. The rats were allowed to acclimatize to laboratory conditions for about two weeks before the commencement of the experiment. They were fed with animal feed obtained from Vital Feeds Ltd and were given tap water \textit{ad libitum}.

\subsection*{Extract preparation}

The stem bark of \textit{F. albida} was removed from the plant, washed and air-dry for 5 days at a room temperature. It was then pounded using pestle and mortar. The powder (150 g) was macerated in methanol (1000 ml) and left overnight. The mixture was filtered and evaporated using rotary evaporator.

\subsection*{Phytochemical analysis}

Chemical tests were conducted on the crude methanolic stem bark extract of \textit{F. albida} using standard procedures to identify the constituents as described by Trease and Evans (1989) and Sofowora (1993).

\subsection*{Column chromatography}

Slurry was prepared by dissolving 30 g silica gel in 100ml methanol: water (1:1) and packed in a column (1.5 x 30 cm). The column was loaded with 15 ml of the crude methanolic stem bark extract of \textit{F. albida} and sequentially Eluted with benzene/methanol (9:1), and acetic acid/methanol (1:1) ethylacetate/methanol (19:1). The fractions were collected separately, concentrated under pressure using rotary evaporator. The fractions were designated: I, II, and III. (NOK et al., 1993).

\subsection*{Animal grouping and extract administration}

The \textit{in vivo} activity was evaluated using the castor oil-induced diarrhoea model in rats (Awouter et al., 1978). The rats were randomly grouped into eight (8) groups with five (5) rats per group. The rats were fasted for 24 h prior to the experiment. Groups 1 and 2 were given normal saline 1ml/kg and 16 mg aspirin/kg orally, which served as controls. Groups 3, 4, and 5 were treated with 125, 250 and 500 mg/kg body weight of the crude methanolic stem bark extract of \textit{F. albida} respectively; while groups 6, 7 and 8 were given 125, 250 and 500 mg/Kg body weight of the most active fraction of the crude extract (Fraction III). One (1) hour after the treatment, rats in all groups were given 1ml castor oil/100g body weight orally. The rats in each group were placed singly in cages having adsorbent paper beneath and examined for the presence and frequency of wet stool every hour for four (4) hours. Absence or delay in production of watery stool was regarded as protective or positive.

\section*{RESULTS}

\subsection*{Phytochemical analysis}

The phytochemical analysis of the crude methanolic stem bark extract of \textit{F. albida} and the most active fraction of the extract revealed the presence of tannins, saponins and alkaloids (Table 1).

\subsection*{In vivo analysis}

The \textit{in vivo} analysis of both the crude methanolic stem bark extract of \textit{F. albida} and the most active fraction of the crude extract exhibited anti-diarrhoeal effect with 500 mg/kg body weight of the crude maintaining maximal inhibition and while 250 and 500 mg/kg body weight of the most active fraction maintaining maximal inhibition throughout the period of the study (Tables 2 and 3).

\subsection*{Discussion}

The phytochemical analysis of the crude methanolic extract of stem bark of \textit{F. albida} and the most active fraction of the crude (Fraction III) revealed the presence of tannins, saponins and alkaloids (Table 1), this findings
Table 1. Phytochemical Analysis of the crude methanolic stem bark extract of *F. albida* and the most active fraction of the crude extract (Fraction III).

<table>
<thead>
<tr>
<th></th>
<th>ALK</th>
<th>ANT</th>
<th>GLY</th>
<th>SAP</th>
<th>FLV</th>
<th>TAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude extract</td>
<td>+</td>
<td>_</td>
<td>_</td>
<td>+</td>
<td>_</td>
<td>+</td>
</tr>
<tr>
<td>Fraction III</td>
<td>+</td>
<td>_</td>
<td>_</td>
<td>+</td>
<td>_</td>
<td>+</td>
</tr>
</tbody>
</table>

+= Present, - = Absent
ALK = Alkaloids, ANT = Anthraquinones, GLY = Glycosides, SAP = Saponins, FLV = Flavonoids, TAN = Tanins.

Table 2. *In vivo* effect of crude methanolic stem bark extract of *F. albida* in rats.

<table>
<thead>
<tr>
<th>Time(h)</th>
<th>Group</th>
<th>Treatment</th>
<th>Dose(mg/kg)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Normal Saline</td>
<td>-</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
</tr>
<tr>
<td>2</td>
<td>Aspirin</td>
<td>16</td>
<td>5(100%)</td>
<td>5(100%)</td>
<td>4(80%)</td>
<td>4(80%)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Extract</td>
<td>125</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td>2(40%)</td>
<td>3(60%)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Extract</td>
<td>250</td>
<td>4(80%)</td>
<td>5(100%)</td>
<td>5(100%)</td>
<td>5(100%)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Extract</td>
<td>500</td>
<td>5(100%)</td>
<td>5(100%)</td>
<td>5(100%)</td>
<td>5(100%)</td>
<td></td>
</tr>
</tbody>
</table>

Values are expressed as percentage inhibition, n = 5

Table 3. *In vivo* effect of fraction III in rats.

<table>
<thead>
<tr>
<th>Time (h)</th>
<th>Group</th>
<th>Treatment</th>
<th>Dose(mg/kg)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Normal Saline</td>
<td>-</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
</tr>
<tr>
<td>2</td>
<td>Aspirin</td>
<td>16mg</td>
<td>5(100%)</td>
<td>5(100%)</td>
<td>4(80%)</td>
<td>4(80%)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Extract</td>
<td>125</td>
<td>0(0%)</td>
<td>1(20%)</td>
<td>2(40%)</td>
<td>4(80%)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Extract</td>
<td>250</td>
<td>5(100%)</td>
<td>5(100%)</td>
<td>5(100%)</td>
<td>5(100%)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Extract</td>
<td>500</td>
<td>5(100%)</td>
<td>5(100%)</td>
<td>5(100%)</td>
<td>5(100%)</td>
<td></td>
</tr>
</tbody>
</table>

Values are expressed as percentage inhibition, n = 5

is in agreement with that of Tijani et al. (2008) but in contrast with that of Kubmarawa et al. (2007) who stated that none of these bioactive components are present in the stem bark. The observed difference could be due to environmental changes where the plants were collected or seasonal changes that could have altered the plant components. It could also have been as a result of changes during extraction and/or storage.

The *In vivo* analysis of the crude methanolic stem bark extract of *F. albida* revealed that at the concentration of 500 mg/kg body weight given to the rats maintained a maximal inhibition of diarrhoeal throughout the period of the study and this is in contrast with the view of Tijani et al. (2008) who stated that it was at 250 mg/kg body weight that produced maximal inhibition using the aqueous stem bark extract of *F. albida*, but the most active fraction of the crude methanolic stem bark extract of *F. albida* (Fraction III) is in agreement with the view of Tijani et al. (2008) that 250 mg/kg and 500 mg/kg body weight produced maximal inhibition (Tables 2 and 3). The observed differences may be due to the different solvents used because according to the findings of Gunner (1991) different solvent extracts of some plants may exhibit different pharmacological properties.

The *In vivo* effect of the crude methanolic stem bark extract of *F. albida* and the most active fraction of the extract were observed in rats using castor oil induced diarrhoea model (Awouter et al., 1978). Several
mechanisms have been previously proposed to explain the diarrheal effect of castor oil including inhibition of intestinal Na⁺, K⁺ ATPase activity to reduce normal fluid absorption (Gaginella and Bass, 1978), activation of adenylatecyclase or mucosal cAMP mediated active secretion (Capasso et al., 1994), stimulation of prostaglandin formation (Galvez et al., 1993), platelet activating factor and recently nitric oxide has been claimed to contribute to the diarrheal effect of castor oil (Mascolo et al., 1996). However, it is well evident that castor oil produces diarrhoea due to its most active component recinoleic acid which causes irritation and inflammation of the intestinal mucosa, leading to the release of prostaglandin which results in the stimulation of secretion (Gaginella et al., 1985). Since the crude methanolic stem bark extract of *F. albida* and the most active fraction of the extract (fraction III) successfully inhibited the castor oil induced diarrhoea, they might have exerted the anti-diarrhoeal action via anti-secretory mechanism or the anti-diarrhoeal property may be attributed to the presence of tannins, the phytochemical which is known to reduce the effect through denaturing the protein by the formation of protein tannate, thereby causing the intestinal mucosal more resistant and reduces secretion (Tripathi, 1994). Hence tannins present in the extracts may be responsible for their anti-diarrhoeal activity (Yu et al., 2000; Devi et al., 2002) and also be partly responsible for other pharmacological properties. Even though quantitative analysis of the phytochemical constituents was not determined, it is presumed that the active component dissolves more in Ethyl acetate/methanol and hence the high activity of the fraction III observed.

Aspirin and other aspirin like drugs were observed to prevent diarrhoea induced by castor oil. Our present study revealed the ability of aspirin to inhibit diarrhoea, which indicates possible inhibition of prostaglandin synthesis. It is also evident that oral administration of extracts undergoes biotransformation from active to inactive components and vice versa. In the present study, oral administration did not change the activity of both the crude and fraction (III) extracts.

In conclusion, this study has confirmed the basis of using the stem bark of *F. albida* by traditional healers for treatment of diarrhoea. Therefore, there is an increased need for research in the investigations on plants as a source of human disease management.

REFERENCES


