Introduction

In African herbal medicine, herbs are used for the management of disease conditions, including diarrhea and abdominal pain. Diarrhea presents as a disease or as symptoms of some disease conditions. It is associated with viral, bacterial and fungal infections, food poisoning and other disease conditions. Uncontrolled diarrhea is dangerous as it can lead to loss of body fluid and electrolyte imbalance. Excessive loss of body fluid results in severe dehydration and death. Maintenance of electrolyte balance and replacement of fluid is therefore crucial in the management of diarrhea. Children with diarrhea are often at risk, as little loss of body fluid can be fatal. Search for potent and cheap drug with anti-diarrhea properties is on with the hope of discovering well tolerated anti-diarrhea drug with fewer side effects. Presently, the management of diarrhea involves the use of anti-motility agents, anti-secretory agents, anti-fungi and anti-bacteria agents and/or oral rehydration therapy (ORS). Low income earners or jobless Nigerians depend on herbal medicines to meet their health needs. Evaluation of the pharmacological properties of such herbs is imperative as it will enable health workers to advice patients appropriately.

Some pharmacologically active plants have been confirmed to have anti-diarrhea properties. They include; ocimum gratissimum 5, Asparagus pubesons, Conyza dicroscidis, Albagi maorum, Mentha microphylia, zygophyllum album and Conyza linifolia 2 Pergularia daemia 3 and Moringa oleifera3.

K. africana (Lam) Benth, is used locally in Nigeria for the management of chronic abdominal pain. It is commonly called Sausage tree (English); Worsboom (Africa); Muvevha (Venda); umxhono (isiXhosa). In the United States, K. africana is one of the active principles in a skin care product (www.sheaterraorganics.com). Its fruits are prepared for consumption by drying, roasting or fermentation 5. In Botswana the timber is used as yokes and oars7.

E. senegalensis a. dc. is a coral tree. Coral trees are used widely in the tropics and subtropics as street and park trees, especially in drier areas. It is found in Mali, Senegal, and Nigeria. E. senegalensis is used in traditional medicine for the management of amnorrhoea, dysenorrhoea, malaria, infection, wound and body pain (chest pain, back pain, abdominal pain), headaches and body weakness, gastric ulcer, diarrhea and constipation. E. senegalensis is well studied, chemicals elucidated from it include: Prenyllflavonoids, 8-prenyllumelto, auriculatin, ursenegalensin O, ursenegalenelin D, ursenegalensin M, derrone, alpinumbiosavon, and 6, 8-diprenylgenistein 9.

The plant also contain isoflavonoid (2, 3 dihydroauriculatin, and 6-8 diprenylgenistein) with anti-bacterial activity 10, flavonoid (Erybradin A) with anti-microbial and anti-fungal properties, Loncho carpol A and prenylisoflavonoid with HIV-inhibitory properties, 11, and Alpumisavon, a substance used for the management of schisto-somiasis infection.

Materials and Methods

Animals

Albino rats (weighing between 125 - 220g) and Rabbits (1.7 - 1.9Kg) were used for this experiment. They were purchased from the University of Jos, Animal House. They were fed with standard commercial feeds (Vital Feeds, Nigeria) and tap water (ad libitum).

Collection and Preparation of Plant Materials

The bark and root of E. senegalensis and K. africana respectively were collected in the month of September 2007 by a herbalist in Jos, Plateau State, Nigeria. The plants were authenticated by Dr. A. Karim of the Federal School of Forestry. Jos. Collected plant materials were dried under shade to prevent direct effect of sun, which might affect the chemical constituents in the extract. The resultant dried plant parts were individually reduced to powder with mortar and pestle, sieved and kept in a clean dried cupboard before use. Ninety grams of each of the powdered plant materials were separately soaked extracted for 72 hours with ethanol at 50°C. The resultant dried extracts were labeled and preserved in the refrigerator until needed.

Castor oil Induced Diarrhea in Rats

The method described by Galvez 12 was used for this experiment. Male and female wistar rats (weighing 125-220g) were divided into six groups of five animals each and housed in separate cages, during screening. The rats were denied access to food for 24 hours before commencement of the experimental procedures, but allowed free access to water. Animals in group one received 0.5ml of distilled water (intra-peritoneally, IP) while animals in group two received loperamide (4 mg/kg). Groups three and four received methanolic extract of K. africana (500 mg/kg and 1000 mg/kg respectively), IP, while animals in groups 5 and 6 rats received methanolic extract of E. senegalensis (500 mg/kg and 1000 mg/kg respectively). Thirty minutes after treatments, each animal received 0.5 ml of castor oil orally via orogastic cannula. The animals were then placed in separate cages over clean white paper and observed for 6 hours for the onset of diarrhea, and number of diarrhea episodes. Absence or reduction in number of loose stool was recorded as a protection from diarrhea13.
Anti-motility activity

Rabbits were killed by a blow on the head, dislocating the neck, and exsanguination. Segments of the jejunum, about 2.0 cm long, were removed and dissected free of adhering mesentery. The intestinal contents were removed by flushing with Tyrode solution. The isolated tissue was mounted in a 50 ml organ bath containing Tyrode’s solution maintained at 37°C and aerated with air. A load of 0.5 g was applied and equilibration period of 60 minutes was allowed during which the physiological solution was changed every 15 minutes. At the end of the equilibration period, the effects of acetylcholine (1 x 10⁻⁵ g/ml), were determined. The effect of graded doses of the extracts of bark of *E. senegalensis* (0.2, 0.4, 0.8, 1.2, 1.6 and 2.0 ug/ml) and the extract of the roots of *K. africana* (0.2, 0.4, 0.8, 1.2, 1.6 and 2.0 ug/ml) were recorded using Ugo Basile unirecorder 7050. The effects of graded doses of acetylcholine (0.02, 0.04, 0.08, 0.12, 0.16 and 0.2 ug/ml) in the presence of graded doses of *E. senegalensis* and *K. africana* were also recorded.

RESULTS

Table 1: Effects of Methanolic Extracts of *E. senegalensis* and *K. africana* on Castor Oil Induced Diarrhea

<table>
<thead>
<tr>
<th>Treatment dose</th>
<th>Mean onset of Diarrhea (hrs)</th>
<th>Mean weight of stool (g)</th>
<th>Mean No. of loose stool</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (0.5 ml distilled water)</td>
<td>2.95±1.83</td>
<td>6.73±0.68</td>
<td>4.3±1.77</td>
</tr>
<tr>
<td>Loperamide 4mg/kg</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><em>E. senegalensis</em> 500mg/kg</td>
<td>4.10±1.62*</td>
<td>2.3±1.16 b</td>
<td>1.75±0.83 b</td>
</tr>
<tr>
<td><em>K. africana</em> 500mg/kg</td>
<td>3.17±1.13 a</td>
<td>2.65±0.7 b</td>
<td>2.00±0.71 b</td>
</tr>
<tr>
<td><em>E. senegalensis</em> 1000mg/kg</td>
<td>4/69±0.82 a</td>
<td>1.55±0.46 b</td>
<td>1.25±0.75 b</td>
</tr>
<tr>
<td><em>K. africana</em> 1000mg/kg</td>
<td>4/69±0.82 a</td>
<td>1.55±0.46 b</td>
<td>1.25±0.75 b</td>
</tr>
</tbody>
</table>

a=P>0.05, b=P<0.05, when values were compared with control values. Values are in Mean ± Standard Error of Mean (SEM). N=5
The bark of *Esenegalensis* and the root of *K. Africana* are used for the management of colic pain (which often is associated with diarrhea). Results obtained from this study suggest that the methanolic extract of the bark of *E. senegalensis* and the root of *K. africana* possesses anti-diarrhea activities. In castor oil induced diarrhea, both extracts dose dependently reduced the onset of diarrhea and amount of watery stool produced by the Prolonged the onset of diarrhea, but significantly (P < 0.05) reduced the frequency of loose stool and the amount of stool produced. Higher dose of the extract produced greater significant reduction in the amount of stool excreted and the amount of loose stool. This implies that the extract dose dependently inhibits the production of lose stool. The anti-diarrhea effects observed was comparable to the anti-diarrhea effect of Loperamide (4mg/kg), a standard anti-diarrhea drug.

*K. africana* (500mg/kg) prolonged of the onset of diarrhea (Table 1, Figure 2), reduced the frequency of stooling and inhibited loose stool production (Figure 3). At a higher dose, it produced greater effects, revealing that the extract produces dose dependent anti-diarrhea effect.

Diarrhea involves both an increase in the motility of the gastrointestinal tract, increased gastro intestinal (GIT) secretion and a decrease in the absorption of GIT fluid, the overall effects is reduction in the loss of electrolyte (particularly Na+) and water15. Foster and Cox (1983)16 stated that diarrhea can result from an increase in GIT motility (Intestinal hurry), which leads to reduction in transit time of fecal materials in the colon. Any substances that decrease intestinal motility (anti-motility) and/or decreases secretion (anti-secretory) will have anti-diarrhea activity.

*E. senegalensis* and *K. africana* extracts significantly reduced (P < 0.05) the motility of isolated rabbit jejunum (Figure 4). They reduced the amplitude of contraction (figure 3 and 4). The observed relaxation of the smooth muscle shows that these extracts possess anti-motility and thus anti-diarrhea activities. The extracts exhibited dose dependent anti-motility effects (Figure 7, 8). It was also observed that graded doses of *E. senegalensis* and *K. africana* significantly (P < 0.05) inhibited the enhanced motility effect of acetylcholine (Figure 9, 10).

**CONCLUSION**

The methanolic extract of *E. senegalensis* and *K. africana* inhibited castor oil induced diarrhea and reduced the spontaneous contraction of the isolated rabbit jejunum. The anti-motility effect of these plants supports the use of these plants in folk medicine for the management of colic in children. The observed effects (anti-motility and inhibition of castor oil induced diarrhea) revealed that these extracts may be useful in the management of diarrhea.

**REFERENCES**


11. Jisuk Lee1,Won Keun Oh2, Jong Seog Ahn2, Yong Hae Kim3, J. Tanyi Mbafor4, Jean WandJ4, Z. Tanee Fomum4


