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REVIEW ARTICLE

Phytochemical Screening, Antimicrobial and Anti-Diarrhoeal Activities of the Leaf Extract of Sweet Broom (*Scoparia Dulcis*)

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ABSTRACT

The leaf extract of *Scoparia dulcis* was claimed by local ethno medical practitioners to have antidiarrhoea activity especially for the treatment of diarrhoea in children. This study, therefore investigated this claim by checking its phytochemical compounds, antimicrobial activities and antidiarrhoeal effects using laboratory mice and Wister rats. Phytochemical screening of the leaf extract showed that it contains alkaloids, tannins, saponins, glycosides, proteins and starch. Antimicrobial assay revealed that the extract has the ability of inhibiting gram positive and gram negative bacteria, such as *Escherichia coli, Staphylococcus aureus, Streptococcus feacalis, Klebsiella aerogenes and Pseudomonas aeroginosa* but exerted no effect on *Candida tropicalis.* Antidiarrhoea assay of the extract on adult albino mice and adult Wister rats induced diarrhoea using castor oil showed that the extract inhibits diarrhoea at the lowest dose of 30 mg/ml/kg body weight. The dose of the extract that inhibits diarrhoea is comparable with 5 ml of the control drug, diphenoxylate. The extract produced a comparably high protection against castor oil – induced diarrhoea in Wister rats relative to diphenoxylate. The extract thus has promising antimicrobial and antidiarrhoea activities and the findings therefore support the local claims. Further systematic search should be carried out to screen the extract for other bioactive agents and, possibly, analgesic potency.

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INTRODUCTION

Many plants of great medicinal value exist around us. Ancient health care of our ancestors depends largely on herbal medicine. Up till today, many people around the globe still depend on ethno medicine for their cure. In Nigeria as in many African countries, more than 50 % of the populace depends solely on traditional herbal practitioners for their health care (Nwoko *et al*., 2008).

Over 70 % of the plants worldwide provide medicine to the people. Among these plants is the weed under study. *Scoparia dulcis* (sweet broom) is a common weed of waste ground, found growing near houses in the tropical countries. It belongs to the family *Scrophulariaceae* and genus *dulcis* (Graham, 1963; Umerie *et al*., 2007). The plant is a small, erect, branched herb which grows to an average height of 46 cm. The leaves are simple opposite with serrated edges. Mature plant produces white inflorescence flowers which have four-lobbed corolla (Dutta, 1995). The sepals are gamesepallous, five-lobbed and often imbricate. The fruits are mostly capsulate and the seeds are numerous, tiny and endospermic.

Although a widespread common weed, its medicinal use is not popular. Among the Igbo ethnic group in the Southeastern part of Nigeria, the crushed leaf extract are pressed out and the juice taken for the treatment of diarrhoea. This is used mainly in children for the treatment of this killer disease of the under five population in Nigeria. Though modern treatments for diarrhoea abound, local dwellers still use these herbs which they believe that their forefathers used. In order to ascertain these claims by local users and some ethno medical practitioners, the present study is therefore carried out to investigate the pharmaceutical components of the plant, the antimicrobial and anti-diarrhoea activities of the leaf extract.

MATERIALS AND METHODS

Collection and preparation of the plant material

Fresh leaves of *Scoparia dulcis* were collected from botanical garden at Nnamdi Azikiwe University premises and identified in the Department of Botany, Nnamdi Azikiwe University, Awka, Nigeria. Figure 1 presents a typical stand of Sweet Broom (*Scoparia dulcis*). The leaves were air-dried for 3 weeks, the dried leaves were pulverized using a sterile manual Corona grinding machine. 200 g of the powder was macerated in 3 litres of absolute ethanol for 72 hours with intermittent stirring to aid extraction. The mixture was sieved through a cheese cloth and cotton wool to obtain a clear filtrate. A semi-solid extract, free from chlorophyll was obtained in vacuo using a rotary evaporator.

Extract analysis

Phytochemical screening of the crude extract was carried out using the methods of Harborne (1998) and Evans (2002). The extract further analyzed using Atomic Absorption Spectrophotometer (AAS), Unican 969.

Proximate analysis

Atomic absorption spectroscopy (AAS) method as outlined by Willard *et al.* (1974) was used to determine the mineral elements in the plant extract.

Drug preparation

The plant extract was prepared in normal saline in the ratio 1:2 w/v.

Experimental Animals

Adult male albino mice (18 – 22 g) and adult Wister rats (120-130g) used for the experiment were obtained from the animal house at University of Nigeria, Nsukka. The animals were housed and fed in the laboratory for two weeks before the experiment. They were allowed free access to water and their accustomed feed.

Bacterial stock cultures

Pure stock cultures of organisms were obtained from the Department of Applied Microbiology and Brewing, Nnamdi Azikiwe University, Awka, Nigeria. They were sub cultured in their appropriate medium to obtain fresh colonies. The organisms used are; *Escherichia coli, Staphylococcus aureus, Streptococcus feacalis, Klebsiella aerogenes, Pseudomonas aeroginosa and Candida tropicalis.*

Antimicrobial test

Appropriate culture media were used for the antimicrobial test and the agar diffusion method of Baker *et al*. (2001) was used.

Effective dose (ED) and Acute toxicity assays

The method of Umerie *et al*. (2007) was used with slight modifications using the albino mice. Thirty two mice were randomized into eight groups of four mice each. All the mice were starved overnight, given only water and 0.5 ml of castor oil orally to induce diarrhoea. The crude ethanol extract of the plant was administered to each group (1-7) at different doses of (10 mg, 20 mg, 30 mg, 40 mg, 60 mg, 80 mg and 100 mg)/ml, respectively. Equivalent volume of normal saline was given to each mouse in the control group (group 8). The animals were given the drug intra peritonially. The animals were allowed free access to feed and water and observed for twenty four hours. The numbers of animals that died in each group within the period were noted and expressed as a percentage of the total number of animals in the group (Nwoko *et al*., 2008). The effective dose (ED) was determined as the mean dose administered to the surviving viable mice after the test period. The lethal dose (LD_{50}) of the extract was calculated as the geometric mean of the maximum dose that caused 0 % death and the minimum dose that caused 100 % death (Umerie *et al*., 2007).

Anti-diarrhoea test

The method adopted by Nwoko *et al*. (2008) was used to carry out the antidiarrhoea test. Twenty four adult rats were prepared for the experiment by starving them of food (overnight) but allowing them free access to water. All the Wister rats received oral administration of 1 ml castor oil as diarrhoea inducing drug. The rats were divided into four groups of six rats each. After 1 hour of castor oil administration, group 1 and 2 (control) were given 5 ml of Diphenoxylate (an antidiarrhoea agent) and 30 ml of normal saline, respectively. Group 3 and 4 received 30 mg/ml and 40 mg/ml of the extract, respectively. All the animals were transferred to their individual cages spread with white linings and the cages labeled accordingly. Each animal was monitored for formed stool and change in behavior over a period of 24 hour period. The presence of formed stool or watery droppings was recorded.

RESULTS AND DISCUSSION

Phytochemical screening

The phytochemical constituents of the leaf extract of *Scoparia dulcis* showed the presence of alkaloids, tannins, saponins, glycosides, protein and starch (Table 1).

Table 1: Phytocompounds in the leaf extract of *Scoparia dulcis*

Phytocompounds	Abundant level
Alkaloids	+ +
Tannins	+ +
Saponins	+
Flavonoids	-
Glycosides	+
Protein	+ +
Starch	+

Key – not present; present; + abundant

Antimicrobial test

This revealed that the extract exacts a positive effect on *Escherichia coli, Staphylococcus aureus, Streptococcus Feacalis, Klebsiella aerogenes and Pseudomonas aeroginosa* with reasonable zones of inhibition and mean inhibitory concentration (Table 2).

Acute toxicity test

Oral administration of castor oil in mice resulted in watery stool after one hour. Twenty four hours after the intra peritoneal administration of the graded doses of the

extract, those given 10 mg/ml passed watery stool continuously while 2 mice out of the 4 that received 20 mg/ml passed watery stool after 12 hours. Those that were given 60 mg/ml were weak while those given 80 mg/ml and 100 mg/ml died due to over dose. Those that received the dose of 30 mg/ml and 40 mg/ml remained healthy. The ED assay showed that the extract had an LD 50 of 74.5 mg/kg body weight in mice. From this dose a maximum dose of 40 mg/kg body weight was chosen as the highest dose in the experiment.

Table 2: Some mineral elements present in the leaf extract

Minerals	Presence
Iron	+
Magnesium	+
Lead	-
Calcium	+
Phosphorous	+
Copper	-
Manganese	+

Key: - not present; + present

Antimicrobial assay

The effects of the leaf extract of *Scoparia dulcis* on selected microorganisms showed that it is effective against the tested organisms except *Candida tropicalis* (Table 3). The extract has the highest effect on *Escherichia coli* and *Staphylococcus aureus*, and less effect on *Klebsiella aerogenes and Pseudomonas aeroginosa.*

Table 3: Antimicrobial test, Min inhibitory concentration (MIC) and Diameter of zone of inhibition of the extract

Organisms	Antimicrobial test	MIC (mg/ml)	Diameter of Inhibition (mm)
Escherichia coli	+	30	10
Staphylococcus aureus	+	20	6
Streptococcus faecalis	+	16	5
Klebsiella aerogenes	+	12	3
Pseudomonas aeroginosa	+	12	3
Candida tropicalis	-	-	-

Key – negative; + active

Antidiarrhoea test using the leaf extract of *Scoparia dulcis*

The albino Wister rats instantly developed diarrhoea after one hour of 1 ml castor oil administration. The result of the antidiarrhoea test showed that the dose of 30 mg/ml and 40 mg/ml was able to protect the rats from watery stool. The level of protection was comparable to that of the control drug (Diphenoxylate). Only one rat produced watery stool after six hours of administration of the dose of 30 mg/ml and none of those that received 40 mg/ml did show any sign of diarrhoea during the experiment. In contrast, the first control group that received normal saline all passed out watery stool while those given 5 ml of diphenoxylate did not develop diarrhoea after 24 hours.

Results obtained from this study showed strong evidence that the plant (*Scoparia dulcis*) leaf extract exerts antimicrobial activity on the organisms tested. The extract has activity against all the bacterial species tested but fails to inhibit the only fungi used in the work (Table 3). Susceptibility of bacterial organisms to the extract depends on species and the activity was against both the gram positive and gram negative organisms.

The crude extract also exerts antidiarrhoea effect on both the adult Albino mice and Wister rats. The antidiarrhoea effect appeared to be dose dependent, in that all the animals in the higher dose of 40 mg/ml showed no sign of diarrhoea. This compared favorably with the control drug, diphenoxylate though to a higher dose due to its crude nature.

Fig. 2: Sweet Broom (*Scoparia dulcis*)

Phytochemical screening of the leaf extract showed that the extract contains phytocompounds as shown in Table 1. Tannins were heavily present in the crude extract. They are reported to absorb bacterial toxins thus reducing the irritability and motility of the bowel that could promote the development of watery stool (Keay, 1992). According to Okonkwo *et al*., (2008), the astringent action of tannins gives it its medicinal value of preventing diarrhoea, controlling haemorrage, healing of wounds and inflamed mucous membrane. All the other phytocompounds in the extract also expose the plant for other medicinal uses if processed and purified.

It might be possible that the tannins present in the leaf extract of *Scoparia dulcis* contributes to the overall activity of inhibiting diarrhoea which is suggestive of its reduction of the intestinal motility of the bowel and detoxification (Nwoko *et al*., 2008). The crude extract of *Scoparia dulcis* has promising antimicrobial and antidiarrhoea activities, which may explain the basis of its local use for the treatment of diarrhoea over the years by local ethno medical practitioners in Nigeria.

Conclusion

The effect of the antimicrobial and antidiarrhoea activities makes the leaf extract a potent antidiarrhoea agent with potential for multiple-action. It would

therefore, be necessary to further purify the extract. This may produce drugs with better activity at even lower doses and then commence the systematic search for other bioactive agents in the plant, and to see, for example, if the plant leaf extract has any analgesic potency. It is therefore recommended that the growing of the Sweet Broom be commercialized and that the bioactive components discovered in this plant including alkaloids, tannins, saponins, glycosides, etc, be extracted and purified for bio-industrial and pharmaceutical purposes.

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