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Abstract

Background: The root and stem bark of *Cassia sieberiana* DC. (Caesalpiniaceae) and the root of *Senna obtusifolia* (Linn) Irwin and Barneby (Caesalpiniaceae), used for constipation in Nigeria, were assayed for laxative properties in male albino rats using the official senna leaf (*Senna alexandrina* Mill. family Caesalpiniaceae) as the reference standard. This is with a view to finding alternative laxative drug to official senna which is presently being imported into Nigeria from the United Kingdom.

Materials and Methods: The mean percentage of wet faeces in rats, an indication of laxative activity, were obtained using established methods. The laxative activity was established at 500 mg/kg after the infusion of the drug was orally administered on male albino rats following established methods while a set of data was analyzed at 95 % confidence level.

Results: At 500 mg/kg, *Senna obtusifolia* root gave about 45 % wet faeces while *Cassia sieberiana* root gave about 40 % wet faeces while at the highest dose of 700 mg/kg, they produced 60 % and 38 % wet faeces, respectively. At these two doses, the official Senna gave 50.6 % and 66 % wet faeces, respectively. Thus, *S. obtusifolia* and *C. sieberiana* roots exhibited 89 % and 80 % of the potency of *S. alexandrina* (the official drug), respectively. The analysis of variance revealed a significant statistical difference in the levels of wet faeces produced by rats dosed with *C. sieberiana* root.

Conclusion: The results have shown that the roots of the two species could be developed as mild laxative drugs for children and pregnant women for whom the official senna will be contraindicated.

Key words: *Cassia sieberiana*, *Senna obtusifolia*, Gastrointestinal, Laxative.

Introduction

Cassia sieberiana DC. (Caesalpiniaceae), commonly known as African laburnum, is distributed from Senegal and eastern part of Gambia to the Democratic Republic of Congo, Uganda and Nigeria. In traditional medicine, the plant is used as antimicrobial, antiviral, antibacterial, anti-inflammatory, antitrypanosomal and antioxidant agent, as a strong purgative, diuretic, abortifacient, anti-schistosomiasis, anti-dysentery and antihaemorrhoid (Kerharo and Adams, 1974; Elujoba *et al.*, 1999). On the other hand, *Senna obtusifolia* (Linn.) Irwin and Barneby (Caesalpiniaceae), commonly known as African foetid cassia or low senna, was introduced to Africa from America and presently found throughout tropical Africa including Nigeria with the exception of Madagascar. The plant is used as antimicrobial, antifungal, anticancer, and antioxidant (Doughari *et al.*, 2008); leaves are chewed for cough, pneumonia, mixed with other plants for fever, parasitic skin-infections and ulcer (Hutchinson and Dalziel, 1958); the root is purgative and anthelmintic (Toruan-Purba, 1999). *Senna alexandrina* (Senna), an official pharmacopoeial drug of the same family, widely used as a self-help household laxative, is not indigenous to Nigeria but over the years, some other *Cassia* and *Senna* species of Nigerian origin have been screened as possible substitutes for *Senna alexandrina* (Elujoba and Iweibo, 1988). The search continues for the most active *Senna* or *Cassia* species among the Nigerian plants which can be proposed as the best substitute for the imported *Senna alexandrina*.

Materials and Methods

Plant materials

The root and stem-bark of *Cassia sieberiana* DC. (Caesalpiniaceae) were collected from Ile-Ife while the root of *Senna obtusifolia* (Linn.) Irwin and Barneby (Caesalpiniaceae), were collected from Iree during the rainy season (August, 2011), identified and authenticated by comparison with the herbarium specimens of previously collected and preserved plants in the Forest Research Institute of Nigeria (FRIN), Ibadan, Nigeria with herbarium numbers FHI 109562 for *C. sieberiana* and FHI 109561 for *S. obtusifolia*. The root and stem-bark were cut into pieces prior to oven-drying for 48 h at 50 °C. They were powdered, kept in sealed amber bottles and stored in a dry cupboard until ready for use. *Senna alexandrina* Mill. (Caesalpiniaceae) leaf (reference standard) was purchased from a Pharmacy store as "Herb Tea" of commerce (Darkin's Brothers London).

Pharmacological analysis

Animals

White wistar male rats weighing between 95 and 215 g were purchased from the animal house of the Faculty of Basic Medical Sciences, College of Health Sciences, Obafemi Awolowo University, Ile-Ife, Nigeria. The animals were housed in wire netting cages and kept in the animal house of the Department of Pharmacology, Obafemi Awolowo University, Ile-Ife, Nigeria. They were fed with rat cubes purchased from Capsfeed Limited Osogbo, and served with water regularly. All animals were cared for in accordance with the Guide for the Care and Use of Laboratory Animals, published by the US National Institute of Health (NIH Publication 83-23, revised 1996).

Laxative assay

The rats were "conditioned" by subjecting them into initial feeding and acclimatization training for 3 weeks, otherwise known as "Dummy assay" (Darcy, 1962) and were deprived of food and water 12 h prior to dosing and any rat producing wet faeces was rejected. This helped to exclude already unhealthy rats that can produce wet faeces and to enable the rats to get acclimatized to the assay procedure and the environment. An infusion stock each of *S. alexandrina* leaf, *S. obtusifolia* root and *C. sieberiana* stem-bark and root, equivalent to 100 mg ml⁻¹ on a moisture free basis was prepared according to Elujoba et al. (1999). Previously established procedures for investigating *Cassia* species for laxative activities in rodents (Lou, 1949; Latven et al. 1951) were carried out. An appropriate aliquot from the stock solution was orally given to each of the five male rats per group (seven groups in all) at appropriate doses equivalent to: 100, 200, 300, 400, 500, 600 and 700 mg kg⁻¹ using a cannula. The faeces were tested and examined for wetness and irregular shapes coupled with the "wire adhesion" hourly for 12 hr following the administration of infusion. The results were expressed as the percentage means of the total faeces that were wet per kg rat.

Gastrointestinal motility assay

Ten (10) rats were fasted for 18 h prior to the experiment. The rats were divided into two groups of five rats each. One group was administered with the infusion of *C. sieberiana* stem-bark while the other group received the infusion of the reference drug (*S. alexandrina*). After 30 mins of administration of respective infusion on each group, charcoal meal (0.2 ml of a 4 % suspension of charcoal in 2 % carboxymethylcellulose solution) was then administered and after another 1 hr, the rats were sacrificed by cervical dislocation and immediately the abdomen was cut open according to Sharma *et al.* (2011) to excise the entire small intestine (from the pylorus region to the caecum). In each experimental group, the total length of the small intestine and the distance between the pylorus region and the front of the transited charcoal meal were measured in order to calculate and obtain the gastrointestinal transit ratio.

Statistical analysis

The results of the laxative activities have been presented as mean percentage \pm SEM (Standard Error of Mean). The variation in a set of data was analyzed through one-way analysis of variance and the difference among the means was considered at 95 % confidence level using the post-hoc test of Dunnett (Dunnett, 1964).

Results

The results of the laxative activities are shown in Tables 1 and 2 and Figure 1.

Discussion

A significant laxative activity of any *Cassia/Senna* species has been previously standardized and defined as an activity of at least 50 % wet faeces of the total faeces produced by the infusion of any *Cassia* species at 500 mg/kg in 12 h when tested alongside with *S. alexandrina* leaf at the same time and under the same experimental conditions (Elujoba and Iweibo, 1988). Therefore, at 500 mg/kg dose in this work, the reference drug, *Senna alexandrina* gave 50.6 % wet faeces and *Senna obtusifolia* root gave 45.0 % wet faeces while *Cassia sieberiana* root and stem-bark gave 40.4 % and 36.0 % wet faeces, respectively under the same experimental conditions (Fig. 1). The analysis of variance at 500 mg/kg for the confidence limit at 95 % interval revealed that the p-value is 0.0067 and $p < 0.01$ for *C. sieberiana* stem-bark, $p < 0.05$ for *C. sieberiana* root and $p > 0.05$ for *S. obtusifolia* root (Dunnett, 1964). Therefore, there is a statistically significant difference in the levels of wet faeces produced by rats dosed with *C. sieberiana* stem-bark and *S. alexandrina* leaf since the p-value is less than 0.01 (Fig. 1). In order to re-affirm this activity for *C. sieberiana* stem-bark, the charcoal-transit experiments were conducted on the gastrointestinal segments of rats. The results showed an increase in the transit ratio by 59.3 % while *S. alexandrina* leaf gave 94.4 % increase confirming the trend observed under the laxative activity experiment (Table 1).

In order to assess the potency of the plant species with reference to the official *S. alexandrina* leaf, both Laxative Senna Equivalent (L.S.E.) and Percentage Senna Activity (P.S.A.) were used. The L.S.E. of any *Cassia* or *Senna* species is the relative laxative activity of that *Cassia* or *Senna* species in relation to that of *S. alexandrina* leaf (Elujoba and Iweibo, 1988). It measures how much *S. alexandrina* leaf is more or less potent than the *Cassia/Senna* species being investigated while P.S.A. measures the relative amount (%) of the activity of *S. alexandrina* leaf exhibited by the *Cassia/Senna* species being investigated. Hence, *C. sieberiana* stem-bark and root possessed L.S.E. of 0.71 and 0.80 with the corresponding P.S.A. of 71 % and 80 %, respectively while *S. obtusifolia* root gave L.S.E. of 0.89 with corresponding P.S.A. of 89 % (Table 2). Similarly, with respect to the transit ratio experiment, *C. sieberiana* stem-bark possessed 62.8 % of *S. alexandrina* activity. The differences emanating from the laxative activities of these *Cassia/Senna* species could be attributed to the varying contents of anthracene glycosides which are well-known to be responsible for the laxative properties of *Cassia/Senna* species (Rai and Abdullahi, 1978).

The present work has thus justified the ethnomedical claims on *C. sieberiana* and *S. obtusifolia* by traditional medicine practitioners and could be used as substitutes for *S. alexandrina* leaf especially as mild laxative drugs for children and pregnant women in place of *S. alexandrina* with violent and severe purgative action.

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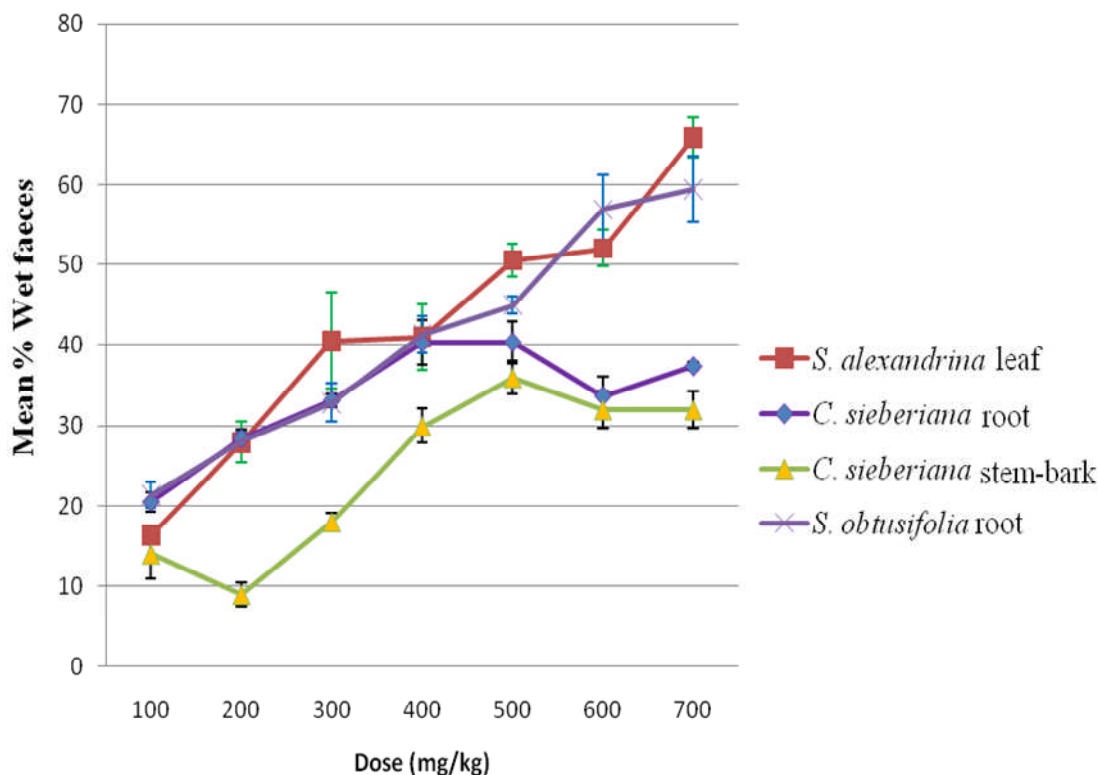


Figure 1: Dose-laxative activity relationship of *S. obtusifolia* and *C. sieberiana* with reference to *S. alexandrina* 12 hour post administration.

Table 1: Transit ratio of *C. sieberiana* stem bark with reference to *S. alexandrina* leaf

	<i>S. alexandrina</i> leaf (reference)					Mean ± SEM	<i>C. sieberiana</i> stem-bark					Mean ± SEM
	Rat A	Rat B	Rat C	Rat D	Rat E		Rat F	Rat G	Rat H	Rat I	Rat J	
Total length of the intestine (cm)	77.50	80.50	78.00	76.00	84.00	79.2 ± 1.40	88.10	79.50	91.30	89.00	81.10	85.8 ± 2.32
Distance travelled by marker (cm)	72.50	78.50	72.60	71.50	78.90	74.8 ± 1.61	52.20	46.10	61.80	52.90	42.20	51.04 ± 3.34
Transit ratio	93.60	97.50	93.10	94.10	93.90	94.44 ± 0.78	59.20	58.03	67.74	59.43	52.00	59.28 ± 2.51

SEM = Standard Error of Mean

Table 2: Percentage Senna Activity (P.S.A.) of *S. obtusifolia* root and *C. sieberiana* stem bark and root with reference to *S. alexandrina* leaf at different doses

Dose (mg/kg)	<i>S. alexandrina</i> (%)	<i>S. obtusifolia</i> root (%)	<i>C. sieberiana</i> root (%)	<i>C. sieberiana</i> stem bark (%)
100	100	132	126	86
200	100	100	102	32
300	100	81	82	44
400	100	101	98	73
500	100	89	80	71
600	100	110	65	62
700	100	90	57	49

References

1. Darcy, P.F. (1962). The conditioning of experimental animals. *Journal of Pharmacy and Pharmacology*. U.K. 14: 411-415
2. Doughari, J. H., El-mahmood, A. M. and Tyoyina, I. (2008). Antimicrobial activity of leaf extracts of *Senna obtusifolia*. *African Journal of Pharmacy and Pharmacology* 2(1): 7-13.
3. Dunnett, C. W. (1964). "New tables for multiple comparisons with a control", *Biometrics*, 20: 482-491.
4. Elujoba, A.A. and Iweibo, G.O. (1988). *Cassia podocarpa* as substitute for official senna. *Planta Medica* 4: 372
5. Elujoba, A.A., Abere, A.T. and Adelusi, S.A. (1999). Laxative activities of Cassia pods sourced from Nigeria. *Nigerian Journal Natural Products and Medicine* 3: 51-53.
6. Hutchinson, J. and Dalziel, J.M. (1958). *Flora of West Tropical Africa*. Vol I part 2. The Whitefriars press Ltd. London.
7. Institute of Laboratory Animal Resources (U.S.), Committee on Occupational Safety and Health in Research Animal Facilities (1997). *Occupational health and safety in the care and use of research animals*. Washington, DC: National Academy Press, 154 p.
8. Kerharo, J. and Adam, J.G. (1974). *La Pharmacopée Sénégalaise Traditionnelle: Plantes médicinales et toxiques*, Editions Vigot frères Paris
9. Burkill, H.M. (1995). *The useful plants of West Tropical Africa*. Families J-L. Royal Botanic Gardens, Kew, Richmond, United Kingdom. 2nd Ed. (3): 857.
10. Latven, A.R., Sloane, A.B. and Munch, J.C. (1951). Bioassay of cathartics. 1. Emodin Type. *Journal of the American Pharmaceutics Association*. Ed. 41, 548-552.
11. Lou, T.C. (1949). Biological assay of vegetable purgatives Part 1. Senna leaf, fruits and their preparations. *Journal of Pharmacy and Pharmacology*. 1: 673-682.
12. Rai, P.P. and Abdullahi, N. (1978). Occurrence of anthraquinone in Cassia species. *Nigerian Journal of pharmacy*. 9. 160-165.
13. Sharma, A., Sarvesh, P., Dwivedi, J. and Amita, T. (2011). First report on laxative activity of *Citrullus lanatus*. *Pharmacologyonline* 2: 790-797.
14. Toruan-Purba, A.V. (1999). Senna Miller. In: de Padua, L.S., Bunyapraphatsara, N. and Lemmens, R.H.M.J. (Editors). *Plant Resources of South-East Asia No 12(1)*. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden, Netherlands. pp. 442-447.