

Full Length Research Paper

Quantitative evaluation of the antipsoriatic activity of sausage tree (*Kigelia africana*)

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The antipsoriatic effect of methanol and hexane extracts of the stem, bark, leaves and fruit of *Kigelia africana* (sausage tree) on cell differentiation was evaluated in the modified mouse tail test for psoriasis. Histopathological studies showed that the topical application of *K. africana* extracts on the tails of male albino mice-induced orthokeratosis in previously parakeratotic areas of the adult albino mouse tail with significant effects on epidermal thickness. The results of our studies showed that the topical application of *K. africana* exhibited an important antipsoriatic activity with *K. africana* stem methanol extracts exhibiting the highest antipsoriatic activity with little irritation potential.

Key words: *Kigelia africana*, psoriasis, mouse tail test, orthokeratosis, parakeratosis, epidermal thickness, irritation potential.

INTRODUCTION

Psoriasis is a chronic, non-contagious disease. It appears as red scaly patches on the skin. These patches are psoriatic plaques which give the skin a silvery white appearance. Psoriasis is estimated to affect 2% of the world's population, that is, about 130 million of whom more than 20 million are affected by moderate to severe cases (Lowe et al., 2007). Prevalence of the disease in western population is estimated to be 3%. However, in Africa, there is a wide variation in the prevalence of the disease in different countries. South Africa has the prevalence of psoriasis set at 4.5%, while Nigeria has the prevalence of the disease set at 0.7% (Raychaudhuri and Farber, 2001). The onset of psoriasis is unpredictable with environmental factors, immunology and genetics all playing important roles (Lui et al., 2007; Galadari et al., 2005). New highly targeted therapies have been developed in the past few decades. However, effective therapies for the disease are limited. Glucocorticosteroids, for example, have been used for many years but they have a lot of side effects. The unavailability of the modern drugs in developing countries and the high cost of purchasing them has led to the

continuous use of traditional herbs that have proven effective in times past in treating psoriasis. *Kigelia africana* is well known in Africa.

It is traditionally used for the treatment of psoriasis in different parts of the continent and it is well distributed in Central, South and West Africa. *K. africana* is well reported for the presence of naphthoquinones, fatty acids, coumarins, irridoids, caffeic acids, nonviburtinal, sterols and flavonoids. These compounds may be responsible for the antifungal, antimicrobial, anticancer and anti-inflammatory properties of *K. africana* (Olatunji and Atolani, 2009).

Psoriasis is a heterogeneous disease with a very complex pathogenesis (Danilenko, 2008). Thus, bearing in mind the various medicinal uses of *K. africana*, the antipsoriatic effect of the topical application of the hexane and methanol extracts of different parts of the plant was evaluated using the modified mouse tail model which mimics some of the acute inflammatory responses seen in psoriasis (Bosman et al., 1992).

MATERIALS AND METHODS

Plant samples

The *K. africana* stem bark and leaves were collected at the Botanical Garden, University of Ibadan, Oyo State, Nigeria and the

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collection was in agreement with the United Nations Convention on biodiversity. The *K. africana* fruits were purchased from Bodija market, Ibadan, Oyo State, Nigeria. The entire plant collection was done in the month of June, 2010. All plant samples were subsequently identified by the assistant chief plant technologist and the officer-in-charge of the botanical garden, Mr Kayode and M. Owolabi. Thereafter, the plant samples were air-dried and pulverized using an electric grinder.

Chemicals

Hexane and methanol solvents used were of analytical grade. Blue seal Vaseline was used as the vehicle for the plant extracts.

Laboratory animals

124 male albino mice purchased from Covenant Farms, Ibadan, Oyo State, Nigeria, were used for the experiments. The experiments were carried out in accordance with the ethical guidelines for investigations in laboratory animals [EE directive of 1886(86/609/EEC)].

Extraction process

Methanol and hexane extracts were obtained from the pulverized samples using a soxhlet extractor. The extracts were subsequently concentrated using a rotatory evaporator.

The modified mouse tail test

The modified mouse tail test established by Bosman et al. (1992) and Ledon et al. (2007) was used. Ointments containing plant extract and vehicle (blue seal Vaseline) were prepared. Ointments had varying concentrations of 200, 100 and 50 mg/ml of the plant extract contained in the vehicle. Tails of mice were treated locally on the proximal part with 0.1 ml of the ointment. For a contact time of 2 to 3 h, plastic cylinders were slipped over the tails. Tails treated with vehicle and tails left untreated were used as Controls 1 and 2, respectively. The animals were treated once daily in the morning hours for 2 weeks. Three animals were used per dosage group. At the end of the treatment, the animals were killed by cervical dislocation, the tails were cut-off and longitudinal sections of tails were prepared and stained with hematoxylin for histological examination.

Histological examination

10 sequential scales were examined for the presence of a granular layer or isolated granular layer cells-induced in the previously parakeratotic skin areas. Measurements were carried out at the border of the scales with a semi-automatic image evaluation unit.

Drug activity and percent orthokeratosis

Drug activity and percent orthokeratosis in those parts of the adult mouse tail, which normally have a parakeratotic differentiation, was quantified measuring the length of the granular layer (A) and the length of the scale (B).

$$\% \text{ Orthokeratosis} = (A/B) \times 100$$

$$\% \text{ Activity} = \frac{\text{Mean OK of treated group} - \text{Mean OK of control group} \times 100}{100 - \text{Mean OK of the control group}}$$

OK = Orthokeratosis

Per animal, 10 sequential scales were measured and the results given in % orthokeratosis per scale. Three animals were taken for one drug concentration or control group. Thus, 30 individual orthokeratosis values were obtained per test group. Per animal and per group, mean and standard error of the mean were calculated.

Epidermal thickness

It was obtained measuring the distance between the dermo epidermal borderline and the beginning of the horny layer. Five measurements per animal were made in every 10 scales and the mean of the different animals was calculated. The change in epidermal thickness was then calculated. It is often regarded to be representative of the extent to which a substance causes irritation (Ledon et al., 2007).

$$\% \Delta \text{ Epidermal thickness} = \frac{\text{ET of treated group} - \text{ET of control group} \times 100}{100 - \text{ET of control group}}$$

ET = Epidermal thickness

RESULTS AND DISCUSSION

No deterioration in the general condition of the mice in any group was observed. However, erythema was observed on the tails of the mice on which the *K. africana* stem methanol extract ointment (200 mg/ml) was applied. No tail erythema was observed in any other group. Application of the ointments resulted in the softening of the tails.

The induction of a granular layer by the topically administered plant extracts was measured in previously parakeratotic scale regions in the mice tails. In the tail skin samples of the control groups, lack of granular layer in the epidermal stratum was observed as expected. The profiles of the percent orthokeratosis shown in Tables 1 and 2 indicate that the topically administered extracts induced a significant and dose-dependent increase in orthokeratosis in the epidermis of the mice tails.

Epidermal thickness is regarded as a parameter of skin irritation. Thus, the larger the increase in epidermal thickness induced, the more likely the ointment is going to cause irritation on the human skin. Generally, the irritation potential of the ointments was relatively low when compared to dithranol which is commonly used in treatment of psoriasis (Figures 1 and 2).

Kigelia africana stem ointments

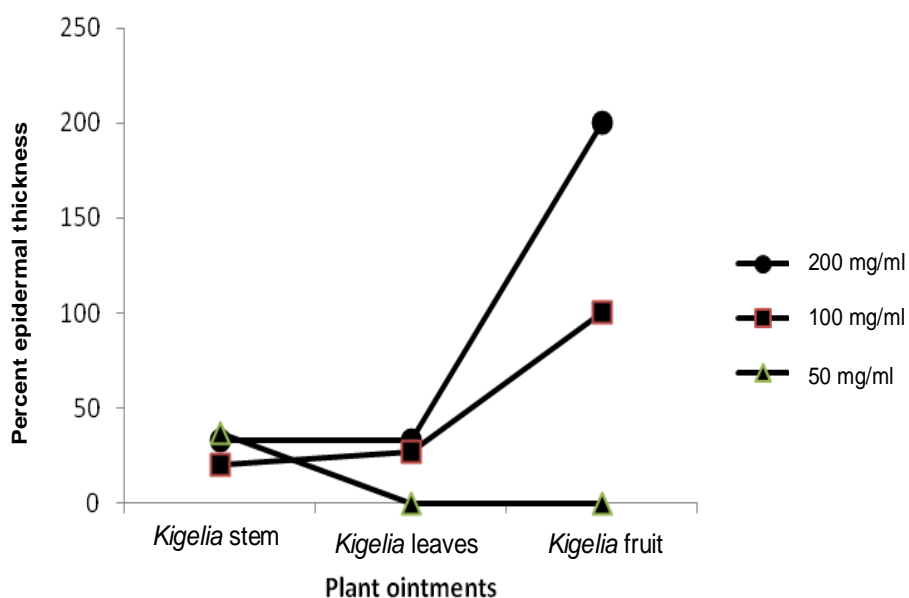
The *Kigelia* stem ointments had a relatively high drug activity when compared to other extracts (Figures 3 and 4). A higher activity was observed for the methanol

Table 1. Percentage (%) orthokeratosis induction for tails treated with methanol ointments of *K. Africana*.

Plant extract	Ointment concentration (mg/ml)	% orthokeratosis
<i>K. africana</i> stem	50	29.7 ± 1.6
	100	35.5 ± 1.7
	200	47.4 ± 2.0
<i>K. africana</i> leaf	50	29.5 ± 1.9
	100	29.7 ± 2.8
	200	33.0 ± 2.2
<i>K. africana</i> fruit	50	32.0 ± 1.4
	100	32.4 ± 0.8
	200	35.2 ± 1.7

Table 2. Percentage (%) orthokeratosis induction for tails treated with hexane ointments of *K. africana*.

Plant extract	Ointment concentration (mg/ml)	% orthokeratosis
<i>K. africana</i> stem	50	32.3 ± 3.0
	100	50.1 ± 2.4
	200	56.2 ± 1.6
<i>K. africana</i> leaf	50	29.6 ± 3.4
	100	30.4 ± 1.9
	200	32.4 ± 2.7
<i>K. africana</i> fruit	50	29.1 ± 1.7
	100	30.1 ± 2.2
	200	33.8 ± 1.5

**Figure 1.** Percent epidermal thickness with varying concentrations of *Kigelia africana* methanol extracts ointments.

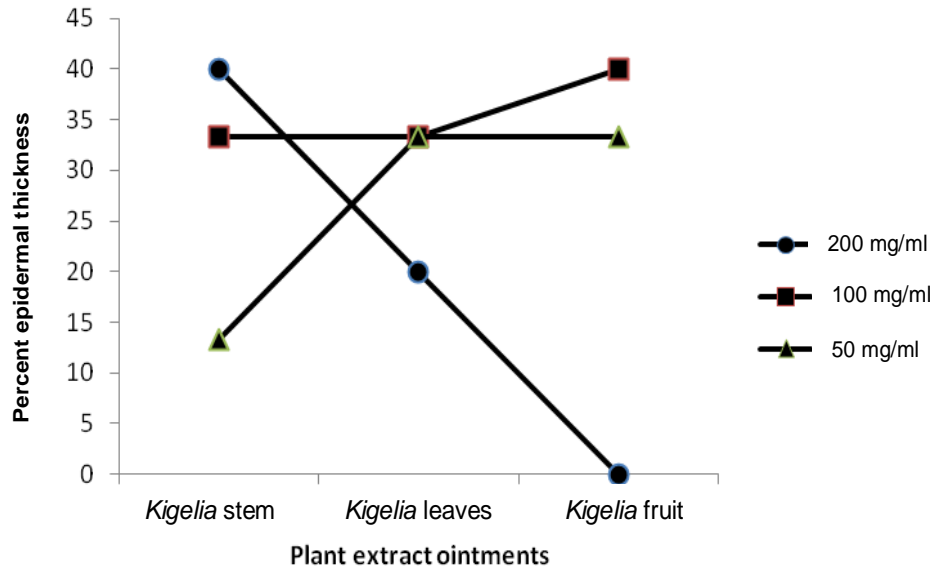


Figure 2. Percent epidermal thickness with varying concentrations of *K. africana* hexane extracts ointment.

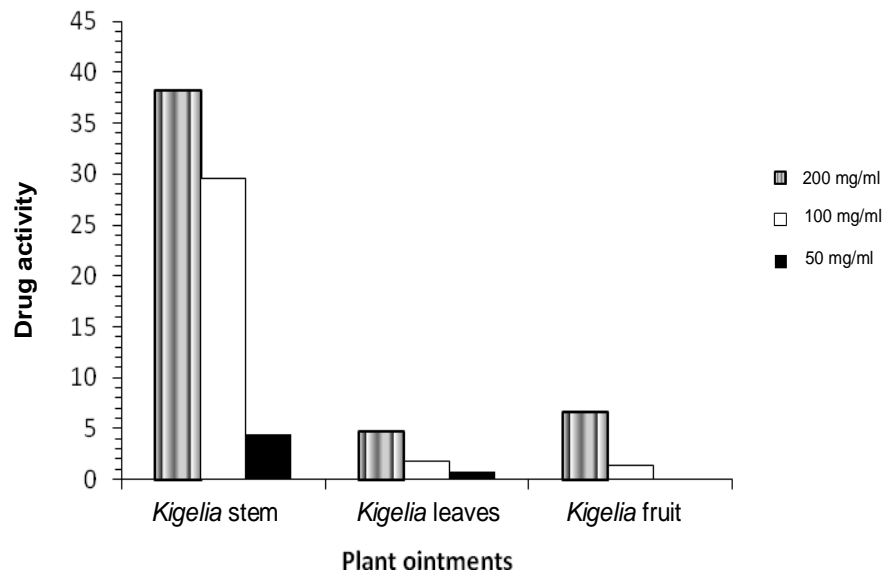


Figure 3. Drug activity of *K. africana* methanol extracts ointments.

extracted *Kigelia* ointments. The prospect of considering the methanol extract ointment over the hexane extract ointment for drug development was enhanced further by the higher irritation potential of the hexane extract ointment.

***Kigelia africana* leaves ointments**

K. africana leaves ointments showed lesser drug activity

relative to that of the stem ointments. Contrary to what was observed with the stem ointments, the activity of the hexane extract ointments of the *K. africana* leaves was generally higher than that of the methanol extract ointments, with a lower irritation potential at 200 mg/ml. The irritation potential of the *Kigelia* leaves ointment was generally lower than that of the *Kigelia* stem. Thus, for more convenient psoriasis treatment options, the *K. africana* leaves might be considered. However, more pharmacological tests and clinical studies still need to be

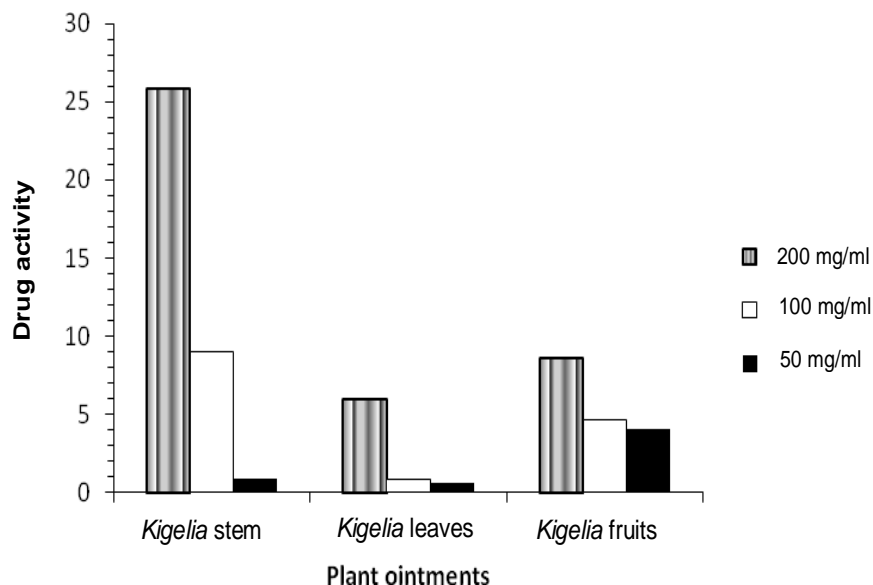


Figure 4. Drug activity of hexane extracts ointments of *K. africana*.

carried out to ascertain the effectiveness of the *K. africana* leaves at the clinical level.

***Kigelia africana* fruit ointments**

The drug activity of the *K. africana* fruit ointments was generally higher than that of the *K. africana* leaves ointment and lower than that of the *K. africana* stem ointments. The hexane extract ointments had a higher activity than that of the methanol extract ointments. The relatively high irritation potential of the methanol ointments might rule out its use at the clinical level. The relatively lower irritation potential of the hexane extract ointments suggests its use as a more convenient treatment option for psoriasis.

Conclusion

The modified mouse tail test carried out showed that all the *K. africana* ointments exhibited varying degrees of dose-dependent antipsoriatic activity. However, the *K. africana* stem appeared to have the highest drug activity, thus, suggesting that it may be a very good antipsoriatic treatment option at the clinical level. The low drug activity observed for the *K. africana* fruit hexane ointment was compensated for by its low irritation potential. Therefore, it could be regarded as a more convenient treatment option.

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