



## EFFECT OF AQUEOUS METHANOLIC STEM BARK EXTRACT OF *MAERUA ANGOLENSIS* DC ON ACUTE AND SUB-ACUTE INFLAMMATIONS

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### ABSTRACT

The anti-inflammatory activities of aqueous methanolic extract of *Maerua angolensis* stem bark were evaluated using carrageenan – induced hind paw oedema and cotton pellet granuloma models in rats. The aqueous methanolic extract dose-dependently inhibited carrageenan-induced oedema in rats. In the granuloma pouch, the extract exhibited a 52.25% reduction in granuloma weight at the dose of 500mg/kg. These activities were comparable to that of diclofenac sodium (5mg/kg), the standard agent used in the study. Phytochemical screening of the extract revealed the presence of tannins, flavonoids, saponins amongst other phytochemical constituents. The oral median lethal dose (LD<sub>50</sub>) value of the extract in rats, found to be greater than 5000mg/kg, suggests that it is non-toxic at the anti-inflammatory doses used in the study. These findings lend pharmacological credence to the ethnomedical use of the plant in the management of inflammatory conditions.

**Keywords:** *Maerua angolensis*, anti-inflammatory activity, diclofenac sodium, paw oedema, cotton pellet.

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### INTRODUCTION

Inflammation is a normal protective response to tissue injury caused by physical trauma, noxious chemicals or microbiologic agents. It is body's response to inactivate or destroy the invading organisms, remove irritants and set stage for tissue repair (Arrigoni-Martellie, 1977). Inflammation is triggered by the release of chemical mediators from the injured tissues and migrating cells. The specific chemical mediators vary with the type of inflammatory process and include amines such as histamine, serotonin, and lipids such as prostaglandins and small peptides such as kinins (Katzung, 1998).

*Maerua angolensis* DC (Synonyms *Maerua arenicola*) is of the family Capparidaceae.

The plant is a medium to big self-planted tree of up to 20 m heights, growing in bush and rocky areas. The plant is used in traditional medicine to treat psychosis, ecthyma, epilepsy, diarrhoea, dysentery, jaundice, hepatitis, insomnia, dyspepsia, neurasthenia, liver diseases (Adjanohoun *et. al.*, 1989; Baerts and Lehmann, 1989). Also, it is useful to treat vomiting, skin rash, nasal infection, stomach ulcer, boils, pimples, miscarriage, bad spirits and to prevent abortion (Adjanohoun *et. al.*, 1989; Chhabra *et. al.*, 1989; Kokwaro, 1976). *M. angolensis* is claimed to be used in the treatment of arthritis by the Hausas of North-western Nigeria. To our knowledge, there is no report on the anti-inflammatory activity of this plant. This study

is therefore aimed at evaluating the anti-inflammatory property of the aqueous methanolic extract of *Maerua angolensis*.

## **MATERIALS AND METHODS**

### **Collection and Identification of Plant material**

The whole plant (*Maerua angolensis*) was collected from the bush area of Basawa, Sabon-gari Local Government Area, Zaria, Kaduna, Nigeria. It was identified by Umar Gallah of the Herbarium section of the Department of Biological Sciences, Ahmadu Bello University, Zaria, Nigeria. A voucher specimen (NO. 900119) was deposited for future reference.

### **Preparation of extract**

The stem bark material was dried under shade and powdered with a pestle and mortar after which it was passed through an 80 mesh sieve. The powdered material was packed into a Soxhlet apparatus (238 g) and defatted with petroleum ether. The dried defatted powder was extracted sequentially with 70% methanol in water. The extract was concentrated *in vacuo* and subsequently referred to as aqueous methanolic extract (AME).

### **Animals**

Adult male Wistar rats (160-295 g) were used. They were housed in standard animal cages in the Animal House section of the Department of Pharmacology and Clinical Pharmacy, Faculty of Pharmaceutical Sciences, Ahmadu Bello University, Zaria-Nigeria. They were given standard laboratory animal diet and water *ad libitum*. All experimental protocols were approved by Ahmadu Bello University, Zaria, Nigeria animal ethics committee.

### **Phytochemical screening**

The extract was screened for the presence of alkaloids, saponins, tannins, flavonoids etc (Evans, 2004).

### **Acute toxicity**

The Median lethal dose (LD<sub>50</sub>) determination was conducted orally in rats, using the method described by Lorke (1983). In the first phase, rats were divided into three groups each containing three rats and were administered with the methanolic stem bark extract at doses of 10, 100 and 1000 mg/kg body weight orally; and observed for signs of toxicity and death for 24 h. In the second phase, three groups each containing one rat were treated with the extract at doses of 1600, 2900 and 5000 mg/kg, and observed for 24 h for signs of toxicity and death.

### **Carrageenan induced rat paw oedema**

The rats were divided into five groups (n=5). Acute inflammation was induced by sub plantar injection of 0.1 mL of 1% freshly prepared suspension of carrageenan (Sigma Chemical Co.) into the right hind paw of each rat (Winter *et. al.*, 1962). The paw diameter was measured at 0, 1, 2, 3, 4 and 5 h after the injection of carrageenan using a vernier caliper. The aqueous methanolic extract of the stem bark of *M. angolensis dc* (500 mg/kg, 250 mg/kg and 125 mg/kg) were administered orally. The standard drug, diclofenac sodium 5 mg/kg was administered orally. The control group received 0.9% normal saline. Drugs were given 30 min after the carrageenan injection. Mean increase in the paw diameter was measured and the percentage of inhibition was calculated.

### **Cotton pellet-induced granuloma**

The rats were divided into five groups (n=5). Cotton pellet induced granuloma in rats was produced by the method described by Winter *et. al.* (1957). After shaving the groin region under aseptic conditions, through a single needle incision, sterile pre-weighed cotton pellets (50 mg) soaked in 0.2 mL of distilled water containing penicillin (0.1mg) and streptomycin (0.13 mg), was implanted subcutaneously bilaterally in the groin under

ketamine (15 mg/kg) anesthesia. Extract (125, 250 and 500 mg/kg), diclofenac sodium (as the standard) and control were administered orally for 9 consecutive days from the day of cotton pellet implantation. On the 10<sup>th</sup> day the pellets were dissected out, dried at 60 °C, and the dry weights were determined. The weight of the cotton pellet before implantation was subtracted from the weight of the dried granuloma pellets. The increment in the dry weight of the pellet was taken as a measure of granuloma formation.

### RESULTS

The preliminary phytochemical screening revealed the presence of tannins, proteins, carbohydrates, terpenes, saponins and flavonoids. The oral LD<sub>50</sub> of the extract was found to be above 5000 mg/kg orally.

In acute inflammation model, the extract showed maximum inhibition of the carrageenan-induced rat paw oedema at the end of 3 h (Table 1). Edema suppressant effect of 125, 250 and 500 mg/kg treated groups were found to be significant ( $P < 0.001$ ) and dose-dependent. The effect of the extract at the highest dose tested (500 mg/kg) was comparable to that of diclofenac sodium, the standard agent.

In sub-acute inflammation model, the extract significantly ( $P < 0.001$ ) and dose-dependently reduced the weight of the granulation tissue formation. The percentage inhibition of the plant extract (500 mg/kg) was found to be comparable to that of diclofenac sodium (5 mg/kg) (Table 2).

**Table 1: Phytochemical screening of aqueous methanolic stem bark extract of *M. angolensis***

Phytochemical constituents	Inference
Alkaloids	-
Anthraquinones	-
Cardiac glycosides	+
Cyanogenetic glycosides	-
Flavonoids	+
Steroids/terpenoids	+
Tannins	+
Resins	+
Carbohydrates	+
Proteins	+

**Key:** + → present, - → absent

**Table 2: Effect of aqueous methanolic extract of *M. angolensis* on carrageenan-induced rat paw oedema**

Group (n=5)	Dose (mg/kg)	Oedema diameter (mL)				
		1h	2h	3h	4h	5h
Control	1mL/kg	0.34±0.01	0.38±0.02	0.42±0.02	0.41±0.01	0.43±0.01
AME	125	0.28±0.03 <sup>NS</sup> (17.64)	0.24±0.02** (36.84)	0.21±0.02** (50)	0.24±0.01** (41.46)	0.25±0.01** (41.86)
AME	250	0.23±0.01* (32.35)	0.21±0.02** (44.74)	0.18±0.01** (57.14)	0.22±0.01** (46.34)	0.24±0.01** (44.19)
AME	500	0.20±0.01** (41.18)	0.14±0.01** (63.16)	0.10±0.01** (76.19)	0.17±0.01** (58.54)	0.19±0.01** (55.81)
DS	5	0.18±0.02** (47.06)	0.14±0.01** (63.16)	0.09±0.01** (78.57)	0.12±0.02** (70.73)	0.17±0.02** (60.47)
<i>One Way ANOVA</i>		F=13.33 P<0.001	F=17.50 P<0.001	F=90 P<0.001	F=115 P<0.001	F=110 P<0.001

Figures in parentheses represent percentage inhibition of inflammation, NS= Not significant; \*P<0.01; \*\*P<0.001 compared to the control (Dunnets post hoc t-test for multiple comparisons). AME=Aqueous methanolic extract of *M. angolensis*; DS=Diclofenac sodium

**Table 3: Effect of aqueous methanolic extract of *M. angolensis* on sub-acute inflammatory model in rats**

Groups (n = 5)	Dose (mg/kg)	Weight of dry cotton pellet granuloma (mg)
Control	1ml/kg	84.41 ± 8.91
AME	125	73.80 ± 7.51 <sup>NS</sup> (12.57)
AME	250	60.61 ± 1.86* (28.19)
AME	500	40.32 ± 3.02** (52.23)
DS	5	34.70 ± 4.02** (58.89)
<i>One way ANOVA</i>		F=13.58 P<0.001

Figures in parentheses represent percentage inhibition of inflammation of granuloma NS: Not significant; \*P<0.01; \*\*P<0.001 compared to the control (Dunnets post hoc t-test for multiple comparison). AME=Aqueous methanolic extract of *M. angolensis*; DS=Diclofenac sodium

## DISCUSSION

Generally, the data presented here suggest that the aqueous methanolic extract of *M. angolensis* contain active constituents with anti-inflammatory properties. Effect of aqueous methanolic extract at a dose of 125, 250 and 500 mg/kg are dose-dependent and significant ( $P < 0.001$ ) in inhibiting carrageenan-induced oedema. Aqueous methanolic extract of *M. angolensis* showed potential inhibitory action on exudates formation. Kinin is said to be main mediator of granuloma, as it both vasodilates and increases vascular permeability in the early stages of inflammation. The probable mechanism of action of carrageenan induced oedema is bi-phasic, the first phase is attributed to the release of histamine, serotonin, 5-HT and kinins in the first hour; while, the second accelerating phase of swelling is related to the release of prostaglandin, bradykinin and lysozymes-like substances in 2-3 h (Brooks *et al.*, 1991; Katzung, 1998). Sub-acute inflammation involves infiltration of macrophages, neutrophils and proliferation of fibroblasts (Grover, 1990). The significant anti-inflammatory activity of the extract in cotton-pellet induced granuloma suggests its efficacy in inhibiting the increase in the number of fibroblasts and synthesis of collagen and mucopolysaccharides evident during granuloma model tissue formation (Arrigoni-Martellie, 1977). Previous studies have reported the anti-inflammatory activities of flavonoids. Also, the anti-proliferative activity of flavonoids evident by decrease in granuloma weight has been reported (Koganov *et al.*, 1999). In the preliminary phytochemical screening, the alcoholic extract showed the presence of terpenes, proteins, carbohydrates, tannins and flavonoids. It is therefore plausible to suggest that the significant anti-inflammatory activity of *M. angolensis* in

both models of inflammation could be due to the presence of flavonoids, either alone or in combination with other constituents. The present study has lent credence to the folkloric use of *M. angolensis* in the treatment of inflammatory diseases like arthritis.

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