

ANALGESIC AND ANTI-INFLAMMATORY ACTIVITIES OF LEAF AND STEM ESSENTIAL OILS OF *Jatropha tanjorensis* (Euphorbiaceae)

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ABSTRACT

Since health is wealth, management of pain has generated great interest due to the economic hardship generally being experienced by nations. *Jatropha tanjorensis* is a shrub found in Asia, America and Africa, with reported nutritional and biological activities. This study was designed to investigate the analgesic and anti-inflammatory activities of the leaf and stem essential oils of *Jatropha tanjorensis*. Plant sample was obtained from Gboko, Nigeria. Essential oils from leaf and stem of this plant were extracted by hydro distillation using all-glass Clevenger apparatus. Acute toxicity test on essential oil samples of *Jatropha tanjorensis* was carried out using various dosages. Analgesic activity of these essential oils was investigated by measuring the number of acetic acid induced writhing in rats while oedema volume of rat's paw was used to determine the anti-inflammatory activity of the essential oil samples. Essential oil samples were safe at 25 ml/kg bodyweight. Analgesic activity of essential oil was very good on leaf (65.57 %) at 15 ml/kg bodyweight, however, less active than diclofenac (75.95 %) at 40 mg/kg bodyweight. During investigation of anti-inflammatory activity, all two essential oil samples; leaf and stem, showed better activity than the standard drug, indomethacin. Both leaf and stem essential oils of *Jatropha tanjorensis* exhibited early (0 minutes) and late phase (120 minutes) inhibitory activity. Results show that leaf and stem essential oils of *Jatropha tanjorensis* exhibited good anti-inflammatory activity and can be researched further in this regard as a possible drug.

Keywords: *Jatropha tanjorensis*, essential oil, anti-inflammatory, analgesic, diclofenac, indomethacin

INTRODUCTION

Natural Products are naturally occurring substances generally found in living organisms including animals, plants, fungi, and algae [1]. These substances have found good use in our everyday life. Their use in medicine has received great attention over the years. Researches on these plant products have focused on crude

extracts, essential oils and chemical compounds found in them.

Essential oils are volatile, lipophilic and odoriferous compounds extracted from plant substances using hydro-distillation [2]. Essential oil components are composed of mainly two groups; terpenoids and non terpenoids. These oils have been employed in perfumery, medicine,

aromatherapy, apothecary among others [3]. They have been found to be pharmacologically active against health challenges including cancer, diabetes, microbes and inflammation [3]. Most health challenges are attended by pain, which often is occasioned by inflammation. The quest to address ailments, of a necessity, must be accompanied by the need to reduce or eradicate the attendant pain and/or discomfort.

Reports have shown various biological activities of the *Jatropha* genus including *gossypifolia* [4][5], *curcas* [6][7], *mutabilis* [8], *intigrimma* and *roseae* [5].

Jatropha tanjorensis, another member of the *Jatropha* genus is a shrub which originated from Central America [9]. This plant belongs to the *Euphorbiaceae* family [10]. It is largely found in Asia, America and Africa [10] and its seeds, leaves and stem are used in traditional medicine [11]. *Jatropha tanjorensis* is popularly known as ‘hospital too far’ or ‘Catholic vegetable’ in Nigeria. In South-Western Nigeria, where the leaves are used as food, the Yorubas call it ‘*Iyana Ipaja*’ or ‘*lapa lapa*’. The Ibos of South-Eastern Nigeria refer to it as ‘*ugu-oyibo*’ while the Tiv people of North-Central Nigeria call it *Kpan gyedam* [12].

Crude extract of *Jatropha tanjorensis* has exhibited various activities including cardioprotection [13], anti-obesity [14], anti-inflammatory [15], anti-anaemia [16], anti-microbial [17] and antioxidant [10][18].

In this study, we set out to assess the analgesic and anti-inflammatory activities of essential oils of *Jatropha tanjorensis* using wistar rats.

MATERIALS AND METHODS

Collection of Plant Materials:

Jatropha tanjorensis plant was collected from Mkar settlement in Gboko, Benue State, Nigeria, which lies between longitude (7° 47’ 0” and 10° 0’ 0” E) and latitude (6° 25’ 0” and 8° 8’ 0” N). Plant sample was identified and authenticated. The collected plant was separated into leaf and stem parts.

Preparation of Plant Material:

The freshly obtained plant material was washed with water to remove contaminants. Leaf and stem parts were each separated and weighed.

Drugs and Chemicals:

Diclofenac sodium was purchased from Normed Pharmacy Ltd, a registered pharmacy in Gboko, Nigeria. All other chemicals were products of Sigma-Aldrich (Germany).

Experimental Animals:

Rats of both sexes weighing between 15 to 32 g obtained from the animal house of University of Mkar, Mkar were used for the study. Animals were acclimatized at room temperature (29°C) with a relative humidity of 70% in standard cages for 4 to 5 days prior to commencement of the experiment. Throughout the period of study, animals were kept under hygienic conditions by constant cleaning and removal of faeces and spilled feeds from cages daily. The study was approved by the Animal Welfare and Ethics

Committee of University of Mkar, Mkar, Benue State, Nigeria and issued an Approval number: UMM/DOR/ECSBS/21/01. All conditions of animals used were as approved by United States National Institute of Health (NIH) guide for Care and Use of Laboratory Animals.

Extraction of the Essential Oil Components:

Essential oil extractions were carried out by the use of an all-glass Clevenger-type apparatus designed to British Pharmacopeia specifications. 250 g each of leaf and stem of *Jatropha tanjorensis* were crushed and hydro-distilled for 2 hours. 2.0 ml each of distilled hexane were used to remove the essential oils. The oils were then stored in vials and refrigerated.

Acute Toxicity Studies

The acute toxicity (median mean dose, LD₅₀) was determined using albino rats. Twenty five rats were grouped into five groups with five rats per group. The rats in each group were treated with leaf and stem essential oils of *Jatropha tanjorensis* at doses of 5, 10, 15, 20 and 25 ml/kg bodyweight. The experimental animals were observed for 72 hours for signs and symptoms of toxicity after treatment.

Drug:

Diclofenac was used as a standard drug for analgesic activity at a dose of 25 mg/kg bodyweight.

Analgesic Activity Assay

Acetic Acid Induced Writhing Test:

The abdominal constriction was induced in rats (weighing 15-32 g) by intraperitoneal injection of 1% (v/v) acetic acid (2.3 ml/kg), as described by

Santos *et al.* [19]. Animals were pretreated with leaf, stem and root essential oils of *J. tanjorensis* at doses of 5, 10 and 15 ml/kg, intraperitoneally, 45 minutes before acetic acid administration. Control animals received 2 ml volume of hexane and the positive control animals were treated with the reference analgesic drug; Diclofenac sodium (40 mg/kg bodyweight). Animals were treated one at a time. The number of abdominal constrictions was cumulatively counted over a period of 20 minutes after acetic acid administration. The percentage inhibition of analgesic activity was calculated using the following formula [19];

% Analgesic Activity

$$= \frac{\text{Mean writhing count (Control group – treated group)}}{\text{Mean writhing count of control group}} \times 100$$

Anti-inflammatory Activity Assay

Egg Albumin Induced Oedema

The test was conducted using a modified method of Winter *et al.*, 1963 as described by Akah and Nwabie [20]. The rats were divided into five groups of five rats of either sex per group and treated as follows: Group A which served as the negative control received hexane (2 ml), while Group B which was the positive control received 25mg/kg bodyweight of indomethacin. Groups C, D and E were administered 5, 10 and 15 mL/kg bodyweight of the leaf and stem essential oils of *Jatropha tanjorensis* respectively, orally. After 45 minutes of essential oil administration,

oedema was induced by sub-plantar injection of 0.1ml of fresh raw egg albumin in the left hindpaw. This was carried out by wrapping a piece of cotton thread round the paw and measuring the circumference with a metre rule. The readings were taken at 20 minutes intervals, that is; 0, 20, 40, 60, 80, 100 and 120 minutes after albumin administration. The average

increase in paw size of each group was calculated and compared with the controls; groups A and B.

Statistical Analysis:

Data obtained was expressed as Mean± Standard Error of Mean and analyzed using the Analysis of Variance ‘ANOVA’ [21] and SPSS (version 20) where applicable. Values at $P < 0.05$ were regarded as significant in comparison with appropriate controls.

RESULTS AND DISCUSSION

Yield of leaf and stem essential oils of *Jatropha tanjorensis* was 1.09 and 1.15 % respectively (Table 1). These essential oil samples were safe at 25 mL/kg bodyweight (Table 2).

Table 1. Yield of Leaf and Stem essential oils of *Jatropha tanjorensis*

Plant part	Weight of sample (g)	Weight of essential oil procured (g)	Yield of essential oil (%)
Leaf	101.0	1.1	1.09
Stem	104.0	1.2	1.15

Essential oils comprise monoterpenes, sesquiterpenes, and phenylpropanoids as the main chemical constituents [22]. Several essential oils have been reported to exhibit various pharmacological activities including antioxidant, analgesic [23][24][25], antimicrobial, anticonvulsant, hypnotic, anxiolytic or anticancer [22][26] and anti-

inflammatory [24]. Monoterpenes responsible for these biological activities of essential oils include menthol, linalool, limonene, myrcene and 1,8-cineole [26].

Table 2. Acute toxicity determination for Leaf and Stem Essential oils of *Jatropha tanjorensis*

Dose (ml/kg)	Plant Part	
	Leaf	Stem
5	0/5	0/5
10	0/5	0/5
15	0/5	0/5
20	0/5	0/5
25	0/5	0/5

Key: 0 = number of death, 5 = number of rats

Analgesic Activity

Writhing test as a chemical method is used to induce pain of peripheral origin by administration of irritant principles such as phenylquinone or acetic acid in mice. Acetic acid induced abdominal writhing is useful in testing new

analgesic drugs. Abdominal injection of acetic acid in mice has been attributed to the release of arachidonic acid, which results in the synthesis of prostaglandins via cyclooxygenase enzyme and hence this mediator stimulates pain. Pain release by mice is traced to the fact that special nerve endings that sense pains are extremely sensitive to prostaglandin hence when prostaglandins are released, the nerve ending responds to it via prostaglandins E2 receptor by picking up and transmitting the pain and injury messages to the brain and thereby causing visceral writhing stimuli in mice [27]. Analgesic activity of the test compound was deduced from decrease in the frequency of writhing. This method was employed to evaluate the possible peripheral analgesic effect of leaf and stem essential oils of *J. tanjorensis*. Leaf essential oil of *Jatropha tanjorensis* at 5 mL/kg exhibited less significant analgesic activity of 17.47%. At dosage of 10 mL/kg, the analgesic activity is 59.24% while a marked increase in analgesic activity is observed at 15 mL/kg (65.57%). The standard drug, diclofenac, showed better analgesic activity (75.95%) as compared to all three leaf essential oil dosages. The three different dose levels of 5, 10 and 15 mL/kg leaf essential oils of *J. tanjorensis* exhibited analgesic activity in the acetic acid-induced abdominal writhes in mice, in a dose dependent manner.

Stem essential oil of *J. tanjorensis* at 5 mL/kg bodyweight showed poor analgesic result. The percentage analgesic activity at 10 mL/kg stem essential oil is 52.1% while 15 mL/kg

bodyweight exhibited 59.5% analgesic activity. This is also less active than diclofenac. The analgesic activity of stem essential oils at 5, 10 and 15 mL/kg bodyweight is dose dependent.

Anti-inflammatory Activity

Albumin induced oedema is a biphasic response; the early phase being mediated through the release of histamine, serotonin and kinins while the late phase is related to the release of prostaglandins and mediated by bradykinin, leucotrienes, polymorphonuclear cells and prostaglandins produced by tissue macrophages [2].

A significant decrease in paw size was observed at 5 mL/kg leaf essential oil administration at 0 minutes, meaning good anti-inflammatory effect. This is a sign of early phase action. This is better, compared to indomethacin, the standard drug used. Anti-inflammatory activity at 10 mL/kg bodyweight was significant in the late phase, at 120 minutes. Late phase effect (120 minutes) was also observed at 15 mL/kg bodyweight. Indomethacin had a steady effect with the later phase more pronounced for the leaf essential oil sample. The anti-inflammatory effect of leaf essential oil of *J. tanjorensis* is dose dependent in an increasing manner. The activity of leaf essential oil of *J. tanjorensis* is both in the early and late phase and more pronounced in an increased dosage form.

The stem essential oil of *J. tanjorensis* at 5, 10 and 15 mL/kg at 0 minutes exhibited good reduction in paw volume and hence good anti-

inflammatory activity. This shows early phase drug action.

This, in contrast with indomethacin, is far better.

A little rise in paw volume was seen at 5 mL/kg

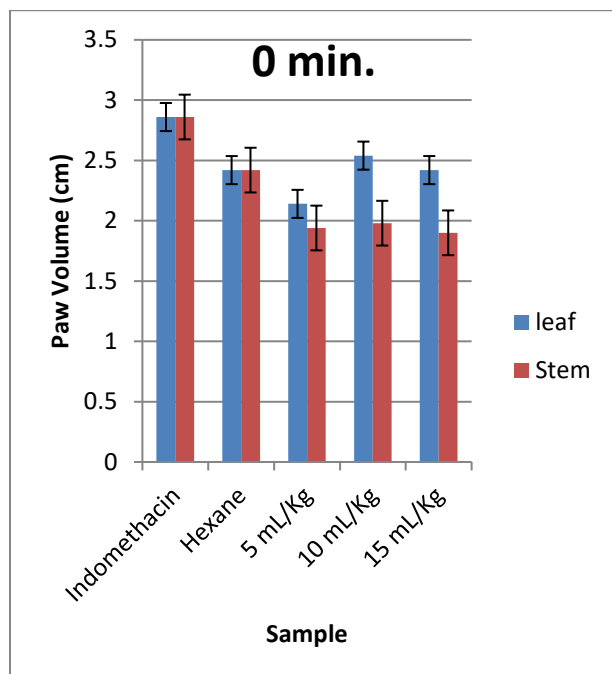


Figure 1: Comparative Anti-inflammatory Activities of Leaf and Stem Essential oils of *Jatropha tanjorensis* 0 minutes after Administration

Discussion

Phytol, a diterpene compound, a long chain unsaturated acyclic alcohol, found active against inflammation, cellular oxidants and microbes [28] was reported to be present in *Jatropha* genus; *Jatropha tanjorensis* [11], *Jatropha intigrimma*, *Jatropha gossypifolia* and *Jatropha roseae* [5], *Jatropha curcas* [6], *Jatropha mutabilis* [8] and *Jatropha gossypifolia* [4]. Phytols are also reported to exhibit analgesic activity [28]. The anti-inflammatory activity of these essential oils can be linked to phytol due to

bodyweight from 20 minutes and a steady reduction from 60 minutes to 120 minutes. A general decrease in paw volume was observed at 120 minutes for 5, 10 and 15 mL/kg bodyweight of stem essential oil of *J. tanjorensis* and indomethacin.

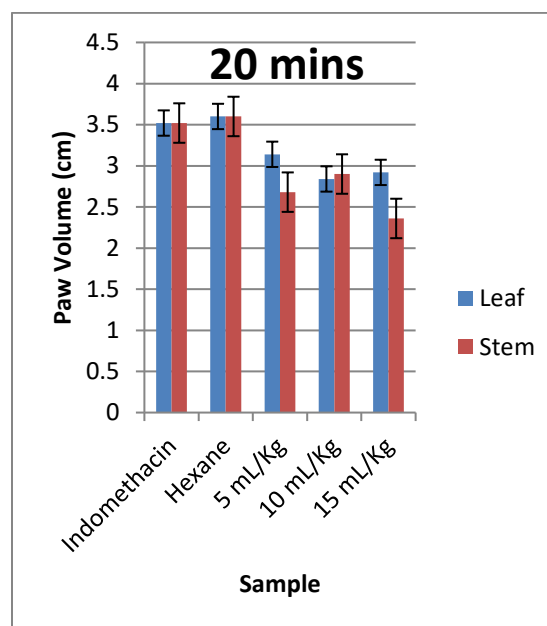


Figure 2: Comparative Anti-inflammatory Activities of Leaf and Stem Essential oils of *Jatropha tanjorensis* 20 minutes after Administration

its similarity to report by Islam *et al.* [28]. In this report, an In silico study indicated that phytol strongly interacts with cyclooxygenase 2, the enzyme responsible for inflammatory prostaglandins generation.

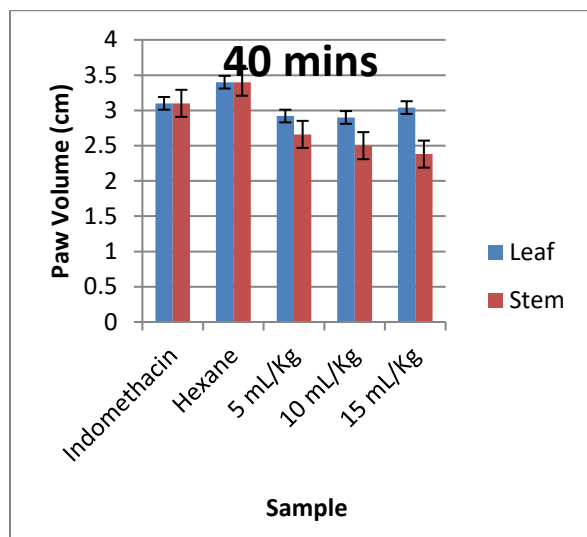


Figure 3: Comparative Anti-inflammatory Activities of Leaf and Stem Essential oils of *Jatropha tanjorensis* 40 minutes after Administration

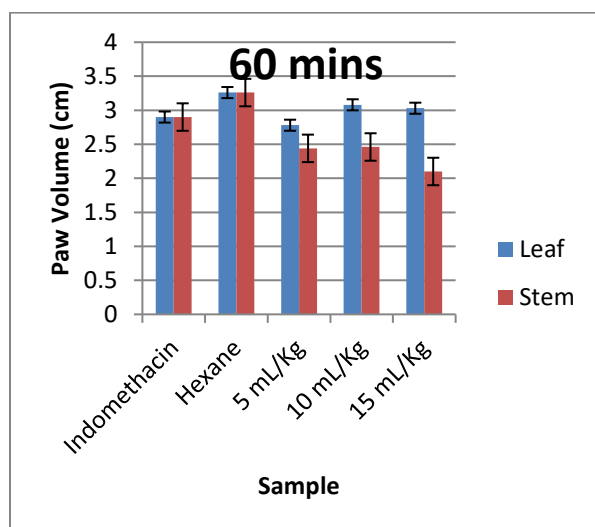


Figure 4: Comparative Anti-inflammatory Activities of Leaf and Stem Essential oils of *Jatropha tanjorensis* 60 minutes after Administration

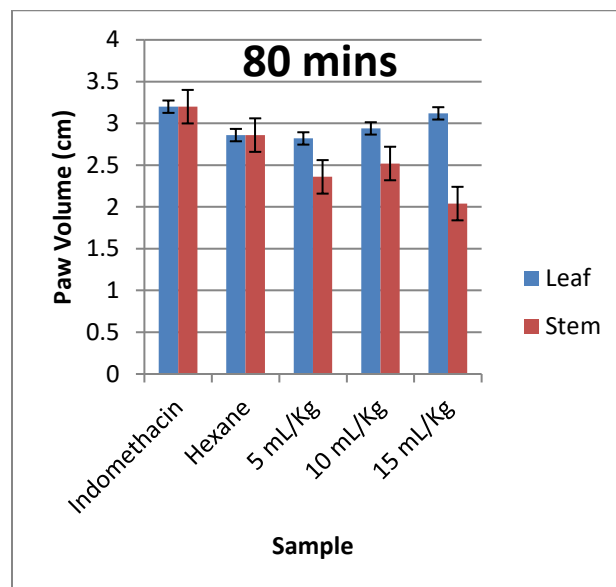


Figure 5: Comparative Anti-inflammatory Activities of Leaf and Stem Essential oils of *Jatropha tanjorensis* 80 minutes after Administration

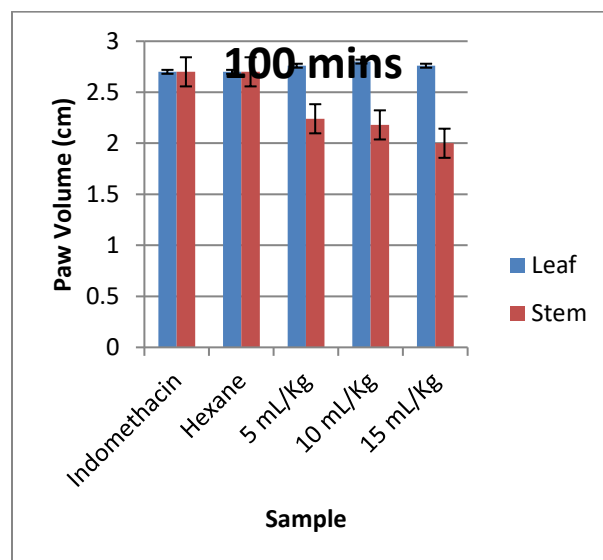


Figure 6: Comparative Anti-inflammatory Activities of Leaf and Stem Essential oils of *Jatropha tanjorensis* 100 minutes after Administration

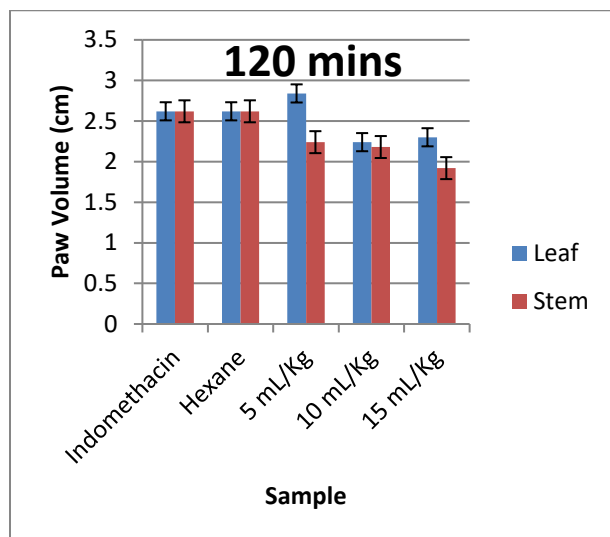


Figure 7: Comparative Anti-inflammatory Activities of Leaf and Stem Essential oils of *Jatropha tanjorensis* 120 minutes after Administration

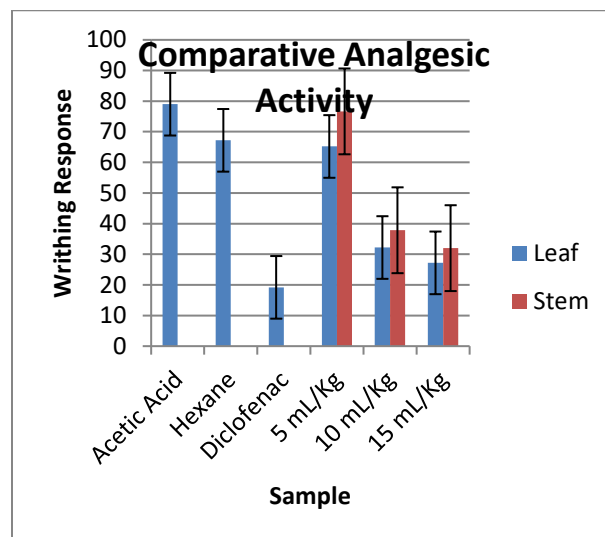


Figure 8: Comparative Analgesic Activities of 5, 10 and 15ml of Leaf and Stem essential oils of *Jatropha tanjorensis*.

Furthermore, phytol was reported to have shown significant interaction with NF- κ B, a regulatory protein that mediates COX-2, TNF- α , and IL-1 β expression [29]. These results also revealed a noticeable interaction of phytol with COX-1 and IL-1 β , agreeing with Silva *et al.* [30], who suggested IL-1 β and TNF- α levels reduction, triggered by phytol, as a potential mechanism of its anti-inflammatory action.

In a report by Oluwakayode *et al.* [11], leaf essential oils of *J. tanjorensis* showed sensitivity for *Escherichia coli*, *Staphylococcus aureus*, *Bacillus subtilis* and *Salmonella typhi* at all tested concentrations. Leaf and stem essential oils of *Jatropha gossypifolia* have also shown potent antibacterial and antioxidant activities as reported by Okoh *et al.* [31].

These reports agree with anti-inflammatory capacity of this leaf and stem essential oils. This is because antimicrobial activity can be linked to anti-inflammation since antibiotics like doxycycline can affect immune cell function and reduce the release of inflammatory cytokines [32].

CONCLUSION

Biological activities of essential oils have been widely reported. This report highlights that analgesic activity of leaf and stem essential oils of *Jatropha tanjorensis* at dose levels of 10 mL/kg (59.24 %) and 15 mL/kg (65.57 %) bodyweight showed good activity although less than diclofenac (75.95 %) at 40 mg/kg bodyweight. Anti-inflammatory screening shows that leaf and stem essential oils of *Jatropha tanjorensis* exhibit

activity at both early (0 minutes) and late phases (120 minutes).

In conclusion, leaf and stem essential oils of *Jatropha tanjorensis* possess better anti-

inflammatory activity at various dosages. This suggests it to be a drug of promise.

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