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**Harpreet Singh**
Department of Pharmacology and Toxicology, College of Veterinary Sciences, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab, India

**VK Dumka**
Department of Pharmacology and Toxicology, College of Veterinary Sciences, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab, India

**Rashmi Sagar**
Department of Pharmacology and Toxicology, College of Veterinary Sciences, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab, India

**Varun Kumar**
Department of Pharmacology and Toxicology, College of Veterinary Sciences, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab, India

**Correspondence**
**Harpreet Singh**
Department of Pharmacology and Toxicology, College of Veterinary Sciences, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab, India

# Evaluation of antipyretic, anti-inflammatory and analgesic activities of various leaf extracts of *Kigelia africana*

**Harpreet Singh, VK Dumka, Rashmi Sagar and Varun Kumar**

**Abstract**
Present investigation was done on 50 Albino Wistar rats of either sex. Various extracts of *Kigelia africana* i.e aqueous, alcoholic, acetone and chloroform were evaluated for antipyretic property, anti-inflammatory activity using carrageenan induced paw edema and analgesic activity by tail flick method. Alcoholic extract @ 50 mg/kg showed decrease in temperature after one hour. Aqueous extract @ 100 mg/kg and alcoholic extract @ 50 mg/kg showed significant anti-inflammatory activity whereas significant analgesic activity was shown by aqueous and alcoholic group.

**Keywords:** Antipyretic, Anti-inflammatory, Analgesic, *Kigelia africana*

## Introduction
Nature has been a source of medicinal agents for thousands of years and an impressive number of modern drugs have been derived from natural sources, many of these isolations were based on the uses of the agents in traditional medicine (Cragg and Newman 2001) [1]. Ethno-medicinal plant use data in many forms has been heavily utilized in the development of formularies and pharmacopoeias, providing a major focus in global healthcare, as well as contributing substantially to the drug development process (Graham *et al* 2000) [2]. The importance of medicinal plants and traditional health systems in solvingthe health care problems of the world is gaining increasing attention. Most of the developing countries have adopted traditional medical practice as an integral part of their culture. Natural products have served as a major source of drugs for centuries, and about half of the pharmaceuticals in use today are derived from natural products. Quinine, theophylline, penicillin G, morphine, paclitaxel, digoxin, vincristine, doxorubicin, cyclosporin, and vitamin A all share two important characteristics: they are cornerstones of modern pharmaceutical care, andthey are all natural products (Ebadi 2007) [3].

*Kigelia Africana* (Lam) Benth, (*K. pinnata*) belongs to the family Bignoniaceae. Its common names include sausage tree (Eng.); worsboom (Afr.); um vunguta, umfongothi (Zulu); modukguhlu (North Sotho); muvevha (Venda) (Coats-Palgrave, 1988) [4] pandoro (West Nigeria) (Aiyelola *et al* 2006) [5] Saucissonnier; Faux baobab (Fr) Mvungunya, mwegea, mwicha, mranaa (sw). It is also known as Balamkheera in hindi and distibutedall over India but found abundantly in West Bengal. It is a tree growing up to 20 m tall or more. The bark is grey and smooth at first, peeling on older trees. It can be as thick as 6 mm on a 15 cm branch. The wood is pale brown or yellowish, undifferentiated and not prone to cracking. (Roodt, 1992) [6] The tree is evergreen where rainfall occurs throughout the year, but deciduous where there is a long dry season. The leaves are opposite or in whorls of three, 30 - 50 cm long, pinnate, with six to ten oval leaflets up to 20 cm long and 6 cm broad; the terminal leaflet can be either present or absent. The flowers (and later the fruit) hang down from branches on long flexible stems (2 - 6 m long).Various pharmacological examinations such as antibacterial, antiviral and antioxidant activities have been carried out. The success story of chemotherapy lies in the continuous search for new drugs to counter the challenges posed by resistant strains of microorganism (Khan *et al* 2003) [7].

## Material and methods
### Plant material
The leaves were collected based on ethno pharmacological information. Leaves were collected from campus of Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab. Plant was identified by botanist of Collarative Ayurveda Research Centre, GADVASU, Ludhiana.

Immediately after collection leaves were washed and dried under sunlight. The dried leaves were finely grounded into powder using grinder, weighed and kept for further analysis.

**Extraction**
Four different extracts were prepared i.e aqueous, alcoholic, acetone and chloroform extracts. 100 g of powdered material was soaked in 1 litre of solvent and left for 24 h. Mixture was stirred at 30 min interval. Mixture was filtered with double layered musclin cloth and refiltered with what man filter paper no 1 and evaporated at temperature of 40-45°C. Powdered leaves yielded 10% aqueous, 2.7% alcoholic, 1.3% acetone and 2.3% chloroform extracs which were stored in air tight bottles and refrigerated at 4ºC prior to use.

**Drugs and chemicals**
Paracetamol, E.coli endotoxin, carrageenan, meloxicam were used in experiments.

**Animals**
50 Swiss albino rats (180-200 g) of either sex were kept at Small animal colony, GADVASU, Ludhiana were used. The experiments were approved by the Institutional Animal Ethics Committee (IAEC) vide reference no VMC/13/1786-1806 dated 4/4/13 and were conducted in accordance with ethical committee guidelines. The animals maintained under standard environmental condition had free access to standard rat feed pellets (Ashirwad industries, Mohali, Punjab) and water. Rats were divided into ten groups of five animals each. Group I served as control, group II as positive control and remaining groups served as test groups. Group III and IV were administrated with aqueous extract of concentration 50 mg/kg and 100 mg/kg orally, respectively. Group V and VI were administered with alcoholic extract having concentration of 50 mg/kg and 100 mg/kg, respectively. Similarly group VII and VIII with acetone extract and group IX and X with chloroform extract having concentrations of 50 mg/kg and 100 mg/kg, respectively.

**Antipyretic activity**
In this experiment E.coli endotoxin @ 2 µg/kg was administrated i.p to all groups. Group II was given paracetamol @50 mg/kg orally. Rest of groups were treated as described above. Fever was measured at duration of 1 h, 2 h, 3 h, 4 h, 5 h and 6 h, respectively, with thermometer.

**Anti-inflammatory activity**
In this experiment all groups were administered with 1% carrageenan subplanter@ 0.1 ml to induce inflammation as per method of Winter *et al* (1962) [8]. In group II meloxicam @ 1 mg/kg orally was given as standard drug. Rest of the groups were treated as described above. Increase in paw volume was noted at time interval of 1 h, 2 h, 3 h, 4 h, 5 h and 6 h respectively.

**Analgesic activity**
In this experiment group I was given DW orally. In Group II meloxicam @ 1 mg/kg orally was given as standard drug. Rest of the groups were treated as described above. The tail flick examination was used to calculate analgesic activity by the method defined by D'amour and Smith (1941) [9]. A radiant heat automatic tail flick analgesiometer was applied to measure reaction time. Basal reaction time of animals to radiant heat was recorded by locating the tip (last 1-2 cm) of the tail on radiant heat source. The tail removal from the radiant warmth was taken as end point. The cutoff time of 10 seconds was used to avoid tail injury by heat. Reaction time was measured at duration of 0.5 h, 1 h, 1.5 h, 2 h, 3 h and 4 h, respectively.

**Results and discussion**
**Antipyretic activity**
Results obtained in this experiment re given in Table 1. Group V ( alcoholic 50 mg/kg) showed decrease in temperature after one hour, however increase in temperature was significantly higher than positive control group and decrease in temperature was very less. Group IV(aqueous 100 mg/kg), Group VI (alcoholic 100 mg/kg), Group VII (acetone 50 mg/kg), Group VIII (acetone 100 mg/kg) and Group IX (chloroform 50 mg/kg) showed decline in temperature after two hours of *E. coli* endotoxin administration as compared to control group which showed decrease in temperature after three hours. Group III (aqueous 50 mg/kg) and Group X (chloroform 100 mg/kg) showed decrease in temperature after three hours of *E. coli* endotoxin administration similar to the control group. Group II which was treated with paracetamol as a standard drug @ 50 mg/kg orally showed decline in temperature after one hours of endotoxin administration. In the standard group, the temperature returned to normal after 3 hours whereas in all other groups the temperature returned to normal range after six hours. In this experiment, Group V showed significant antipyretic activity. Group IV, Group VI, Group VII, Group VIII and Group IX showed antipyretic activity but lower than the standard drug. In agreement with the present findings Alam *et al* 2016 who reported decline in temperature after two hours of administration of *Fagoniacretica* flower extract in rabbits. Similar results were also shown by Padhan *et al* (2010) [11] who reportedmethanolic extract of *Capparis. zeylanica* plant to have significant antipyretic activity when compared with the standard drug.

**Anti-inflammatory activity**
Results obtained in this experiment are shown in table 2. After two hours of carrageenan administration, the inflammation in standard group was lower as compared to all other groups and was highest in the control group. Most of extracts showed anti-inflammatory activity but significant activity was shown by Group IV (aqueous 100 mg/kg) and Group V (alcoholic 50 mg/kg). The inflammation started to decrease after three hours of carrageenan administration in all the groups. In the standard group, paw volume became normal after 4 hours whereas in all other groups it was normal after six hours of carrageenan administration. In support of the present findings anti-inflammatory activity has been reported for other plant extracts. Kamau *et al.* (2016) [12] reported that the leaf extract of *Kigeliaafricana* reduced inflamed hind paw diameter of mice significantly. Hafeez *et al* (2013) [13] reported inhibition of paw swelling at 1, 2 and 3 hour after carrageenan injection by orally administering ethanolic extract of *Ficusvirens* plant.

**Analgesic activity**
Results obtained in this experiment are shown in table 3. In standard group there was increase in reflex time at 60 minutes and remained upto 90 minutes after drug administration. It started to decrease after 120 minutes and continued to decrease at 180 minutes and 240 minutes. In the control group there was no significant increase in reflex time. Group V (alcoholic 50 mg/kg) and group VI (alcoholic 100 mg/kg)

showed similar results as compared to standard group where reflex time started to increase at 60 minutes and remained upto 90 minutes and then started to decrease after 120 minutes of drug administration. Increase of reflex time in group V and group VI was significantly lower than standard group. In all other groups there was increase in reflex time after 90 minutes which started to decrease after 180 minutes. Present study showed the analgesic activity of alcoholic extract of *Kigeliaafricana* but it was significantly lower than standard group. In agreement with the present findings Amali *et al* (2012) [14] reported ethanolic extract of stem bark of *Kigeliaafricana* exhibited significant analgesic properties.

**Conclusion**

Most extracts showed antipyretic activity but significant activity was shown by group V (alcoholic @ 50 mg/kg). Most of extracts showed anti-inflammatory activity but significant activity was shown by group IV (aqueous 100 mg/kg) and group V (alcoholic 50 mg/kg). All the groups showed analgesic activity but significant activity was shown by alcoholic and aqueous group.

**Table 1:** Effect of different leaf extracts of *Kigeliaafricana* on *E. coli endotoxin (*2 mg/kg*)* induced fever in rats.

| | | Increase in temperature (ºC)in comparison to normal( 0 hour) value | | | | | |
|---|---|---|---|---|---|---|---|
| **Extract** | **Dose (mg/kg)** | **1 hour** | **2 hour** | **3 hour** | **4 hour** | **5 hour** | **6 hour** |
| Control | - | 0.94±0.16$^{b}$ | 1.34±0.11$^{ab}$ | 1.62±0.16$^{a}$ | 1.12±0.22$^{ab}$ | 0.76±0.18$^{a}$ | 0.38±0.21$^{a}$ |
| Standard | 50 | 0.78±0.28$^{b}$ | 0.26±0.16$^{c}$ | 0.04±0.08$^{e}$ | 0.04±0.08$^{e}$ | 0.04±0.08$^{c}$ | 0.04±0.08$^{b}$ |
| Aqueous | 50 | 1.02±0.14$^{ab}$ | 1.16±0.16$^{ab}$ | 1.26±0.16$^{abc}$ | 0.84±0.18$^{bc}$ | 0.28±0.10$^{bc}$ | 0.16±0.16$^{b}$ |
| Aqueous | 100 | 0.92±0.22$^{b}$ | 1.08±0.22$^{b}$ | 1.00±0.16$^{d}$ | 0.52±0.23$^{cd}$ | 0.20±0.14$^{bc}$ | 0.20±0.14$^{ab}$ |
| Alcoholic | 50 | 1.32±0.30$^{a}$ | 1.24±0.47$^{ab}$ | 1.24±0.47$^{bc}$ | 1.00±0.33$^{ab}$ | 0.76±0.26$^{a}$ | 0.28±0.17$^{ab}$ |
| Alcoholic | 100 | 0.82±0.22$^{b}$ | 1.12±0.33$^{ab}$ | 0.80±0.24$^{d}$ | 0.34±0.34$^{de}$ | 0.18±0.14$^{bc}$ | 0.14±0.16$^{ab}$ |
| Acetone | 50 | 1.00±0.24$^{ab}$ | 1.24±0.16$^{ab}$ | 1.22±0.14$^{bc}$ | 0.60±0.12$^{cd}$ | 0.24±0.16$^{bc}$ | 0.04±0.08$^{b}$ |
| Acetone | 100 | 0.96±0.23$^{b}$ | 1.06±0.19$^{b}$ | 0.72±0.16$^{d}$ | 0.26±0.13$^{de}$ | 0.20±0.07$^{bc}$ | 0.06±0.08$^{b}$ |
| Chloroform | 50 | 1.32±0.26$^{a}$ | 1.50±0.30$^{a}$ | 1.46±0.35$^{ab}$ | 1.18±0.42$^{a}$ | 0.62±0.23$^{a}$ | 0.10±0.0.22$^{b}$ |
| Chloroform | 100 | 0.94±0.16$^{b}$ | 1.26±0.26$^{ab}$ | 1.28±0.30$^{abc}$ | 0.80±0.32$^{bc}$ | 0.32±0.30$^{b}$ | 0.20±0.24$^{ab}$ |

**Table 2:** Effect of different leaf extracts of *Kigeliaafricana* on carrageenan-induced paw odema in rats.

| | | Increase in paw volume(ml) in comparison to normal (0 hour) value | | | | | |
|---|---|---|---|---|---|---|---|
| **Extract** | **Dose mg/kg)** | **1 hour** | **2 hour** | **3 hour** | **4 hour** | **5 hour** | **6 hour** |
| Control | - | 0.32±0.01$^{a}$ | 0.40±0.02$^{bc}$ | 0.26±0.03$^{cd}$ | 0.18±0.02$^{bc}$ | 0.11±0.03$^{b}$ | 0.02±0.03$^{b}$ |
| Standard (Meloxicam) | 1 | 0.18±0.02$^{d}$ | 0.26±0.01$^{f}$ | 0.15±0.02$^{g}$ | 0.09±0.02$^{f}$ | 00±0.0$^{g}$ | 00±0.00$^{c}$ |
| Aqueous | 50 | 0.10±0.01$^{e}$ | 0.33±0.02$^{e}$ | 0.19±0.03$^{f}$ | 0.17±0.05$^{bcd}$ | 0.07±0.04$^{cde}$ | 0.01±0.01$^{bc}$ |
| Aqueous | 100 | 0.15±0.02$^{de}$ | 0.27±0.00$^{f}$ | 0.20±0.03$^{ef}$ | 0.10±0.03$^{ef}$ | 0.04±0.02$^{ef}$ | 0.01±0.01$^{bc}$ |
| Alcoholic | 50 | 0.13±0.05$^{de}$ | 0.29±0.03$^{f}$ | 0.25±0.04$^{cd}$ | 0.18±0.04$^{bc}$ | 0.08±0.01$^{bcd}$ | 0.01±0.01$^{bc}$ |
| Alcoholic | 100 | 0.24±0.05$^{c}$ | 0.35±0.01$^{de}$ | 0.29±0.02$^{bc}$ | 0.12±0.04$^{cdef}$ | 0.02±0.02$^{fg}$ | 0.01±0.02$^{bc}$ |
| Acetone | 50 | 0.30±0.03$^{ab}$ | 0.43±0.01$^{a}$ | 0.30±0.01$^{ab}$ | 0.23±0.09$^{ab}$ | 0.10±0.05$^{bc}$ | 0.01±0.01$^{bc}$ |
| Acetone | 100 | 0.27±0.04$^{bc}$ | 0.37±0.04$^{cd}$ | 0.27±0.04$^{bcd}$ | 0.11±0.05$^{def}$ | 0.01±0.01$^{fg}$ | 0.01±0.01$^{bc}$ |
| Chloroform | 50 | 0.27±0.05$^{ab}$ | 0.42±0.03$^{ab}$ | 0.34±0.02$^{a}$ | 0.26±0.01$^{a}$ | 0.16±0.01$^{a}$ | 0.06±0.01$^{a}$ |
| Chloroform | 100 | 0.27±0.02$^{bc}$ | 0.36±0.01$^{de}$ | 0.24±0.04$^{de}$ | 0.15±0.03$^{cde}$ | 0.06±0.02$^{de}$ | 00±0.00$^{c}$ |

**Table 3:** Effect of different leaf extracts of *Kigeliaafricana* on algesic activity of rats

| | | Reflex time | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Extract** | **Dose(mg/kg)** | **0 min** | **30 min** | **60 min** | **90 min** | **120 min** | **180 min** | **240 min** |
| Control | - | 0.26±0.02$^{c}$ | 0.36±0.04$^{abc}$ | 0.32±0.02$^{c}$ | 0.30±0.03$^{e}$ | 0.34±0.04$^{f}$ | 0.30±0.02$^{d}$ | 0.30±0.03$^{c}$ |
| Standard (Meloxicam) | 1 mg/kg | 0.42±0.02$^{a}$ | 0.42±0.02$^{a}$ | 2.00±0.07$^{a}$ | 3.20±0.12$^{a}$ | 2.94±0.22$^{a}$ | 1.68±0.12$^{a}$ | 1.12±0.18$^{a}$ |
| Aqueous | 50 | 0.34±0.02$^{b}$ | 0.34±0.02$^{abc}$ | 0.38±0.02$^{c}$ | 1.78±0.05$^{b}$ | 0.90±0.04$^{e}$ | 0.66±0.02$^{c}$ | 0.54±0.02$^{b}$ |
| Aqueous | 100 | 0.32±0.02$^{bc}$ | 0.32±0.02$^{bc}$ | 0.32±0.02$^{c}$ | 1.78±0.06$^{b}$ | 1.78±0.06$^{b}$ | 0.68±0.03$^{c}$ | 0.58±0.02$^{b}$ |
| Alcoholic | 50 | 0.32±0.02$^{bc}$ | 0.30±0.03$^{c}$ | 1.54±0.05$^{b}$ | 1.64±0.04$^{bc}$ | 1.40±0.07$^{c}$ | 0.68±0.02$^{c}$ | 0.60±0.01$^{b}$ |
| Alcoholic | 100 | 0.32±0.02$^{bc}$ | 0.40±0.03$^{ab}$ | 1.60±0.11$^{b}$ | 1.58±0.12$^{bc}$ | 1.20±0.08$^{cde}$ | 0.88±0.09$^{c}$ | 0.58±0.05$^{b}$ |
| Acetone | 50 | 0.32±0.02$^{bc}$ | 0.34±0.02$^{abc}$ | 0.36±0.02$^{c}$ | 1.46±0.15$^{cd}$ | 1.46±0.15$^{c}$ | 0.70±0.07$^{c}$ | 0.56±0.02$^{b}$ |
| Acetone | 100 | 0.32±0.02$^{bc}$ | 0.36±0.02$^{abc}$ | 0.38±0.02$^{c}$ | 1.30±0.04$^{d}$ | 1.26±0.06$^{cd}$ | 0.84±0.05$^{c}$ | 0.62±0.02$^{b}$ |
| Chloroform | 50 | 0.36±0.02$^{ab}$ | 0.320±0.02$^{bc}$ | 0.40±0.03$^{c}$ | 1.26±0.05$^{d}$ | 0.98±0.03$^{de}$ | 0.74±0.04$^{c}$ | 0.66±0.04$^{b}$ |
| Chloroform | 100 | 0.34±0.02$^{b}$ | 0.360±0.02$^{abc}$ | 0.46±0.06$^{c}$ | 1.56±0.06$^{bc}$ | 1.50±0.07$^{bc}$ | 1.16±0.16$^{b}$ | 0.68±0.03$^{b}$ |

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