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Research Article

To compare and evaluate the anti-inflammatory efficacy of terminalia arjuna (aqueous extract of bark) with diclofenac sodium on rats

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ABSTRACT

Background: *Terminalia arjuna* is a well-known Indian medicinal plant whose bark is extensively used in ayurvedic medicine. It is one of the most versatile medicinal plants having a wide spectrum of biological activity. The objective of this study was to study and evaluate the anti-inflammatory activity of *Terminalia arjuna* on carragennan induced paw edema in sprague dwaley rats.
Methods: *Terminalia arjuna* aqueous extract of bark in 200, 400 and 800mg/kg doses were administered to sprague dawely rats prior to induction of carrageenan induced paw edema. Statistical analysis: was done by using student t test. $P < 0.05$ was considered statistically significant.
Results: Only 400mg/kg dose of *Terminalia arjuna* aqueous extract of bark was able to decreases the size of paw edema at significant levels in carrageenan induced paw edema in rats.
Conclusions: The aqueous extract of bark of *Terminalia arjuna* possesses anti-inflammatory activity on carrageenan induced paw edema in rat model.

Keywords: Carrageenan, Diclofenac sodium, Flavonoids, Terminalia arjuna

INTRODUCTION

Terminalia arjuna is a well-known medicinal plant whose bark is extensively used in ayurvedic medicine particularly as cardiotonic.[1] It is one of the most versatile medicinal plants having a wide spectrum of biological activity.[2] *Terminalia arjuna* Roxburgh is a tropically woody tree growing throughout India and locally known as Kumbak; (Arjuna in english), is a member of combertaceae family. It is found in abundance near ponds and rivers throughout the Indo sub Himalayan tracts of Uttar Pradesh, South Bihar, Madhya Pradesh, Delhi and Deccan region. It is also found in forests of Sri Lanka, Burma and Mauritius being transported by early Indian migrants.[3] The various constituents present in the bark of Terminalia arjuna include tannins, arjunic acid, arjungenin, arjunglycosides, flavonoids, ellagic acid, gallic acid, oligomeric proathocyanidins (OPCs), phytosterols, calcium carbonate 34%, magnesium, zinc, copper colouring matter and other substance which are proposed to be responsible for anti-inflammatory, antilipidemic, antioxidant, antinociceptive and immunomodulatory activities.[4]

Inflammation

Inflammation is a part of complex biological response of vascular tissues to harmful stimuli, pathogens, damage

cell and irritants. Inflammation is mainly of two types chronic and acute. The signs of an inflammation are redness and swelling with heat and pain.[5]

METHODS

The present study was conducted in the department of pharmacology, MMIMSR, Mullana, Ambala, Haryana, India after approval from the Institutional Animal Ethical committee and CPCSEA vide reference no. 105/IAEC/MMIMSR/2011 3.

Animals used

A total of 30 sprague dawley rats (Rattus norvegicus) of either sex weighing 150-300 gms were obtained from Central Animal House, MMIMSR, Mullana, Ambala, Haryana, India. The animals were housed in polypropylene cages (28×22×14 cm), 6 animals were maintained in each cage in a room at ambient temperature of 22±2^{o}C and humidity maintained in 12 hour dark and light cycle. They were fed on standard diet ad-libitum. Animals were deprived of food for four hours before each experiment in order to avoid interference of food with absorption care of animals was taken as per the guidelines of CPCSEA India.

Drugs used

- Lambda carrageenan was procured from (Sigma Aldrich USA) Mumbai
- Injection diclofenac sodium neon laboratories Ltd.
- *Terminalia arjuna*, aqueous extract of bark (procured from Rajiv Gandhi ayurvedic medical college, Paprola, Himachal Pradesh)
- Physiological solution 0.9% saline 9 gm salt NaCl and are dissolved in 100 ml of distilled water was prepared used as control for all animals.

Dosing Schedule

An 8% stock solution of *terminalia arjuna* was prepared for required doses. Carrageenan 0.1% solution was prepared in normal saline. Diclofenac sodium taken from neon laboratories Ltd. and physiological solution was prepared by dissolving 9gm Nacl in 100 ml of distilled water. *Terminalia arjuna*, diclofenac sodium and physiological salt solution were administered before one hour before carrageenan administration.

Bark extract of *terminalia arjuna* and physiological salt solution were administered orally through gastric tube and diclofenac was administered intra peritoneal. Carrageenan was administered subcutaneous in sub planter region of left paw.

Study design

The total of 30 rats were divided into 5 groups of 6 animals each (group 1 to group 5). All the animals were injected with carrageenan 0.1ml in the left foot subcutaneously in plantar region to induce inflammation.[4]

Group 1 (control group) was given saline (0.9%) p/o through gastric tube, followed by carrageenan 0.1 ml after one hour to induce inflammation.

Group 2 was provided diclofenac sodium 10 mg/kg i/p followed by carrageenan 0.1 ml after one hour to induce inflammation.

Group 3 was given *terminalia arjuna* (aqueous extract of bark) 200 mg/kg/p/o through gastric tube, followed by carrageenan 0.1ml after one hour to induce inflammation.

Group 4 was given *terminalia arjuna* (aqueous extract of bark) 400 mg/kg/p/o.

Through gastric tube, followed by carrageenan 0.1ml after one hour to induce inflammation.

Group 5 was given *terminalia arjuna* (aqueous extract of bark) 800 mg/kg p/o through gastric tube, followed by carrageenan 0.1 ml after one hour to induce inflammation as described.

Induction of inflammation

Inflammation was induced in all the animals only in left hind paw by injecting carrageenan 0.1ml of 1% (w/v) s/c in the planter region.[6]

Measurement

- Right foot served as control in all the animals.
- Left foot was used for observing the effects of *Terminalia arjuna*, Diclofenac sodium and o.9% saline (vehicle).
- The measurements were done by using digital plethysmometer,

Statistical analysis is done by using student t test difference was consider significant at $p< 0.05$.

RESULTS

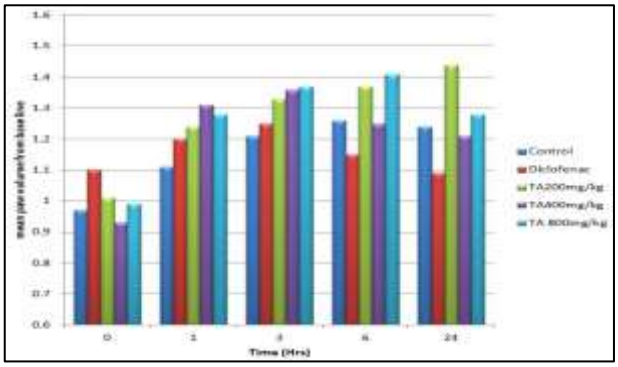

Figure 1: Change in paw volume as compared to baseline.

The paw edema induced by carrageenan in left hind paw of rats when measured at 0, 1, 3, 6 and 24 hours after administration of *Terminalia arjuna* 200, 400 and 800 mg/kg doses. They show significant reduction in paw volume at dose of 400 mg/kg as compare to diclofenac sodium and control group.

Table 1: Effect of *terminalia arjuna* on carrageenan induced paw edema in rats.

Treatment	Mean paw volume (ml)				
	0 hour	1 hour	3 hours	6 hours	24 hours
Normal saline	0.97±0.031	1.11±0.043	1.21±0.035	1.26±0.043	1.25±0.036
Diclofenac sodium 10mg/kg	1.10±0.637	1.20±0.088	1.25±0.040	1.15±0.064	1.09±0.067
Terminalia arjuna200mg/kg	1.12±0.057	1.24±0.027	1.33±0.036	1.38±0.037	1.44±0.043
Terminalia arjuna400mg/kg	0.93±0.043	1.31±0.018	1.36±0.011	1.25±0.009	1.21±0.025
Terminalia arjuna800mg/kg	0.99±0.016	1.28±0.028	1.37±0.031	1.41±0.018	1.28±0.015

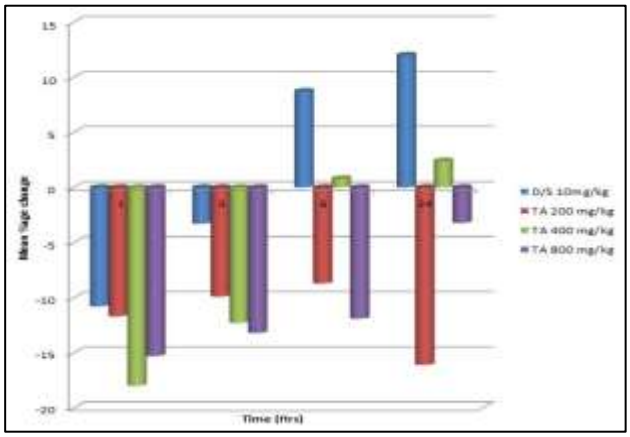

Figure 2: Mean % age inhibition as compared to control group at 1, 3, 6 and 24 hours.

Calculation of % age inhibition as compared to control

%age Inhibition of paw edema = (Vc-Vt/Vc) x 100

Where Vc and Vt represent average paw volume of control and treated animal respectively.

DISCUSSION

Terminalia arjuna is a useful Indian medicinal plant. A number of natural products are used in the traditional system of medicine in India and many countries. The bark leaves and fruits of *terminalia arjuna* have been used in indigenous system of medicine over centuries for different ailments. Bark is considered an important constituent of plant. The bark possesses anti-inflammatory, antinociceptive and immunomodulatory activity.[7] The various constituents present in the bark of Terminalia arjuna include arjunic acid, arjunolic acid, flavonoids, gallic acid: of which flavonoids have been detected to exert anti-inflammatory, antioxidant and lipid lowering effect In present study aqueous extract of Terminalia possessed a significant edema decreasing effect on paw edema induced by carrageenan.[8] Development of edema induced by carrageenan commonly correlated with early exudative stage of inflammation.[9] Carrageenan induced edema is a multimediated phenomenon that librates diversity of mediators. The first phase (1 hour) involves the release of serotonin and histamine while the second phase (over 1 hour) is mediated by prostaglandins, the COX products, and the continuity between two phases is provided by kinins.[10]

Flavonoids are also known as nature's tender drugs, possessing numerous biological/pharmacological activities. Recent reports of anti-inflammatory, antifungal, antioxidant, anti-allergic, antithrombic, hepatoprotective and cytotoxic activities of flavonoids have generated interest in studies of flavonoids containing plants. The anti-inflammatory capacity of flavonoids has long been utilized in Chinese medicine as a form of crude plant extracts.[11] The polyherbal preparations containing Terminalia Arjuna, among other constituents, also possesses antiatherogenic, hypolipidemic and anti-inflammatory activity. Terminalia arjuna is widely recognised for its use in cardiovascular diseases like angina and heart failure.

Since, carrageenan induced inflammation models is a significant predictive test for acute inflammation. The significant acute anti-inflammatory activity of the sample and standard drug observed in present study may be due to the inhibition of histamine 5HT and PG synthesis.

CONCLUSION

The aqueous extract of bark of terminalia arjuna possesses anti-inflammatory activity on carrageenan induced paw edema in rat model.

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Ethical approval: Study was conducted in the department of pharmacology, MMIMSR, Mullana, Ambala after approval from the Institutional Animal Ethical committee and CPCSEA vide reference no: 105/IAEC/MMIMSR/2011.

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