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Assessment of In-Vivo Anti-Inflammatory Properties of Extracts of *Sida Cordata*

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ABSTRACT

Inflammation is a complex physiological process that plays a critical role in the pathogenesis of several chronic diseases. *Sida cordata* (Family- Malvaceae), a medicinal plant traditionally used in Ayurvedic and ethno-medicinal systems, possesses notable anti-inflammatory potential attributed to its phytochemical constituents. The objective is to assess the in-vivo anti-inflammatory activity of water and acetic acid extract of *Sida cordata* using the carrageenan- induced paw edema model in rates. Albino rates were divided into four group (n=6 each): Control, carrageenan control, Water extract (100 & 200 mg/kg), and Acetic acid extract (100 & 200 mg/kg). Inflammation was induced by injecting 0.1 mL of 1% carrageenan into the subplanter region of the left hind paw. Paw volume was measured at 0, 1, 2, 3, 4 and 24 hours post-injection using a Varner callipers. The percentage inhibition of paw edema was calculated, and data were analysed using one-way ANOVA followed by post Turkey's test. Both extract significant reduce power edema volume compared to control. The water extract showed a greater reduce in inflammation throughout the observation. Maximum inhibition was observed at the 4th hour post carrageenan injection. Water and acetic acid extract of *Sida cordata* demonstrate significant in vivo anti-inflammatory activity supporting its traditional use in inflammation disorder. Further isolation of bio active compound and mechanistic studies are warranted.

Key Words:

Sida Cordata, Carrageenan- Induced Paw Edema, Inflammation Management, Anti-Inflammatory, Water Extract.

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I. Introduction

Information is defensive biological responses of vascular tissue to harmful stimuli such as pathogens damaged cells or irritant. While acute inflammation is protective mechanism, chronic inflammation contributes to the progression of several degenerative and autoimmune disorders including rheumatic arthritis, diabetes induce inflammation, and cardiovascular diseases. Non-steroidal anti-inflammatory drugs are commonly used but they are associated with gastrointestinal renal and cardiovascular adverse effect. Consequently, plant based anti-inflammatory agents have gained attention for their efficacy and safety profiles.[1,2]

Sida cordata known as "Bala" in Ayurveda is distributed widely in tropical and subtropical regions. Traditionally it's has been used to treat ailments such as arthritis, bronchial asthma and

inflammation. Pharmacological studies have demonstrated that contains alkaloids, flavonoids, and phenolic compound with potential anti-inflammatory and antioxidant activities.[3,4]

Previous studies has have reported that ethnic extract of plant exhibit inhibitory effect on inflammatory mediators and oxidative stress. However, limited data exist comparing the in vivo anti employment activities of water and acetic acid extracts. The present study aimed to evaluate and compare the in vivo anti-inflammatory potential of these extracts using the carrageenan induced paw edema model in rats a well-established method for acute inflammation assessment.[5,6,7]

II. Material and methods

Collection and identification of the plant

The plant sample has been collected from Chhuikhadan, Rajnandgao district, Chhattisgarh state. The plant specimen was identified as *Sida cordata* with the help of Professor Dr Achal Mishra, Department of Pharmacy, GGU, Bilaspur, Chhattisgarh. The sample was deposited in Botanical survey of India, Allahabad, Uttar Pradesh. The plant was authenticated by Dr Vinay Rajan, HoD and scientist-E (Reference No- S.Bh.V.S/M.CHH.K/PRASH./2023-24/789 Dated-08/02/2024)

Extraction of plant:

The dried part of whole plant S.cordata in powdered form has been taken and extracted with water and acetic acid by sonication extraction method.[8,9]

Both extract were stored in airtight container at four degrees centigrade until use.

Animals

Healthy albino rats of either sex were used. Animal Ware housed under standard laboratory condition with free ss to food and water. All experimental procedure were approved by animal ethical community (CCSEA Ethical Approval Number- SSPU/KIPS/IAEC/2025/15)

Experimental Design

The animals were divided into four groups (n=6 in each group):

• Group I (control): Normal saline (10 ml/kg) was administered.

• Group II (Carrageenan control)

• Group III (aqueous extract): Aqueous extract of *Sida cordata* (100 & 200 mg/kg, p.o.) was administered.

• Group IV (acetic acid extract): Acetic acid extract of *Sida cordata* (100 &b200 mg/kg, p.o.) was administered.[10,21,22]

Measurement of paw edema

Paw volume was measured before carrageenan injection 0 h and at 1, 2, 3, 4, and 24 h post injection using Varner callipers. The increase in paw volume was considered as an index of inflammation.

Inhibition (%)=(Vc−Vt)Vc×100\text{Inhibition (\%)} = \frac{(V_c - V_t)}{V_c} \times 100Inhibition (%)=Vc(Vc−Vt)×100

Where VcV_cVc and VtV_tVt represent the mean paw volumes of control and treated groups, respectively.[11,22,23]

Statistical analysis

Statistical analysis was performed using one way ANOVA followed by Turkey poct hoc test difference were considered significant at $P<0.05$.[12,13]

III. Results

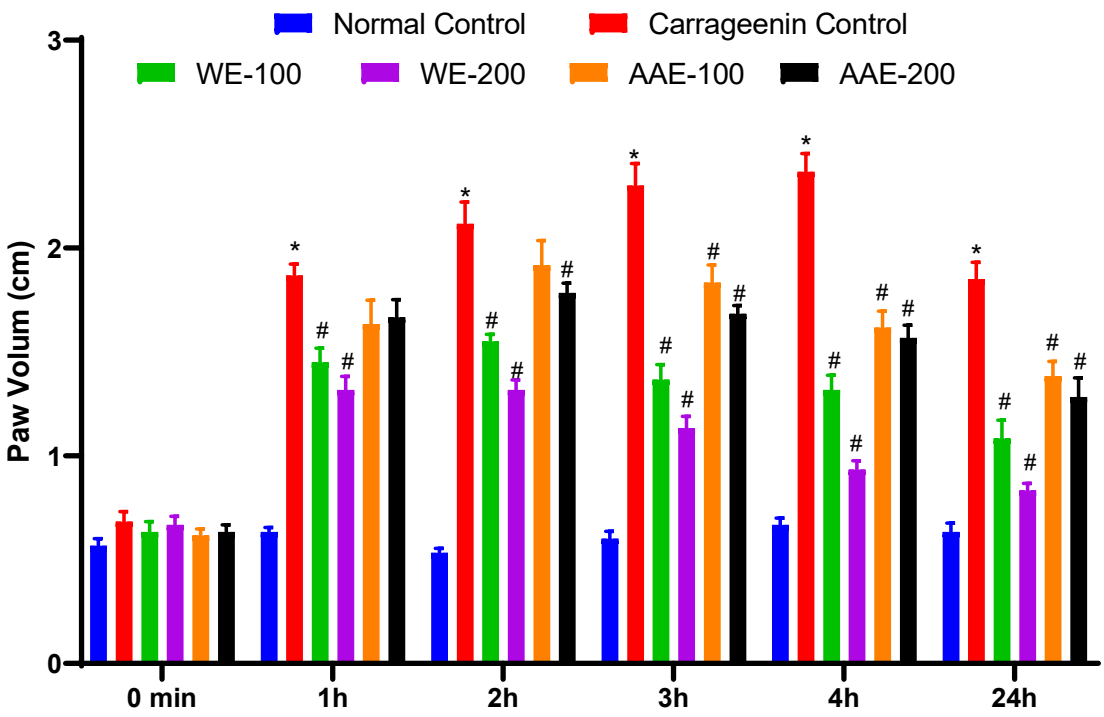
Effect of *Sida cordata* extract on carrageenan induced paw edema

Both water and acidic acid extract of *Sida cordata* significantly reduced paw edema volume compared to control from the first hour onwards. The effect was time dependent, with maximum inhibition observed at the 4th hour.[14,15]

Table 1: Effect of water and acetic acid extracts of *Sida cordata* on carrageenan induced paw edema reduction pattern in all groups.

Time (h)	Control (mL)	Carrageenan Control	Water Extract (100 mg/ml)	Water Extract (200 mg/ml)	Acetic Acid Extract (100 mg/mL)	Acetic Acid Extract (200 mg/mL)
0 min	0.567	0.683	0.633	0.667	0.617	0.633
1 h	0.633	1.867	1.450	1.317	1.633	1.667
2 h	0.533	2.117	1.550	1.317	1.917	1.783
3 h	0.600	2.300	1.367	1.133	1.833	1.683
4 h	0.667	2.367	1.317	0.933	1.617	1.567
24 h	0.633	1.850	1.083	0.833	1.383	1.283

Figure 1: Effect of *Sida cordata* extracts on carrageenan induced paw edema in rates



This graph revealed significant difference between control and treated groups at all-time points. Post hoc comparison indicated that the water extract (200 mg/kg) consistently produces a higher inhibitory effect compared to the acetic acid extract, though both where significantly lower than control.[16,17]

At the 4th hour percentage inhibition Suggested superior efficacy of the letter in suppressing carrageenan induce acute inflammation.

IV. Discussion

The carrageenan induced paw edema model is widely recognised for evaluating the anti-inflammatory effect of natural products. The biphasic nature of the inflammatory responses initially mediated by histamine and serotonin (first 2 hours) and letter by prostaglandins and cytokines (after 3 hours) provides insight into both early and late inflammatory processes.[18,21,22]

In this study both water and acetic acid extract of plant produce significant reduction in paw edema, indicating inhibition of inflammatory mediators in both faces. The water extract demonstrated a greater effect.[19,23]

Phytochemical investigation of plant have reported the presence of alkaloids, flavonoid and phenols. These Compounds are known to exhibit anti-inflammatory effects by inhibiting cyclooxygenase lipoxygenase and nitric oxide synthase pathway. The reduction in paw edema volume in treated groups Suggests separation of prostaglandins synthesis and inhibition of vascular permeability.[20,21,23]

The results of this study aligned with previous report showing the anti-inflammatory activity of ethanolic extract of *Sida cordata*. The water and acetic acid extract may act synergistically through

antioxidant and enzyme inhibitory mechanisms, which should be explored in future mechanistic studies.[24]

Overall, the findings validate the traditional use of Sida cordata in treating inflammatory conditions such as arthritis and muscular pain, and encourage further work on the isolation of its active constituents.

Animal Ethical Approval

The study was conducted following ethical guidelines for animal research and was approved by the Institutional Animal Ethics Committee (IAEC) of Kamla Institute of Pharmaceutical Sciences (KIPS), affiliated with Shri Shankaracharya Professional University, (SSPU), under the Committee for the Control and Supervision of Experiments on Animals (CCSEA), Government of India.

Approval Number: SSPU/KIPS/IAEC/2025/15

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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