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Phytochemical screening and evaluation of plant *boswellia serrata* roxb. acting against inflammation

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***Abstract*---**Hence, in the present study, the leaves of *Boswellia serrata* Roxb. have been selected for phytochemical investigation, anti-inflammatory activity in rats. Flavonoids are a group of polyphenolic compounds, which exhibit several biological effects such as anti-inflammatory, anti-hepatotoxic and anti-ulcer. The result will also supports the treatment of inflammation related disease traditionally. We will observed the best Aqueous extract of leaves of *Boswellia serrata*, who possess good anti-inflammatory activity against carageenan induced paw edema. Our body has an effective defense system against free radical induced damage. On treating with the aqueous extract, LPO, GSH, SOD, CAT, GPx and Na+ /K+ATPase levels were increased.

Keywords*---Boswellia serrata* Roxb., Phytochemical screening, Flavonoids, Anti-inflammatory activity.

Introduction

One of the most significant global health issues is inflammation-related illness. Almost all multicellular organisms respond to infection and damage by initiating a process known as inflammation. It is via the inflammatory response that cellular damage, tissue injury, and invading microorganisms are identified and countered.

Many common and sometimes fatal clinical disorders may be traced back to insufficient inflammation or its dysregulation. This is the case for conditions as diverse as asthma or bronchial hyperreactivity, infection, sepsis, and atherosclerotic disease [1].

Cellular macromolecules like proteins and lipids are vulnerable to oxidative damage, which is considered to play a significant role in the development of various chronic inflammatory conditions. Many chronic and degenerative illnesses may be traced back to this risk factor, including atherosclerosis, ischemic heart disease, and arthritis. Many free radicals are produced by arthritis, and they help to keep inflammation going for as long as possible [2].

Methodology
Pharmacological Studies
Acute Toxicity Studies

The acute toxicity experiments were conducted in accordance with OECD (Organization for Economic Co-operation and Development) Guidelines 423. Three female animals are used at each stage of the process. Two or three stages are often required to make a determination on the acute toxicity of the test drug, however this number might vary widely depending on the death and/or morbidity rates of the animals used. It reduces the number of animals used while yet providing sufficient evidence for a scientific conclusion. Using this method, a drug may be graded and categorized according to the GHS criteria for the categorization of substances that cause acute toxicity, using established dosages (2000 mg/kg body weight) [3].

Experimental Procedure

Due to the low toxicity of the herbs studied, a starting dosage of 2000 mg/kg body weight was chosen for administration to a group of three male Wistar rats ranging in weight from 150 to 220 g. (defined dose by OECD 423 guidelines). Animals were allowed access to drink ad libitum and fasted for 18 hours before to receiving the test medication. Rats were weighed before and after being given the test medication, and researchers looked for changes in the animals' body weight, hair, skin, eyes, mucous membranes, respiratory system, cardiovascular system, and other behaviors including convulsions, tremors, diarrhea, salivation, lethargy, sleep, and coma. Toxic effects and their onset were also recorded [3].
Behavioral profile: Alertness, irritability, restlessness and fearfulness.
Neurological profile: Spontaneous activity, reactivity, touches response and pain response.
Autonomic profile: Defecation and urination, lethality or death of animals was observed after 24 hours and 72 hours respectively [3].

Experimental Animals

Male Wistar rats, weighing between 200 and 250 g, are used in most investigations on animals. They are normally maintained in groups of six per cage. The rats were maintained in polyacrylic cages at a temperature and humidity of 25 2°C (77 F) and 50% RH, respectively, with a light/dark cycle of 12

hours each day. They were fed a normal diet of dry pellets and allowed free access to water at all times. Before any animal studies were carried out, authorization was sought from an IAEC in accordance with CPCSEA **(CPCSEA/IAEC/JLS/17/03/22/036)**. Before beginning the experiment, the rats were given 14 days to acclimate to the laboratory environment. Commercial feed called Gold Mohar from Hindustan Lever Limited in Bangalore was used for the animals [3].

Chemicals
Carrageenan, Standard drug Indomethacin

Methodology

Group I: Served as control (received normal saline).
Group II: Rats were received 0.1 ml of 1 % carrageenan.
Group III: Rats were received indomethacin (10 mg/kg/p.o)
Group IV: Rats were received 1.0ml of aqueous extract of leaves of *Boswellia serrata* Roxb. (200 mg/kg/p.o) and 0.1 ml of carrageenan.
Group V: Rats were received 1.0ml of aqueous extract of leaves of *Boswellia serrata* Roxb. (400 mg/kg/p.o) and 0.1 ml of carrageenan.

Carrageenan Induced Inflammation

After being injected with 0.1 ml of carrageenan (1.0 percent in 0.9 percent clean saline mixture), the mouse displayed signs of substantial irritation or edema on the sub-plantar surface of the right rear paw. Carrageenan was infused intravenously 30 minutes after the vehicle was provided, and indomethacin was administered orally 1 hour before the infusion. At 1, 2, 3, 4, 5, and 6 hours, the pedal volume was determined using a computerized plethysmometer up to the lower leg joint [4].
It was determined what percentage of edema reduction occurred in the drug-treated group vs the carrageenan-alone group by using the following formulas:

$$\text{Percentage Inhibition} = V_c\text{-}V_t \times 100 \,/\, V_c$$

Where Vc-Vt and Vc reflected the average increase in paw edema volume in the control and drug treatment groups, respectively.

Biochemical studies
Estimates of biochemical parameters were made in the blood and tissues of the animals in each group [5].

Biochemical parameters in serum (collection of blood)
Samples of blood were collected and centrifuged at 3000 rpm for 5 minutes in sealed, oxygen-free containers. Alkaline phosphatase, aspartate transaminase, and alanine transaminase levels were measured in serum, and total protein concentrations were calculated using the same methods [6].

Biochemical parameters on tissue homogenate
Once blood was drawn, the mice were killed by cervical dislocation, and the

edematous tissue homogenate was centrifuged at 600 x g for 10 minutes to separate the carrageenan and simulate severe irritation. After centrifuging at 16,000 x g for 30 minutes, the cores, perfect cells, and plasma films (atomic portion) were separated from the supernatant. A 0.25 M sucrose cradle held the silt in place. After removing aliquots at 0 and short intervals, centrifuge at 16,000 x g at room temperature for 30 minutes. The supernatant was then analyzed for the levels of lipid peroxidation (LPO), glutathione (GSH), superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPH), and sodium/potassium adenosine triphosphatase (Na+/K+ ATPase) [7].

Estimation of total protein (TP)

The protein content in the homogenate was calculated using the Lowry method. Five hundred milliliters of serum and five hundred milliliters of ten percent trichloroacetic acid were mixed in a single tube and centrifuged for ten minutes. To calculate the protein concentration, we used 0.1 ml of the fluid containing the precipitate [8].

Activity of Alkaline Phosphatase (ALP)

Alkaline phosphatase activity was measured using the method developed by Kind. Each tube was filled with a volume of 2.0 ml of distilled water and a volume of 0.5 ml of buffered substrate (buffered substrate, pH 10.0). Following thorough mixing, incubate at 37 °C for three minutes. The amount of serum required for the test was just 0.05 ml. Put the blended ingredients into a 37°C incubator for 15 minutes. All tubes received 1 ml of a color reagent (Chromogen reagent), whereas the control tube received 0.05 ml of serum. Following vigorous shaking after each reagent addition, the optical densities of the resulting Blank (B), Standard (S), Control (C), and Test (T) solutions are measured against distilled water (P) using a green filter (510 nm) [9].

Estimation of SGOT (AST)

Serum SGOT levels were calculated using the Reitman and Frankel technique. After incubating the serum/substrate reagent mixture at 37 degrees Celsius for 60 minutes, 0.1 milliliters of serum was withdrawn. After adding half a milliliter of color reagent, the mixture was incubated for 20 minutes at 37 degrees Celsius. The reaction was stopped by adding 3 ml of alkaline reagent, and the intensity of the color was measured at 505 nm [10].

The SGOT activity was expressed as IU/L.

Assessment of SGPT (ALT)

In order to determine serum SGPT, the Reitman and Frankel method was used. The serum/substrate reagent combination was incubated at 37 degrees Celsius for 60 minutes, and then 0.1 milliliters of serum was removed. Twenty minutes into a 37°C incubation, 0.5 ml of color reagent is applied. Three milliliters of an alkaline reagent were then added to stop the reaction, and the intensity of the resulting color was evaluated at a wavelength of 505 nanometers [11].

The SGPT activity was expressed as IU/L.

Estimation Lipid Peroxidation (LPO)

Reagents: Use 0.8% TBA in a 20% acetate buffer at pH 3.5, along with 1.5% sodium dodecyl sulphate and 1.5% of both. A characteristic of lipid peroxidation

is the presence of thiobarbituric acid reactive substances (TBARS), and we used a technique published by Ohkawa et al. to measure TBARS levels in various tissues. For one hour at 95 °C, we mixed 0.4 ml of 10% tissue homogenate with 1.5 ml of 8.1% sodium dodecyl sulphate (SDS), 1.5 ml of 20% acetate buffer (pH 3.5), and 1.5 ml of 0.8% TBA solution. Absorbance at 532 nm was taken of a layer made up of 15 milliliters of n-butanol to 1 milliliter of pyridine after the liquid was chilled [12].

Estimation of Glutathione (GSH)

Reagents: Trichloroacetic acid (TCA) 10% in water (4.0 ml), ethylenediaminetetraacetic acid (EDTA) 1.8 ml, 5,5'-dithiobis- 2-nitrobenzoic acid (DTNB) 0.6Mm, and disodium hydrogen phosphate (H3PO4) 0.2M are the components of the aqueous solution used in the experiment (pH 8.0). In order to quantify GSH levels, we use Beutler and Kelly's technique. Tissue homogenate was diluted with EDTA solution (1.8 ml) (0.2 ml). After standing for 5 minutes, the mixture was centrifuged after 3.0 ml of the precipitating reagent TCA had been added and well mixed. The absorbance at 412 nm was measured by mixing 2 mL of filtrate with 4 mL of disodium hydrogen phosphate solution and 1 mL of DTNB (5, 5-dithio bis 2-nitro benzoic acid) reagent [13].

Assay of Superoxide Dismutase (SOD)

Reagents: The following should be added to a test tube: 0.025 mL of a sodium pyrophosphate cradle (pH 8.3), 0.1 mL of phenazine methosulphate (186 mmol/L), 0.3 mL of nitro blue tetrazolium (300 nmol/L), and 0.2 mL of NADH (780 mmol/L). Kakkar's approach does not provide a definitive answer to the question of how much SOD activity occurs in various systems. The components of the 3 ml test mixture were as follows: sodium pyrophosphate buffer (pH 8.3, 0.025 ml/L), phenazine methosulphate (186 mmol/L), nitro blue tetrazolium (300 nmol/L), NADH (780 mmol/L), denatured protein preparation, and water. Adding 1.0 cc of cold acidic corrosive after 90 seconds of hatching at 30 degrees Celsius elicited a reaction. The reaction mixture was shaken and disturbed vigorously after 4 mL of nbutanol were added. We compared the butanol layer chromogen to n-butanol at 560 nm [14].

Assay of Catalase (CAT)

Reagents: This experiment employed 0.2 M hydrogen peroxide, 0.01 M phosphate buffer (pH 7.0), and 5% potassium dichromate in 1:3 acetic acid as its reagents.
Assaying catalase (CAT) activity through the Sinha method (1972). Two milliliters of 2M hydrogen peroxide, one milliliter of tissue homogenate, and one milliliter of phosphate buffer all combined to make a 1.5 milliliter reaction volume (pH 7.0). Specifically, 2.0 ml of a dichromate acetic acid reagent was used to halt the reaction (5 percent potassium dichromate and glacial acetic acid were mixed in 1:3 ratio). Then, the amount of H2O2 used per minute per milligram of protein was utilized to calculate the CAT activity (M) [15].

Assay of glutathione peroxidase (GPx)

Reagents: Combine.2 milliliters of glutathione with.1 milliliter of hydrogen peroxide with.5 milliliters of 10% trisodium citrate. Rotruk assays were used to determine glutathione peroxidase activity. Two percent glutathione and one tenth of a milliliter of hydrogen peroxide were each added to the solution. After being

well mixed, the tubes were placed in an incubator at 37°C for 10 minutes, alongside control tubes containing all the chemicals except tissue homogenate. Ten minutes later, 0.5 ml of 10% TCA was added to the mixture, and the reaction was terminated. Tests were performed on the tubes to determine the activity-based glutathione content was reported in units of mol/mg protein [16].

Assay of Na^+/ K^+ ATPase

Na+/K+AT The Bonting assay was used to quantify pase activity. We added 0.2 ml of the tissue homogenate and 0.2 ml of a solution containing KCl, NaCl, EDTA, and ATP to a 1 ml test container. The ingredients were incubated for 15 minutes at 37 degrees Celsius. At the end of the incubation period, 1 ml of 10% TCA was injected to halt the process. The Fiske and Subbarow method was applied to the supernatant of the centrifuged sample to determine the phosphorus content. Pi release per milligram of protein per hour was reported as an indicator of enzyme activity [17].

Statistical Analysis

Mean standard error of the mean was determined for each variable. One-way analysis of variance (ANOVA) was used to classify the data, and Dunnett's t-test was used to compare the means. The level of statistical significance utilized was 0.001, and all the work was done in Graph Pad Prism version 6.

Results and Discussion

Acute Oral Toxicity Study

The acute oral toxicity investigation followed the protocols laid forth by OECD 423. Three male rats were given a single oral dosage of 2000 mg/kg of Boswellia serrata Roxb. (AEBS) leaf methanolic extract and monitored for the duration of the treatment. Until the conclusion of the trial period, no evidence of toxicity, fatality, or mortality was discovered at any of the doses tested. Table 6.2 displays the findings of acute oral toxicity tests.

Table 1: Acute Oral Toxicity Study of *Boswellia serrata* Roxb.

S. No.	Treatment group	Dose	Weight of animal in gm		Signs of toxicity	Onset of toxicity	Reversible or irreversible	Duration
			Before Test	After test				
1.	AEOS	2g/kg	160	165	No signs of toxicity	Nil	Nil	14 days
2.	AEOS	2g/kg	170	190	No signs of toxicity	Nil	Nil	14 days
3.	AEOS	2g/kg	200	225	No signs of toxicity	Nil	Nil	14 days

Grouping of Animals

Animals are grouped into five categories which are as follows

S.NO	GROUPS	TREATMENT	ROUTE
I	CONTROL	1.0 ml (Normal saline) – [7days]	p.o
II	CARRAGEENAN	0.1 ml (1% in 0.9% sterile saline solution) – [8th day]	i.p
III	INDOMETHACIN + CARRAGEENAN	10 mg/kg – [7 days + 8th day]	p.o
IV	AEOS 200 mg/kg + CARRAGEENAN	1.0 ml - [7 days + 8th day]	p.o
V	AEOS 400 mg/kg + CARRAGEENAN	1.0 ml - [7 days + 8th day]	p.o

***In-Vivo* Study**
Measurement of paw edema

Table 2: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on carrageenan induced paw edema

Group	Initial Paw Volume	Paw volume After Induction(ml) as measured by mercury displacement at					
		1sthr	2ndhr	3rdhr	4thhr	5thhr	6thhr
I	1.170 ± 0.003	1.170 ± 0.003	1.170 ± 0.003	1.170 ± 0.003	1.170 ± 0.003	1.170 ± 0.003	1.170 ± 0.003
II	1.191 ± 0.005	1.902 ± 0.034****	2.251 ± 0.023****	2.366 ± 0.033****	2.435 ± 0.006****	2.575 ± 0.018****	2.690 ± 0.120****
III	0.988 ± 0.006	2.086 ± 0.031****	1.533 ± 0.021****	1.425 ± 0.020****	1.290 ± 0.059*	1.166 ± 0.004***	1.180 ± 0.004***
IV	1.155 ± 0.214	1.370 ± 0.024^{ns}	1.388 ± 0.155^{ns}	1.278 ± 0.049^{ns}	1.238 ± 0.038^{ns}	1.188 ± 0.024^{ns}	1.163 ± 0.005^{ns}
V	1.000 ± 0.055	1.595 ± 0.058**	1.638 ± 0.049***	1.490 ± 0.078**	1.348 ± 0.024***	1.228 ± 0.022*	1.121 ± 0.009^{ns}

Values (ng/ml) are expressed as mean ± SEM (n=6). Values comparison were made between Group I Vs Group II, III, IV, V (****p <0.0001, ***p <0.001, **p<0.01, *p<0.1, ns- Non Significant).

The treatment of fluid concentrate of leaves of Boswellia serrata Roxb. in carrageenan causes paw edema, as shown in Table 2, which was derived from an estimate of the mercury removal worth in a plethysmometer.

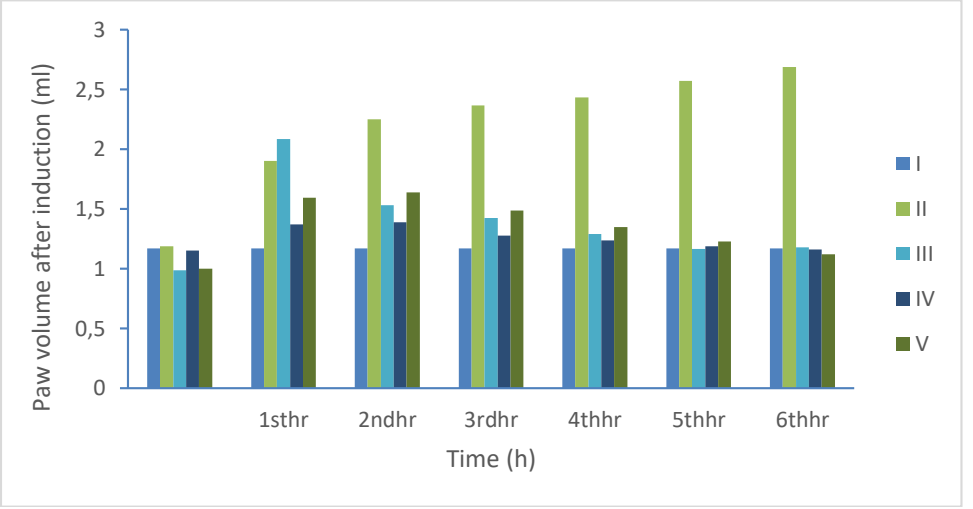

Fig. 1: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on carrageenan induced paw edema

Percentage Inhibition

Table 3: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on percentage inhibition of carrageenan induced paw edema

Group	Initial Paw Volume	6 hr (mm)	Difference in Paw	Inhibition percentage
I	1.178 ± 0.003	1.178 ± 0.003	0.00	100
II	1.191 ± 0.005	2.690 ± 0.120****	1.499	44.27
III	0.988 ± 0.006	1.180 ± 0.004***	0.192	83.72
IV	1.155 ± 0.214	1.163 ± 0.005ns	0.008	99.31
V	1.000 ± 0.055	1.121 ± 0.009ns	0.121	89.20

Values (ng/ml) are expressed as mean ± SEM (n=6). Values comparison were made between Group I Vs Group II, III, IV, V (****p <0.0001, ***p <0.001, ns- Non Significant).

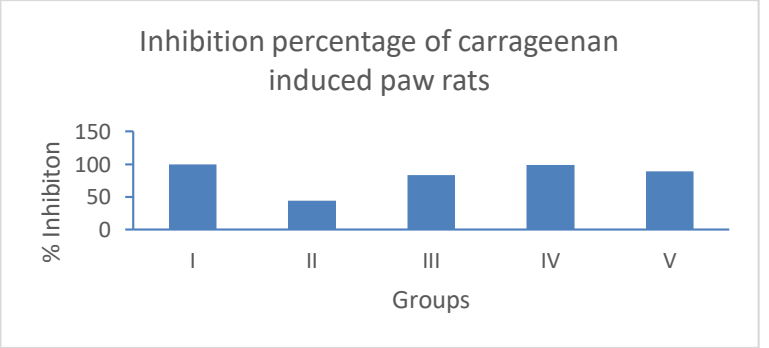

Fig. 2: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on percentage inhibition of carrageenan induced paw edema

a. Biochemical parameters in serum
Total protein (tp)

Table 4: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on Total Protein level in serum

Group	Treatment	Total protein (g/dL)
I	NORMAL SALINE	6.580 ± 0.537
II	CARRAGEENAN	5.083 ± 0.011**
III	INDOMETHACIN + CARRAGEENAN	6.171 ± 0.271ns
IV	AEOS 200 mg/kg + CARRAGEENAN	5.915 ± 0.272ns
V	AEOS 400 mg/kg + CARRAGEENAN	6.431 ± 0.025 ns

Values (ng/ml) are expressed as mean ± SEM (n=6). Values comparison were made between Group I Vs Group II, III, IV, V (**p <0.01, ns- Non Significant).

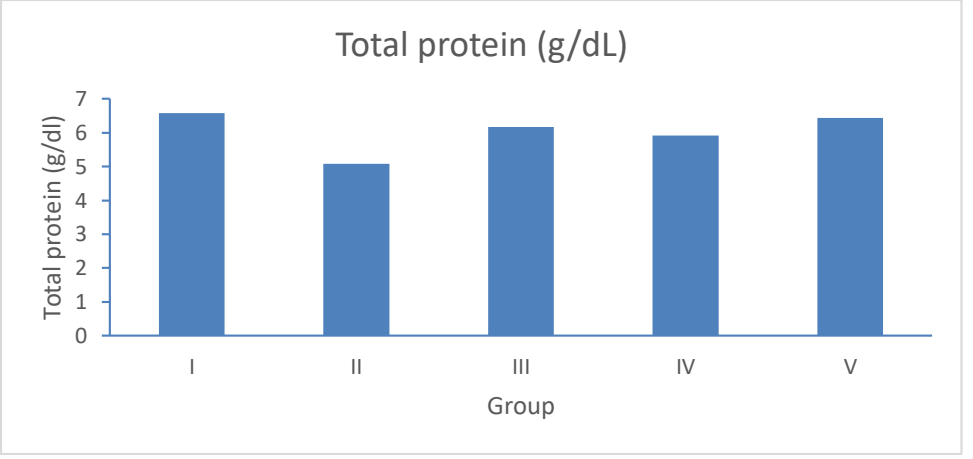

Fig. 3: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on TP level in serum

Alkaline Phosphatase (Alp)

Table 5: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on Alkaline Phosphatase level in serum

Group	Treatment	Alkaline Phosphatase (IU/L)
I	NORMAL SALINE	114.4 ± 6.951
II	CARRAGEENAN	215.2 ± 32.000**
III	INDOMETHACIN + CARRAGEENAN	112.2 ± 20.779ns
IV	AEOS 200 mg/kg + CARRAGEENAN	101.1 ± 6.169ns
V	AEOS 400 mg/kg + CARRAGEENAN	109.5 ± 0.359ns

Values (ng/ml) are expressed as mean ± SEM (n=6). Values comparison were made between Group I *vs* Group II, III, IV, V (**p <0.01, ns- Non Significant).

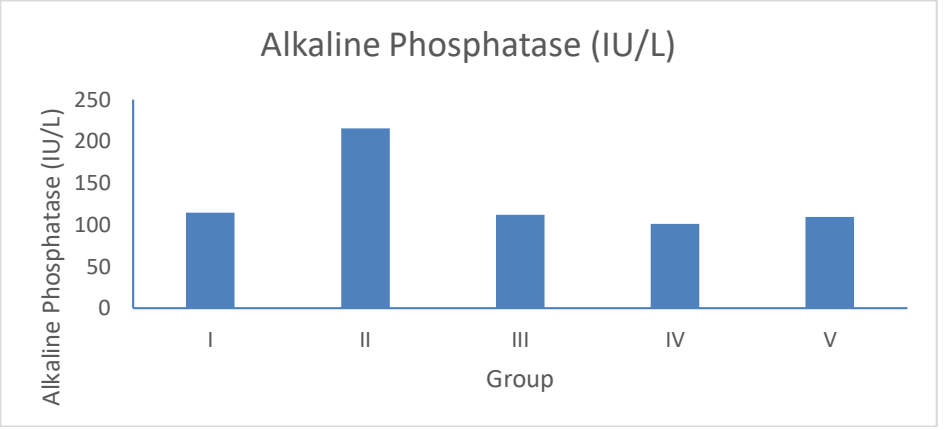

Fig. 4: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on ALP level in serum

Aspartate Transaminase (AST OR SGOT)

Table 6: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on Aspartate Transaminase level in serum

Group	Treatment	Aspartate Transaminase (IU/L)
I	NORMAL SALINE	102.48 ± 0.058
II	CARRAGEENAN	125.28 ± 0.024****
III	INDOMETHACIN + CARRAGEENAN	96.17 ± 2.855**
IV	AEOS 200 mg/kg + CARRAGEENAN	90.85 ± 0.024****
V	AEOS 400 mg/kg + CARRAGEENAN	108.78 ± 0.018**

Values (ng/ml) are expressed as mean ± SEM (n=6). Values comparison were made between Group I Vs Group II, III, IV, V (****p <0.0001, **p <0.01).

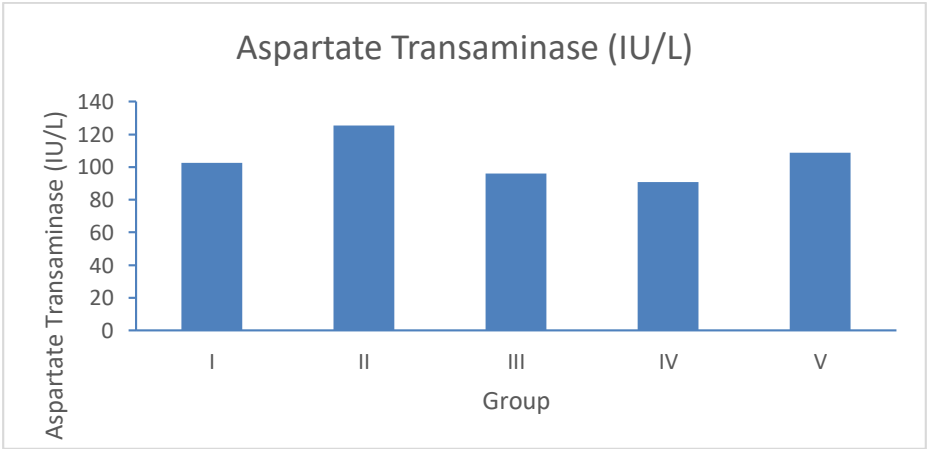

Fig. 5: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on SGOT level in serum

Alanine Transaminase (ALT OR SGPT)

Table 7: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on Alanine Transaminase level in serum

Group	Treatment	Alanine Transaminase (IU/L)
I	NORMAL SALINE	138.2 ± 0.021
II	CARRAGEENAN	159.5 ± 0.055****
III	INDOMETHACIN + CARRAGEENAN	132.5 ± 6.263^{ns}
IV	AEOS 200 mg/kg + CARRAGEENAN	127.2 ± 0.005*
V	AEOS 400 mg/kg + CARRAGEENAN	137.0 ± 0.024^{ns}

Values (ng/ml) are expressed as mean ± SEM (n=6). Values comparison were made between Group I Vs Group II, III, IV, V (****p <0.0001, *p <0.05, ns- Non Significant).

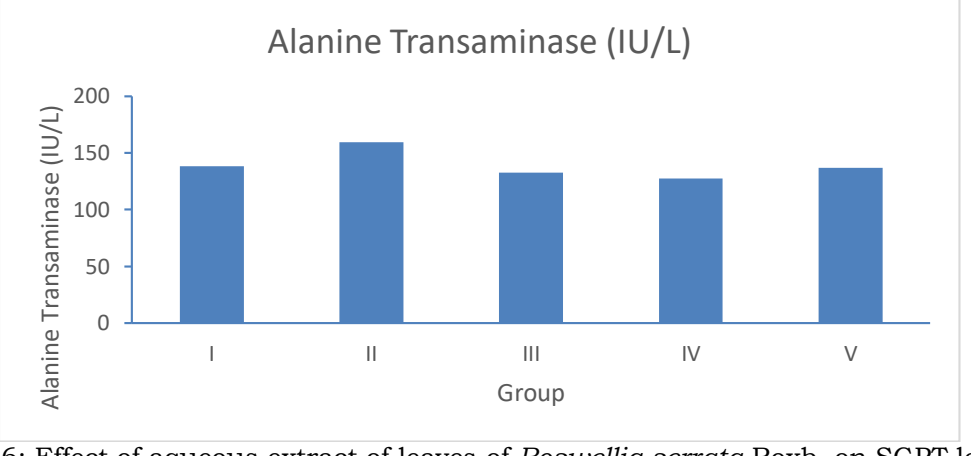

Fig. 6: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on SGPT level in serum

b. Biochemical parameters in tissue homogenate

Lipid peroxidation

Table 8: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on LPO level in tissue homogenate

Group	Treatment	LPO (Units in mol/mg protein)
I	NORMAL SALINE	0.439 ± 0.003
II	CARRAGEENAN	0.580 ± 0.002****
III	INDOMETHACIN + CARRAGEENAN	0.423 ± 0.0005^{ns}
IV	AEOS 200 mg/kg + CARRAGEENAN	0.424 ± 0.0005^{ns}
V	AEOS 400 mg/kg + CARRAGEENAN	0.426 ± 0.0005^{ns}

Values (ng/ml) are expressed as mean ± SEM (n=6). Values comparison were made between Group I Vs Group II, III, IV, V (****p <0.0001, *p <0.05, ns- Non Significant).

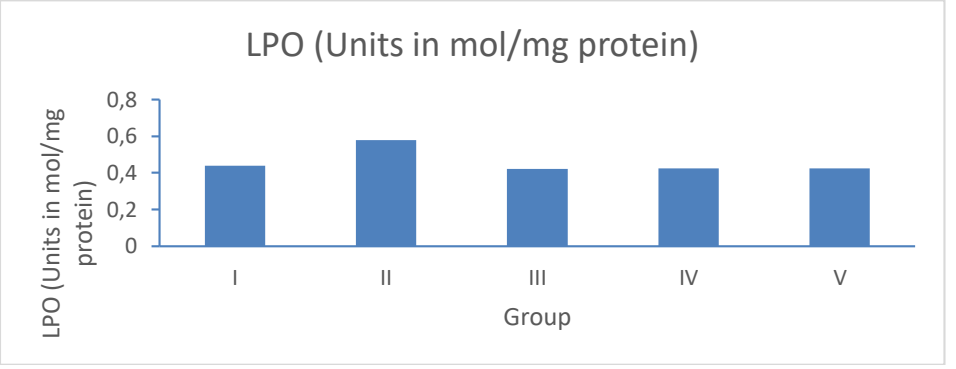

Fig. 7: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on LPO level in tissue homogenate

Reduced Glutathione

Table 9: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on GSH level in tissue homogenate

Group	Treatment	GSH (µ mol/mg protein)
I	NORMAL SALINE	0.5521 ± 0.002
II	CARRAGEENAN	0.4808 ± 0.003****
III	INDOMETHACIN + CARRAGEENAN	0.6016 ± 0.001****
IV	AEOS 200 mg/kg + CARRAGEENAN	0.5941 ± 0.0006***
V	AEOS 400 mg/kg + CARRAGEENAN	0.5723 ± 0.0005**

Values (ng/ml) are expressed as mean ± SEM (n=6). Values comparison were made between Group I Vs Group II, III, IV, V (****p <0.0001, ***p<0.001, **p <0.01).

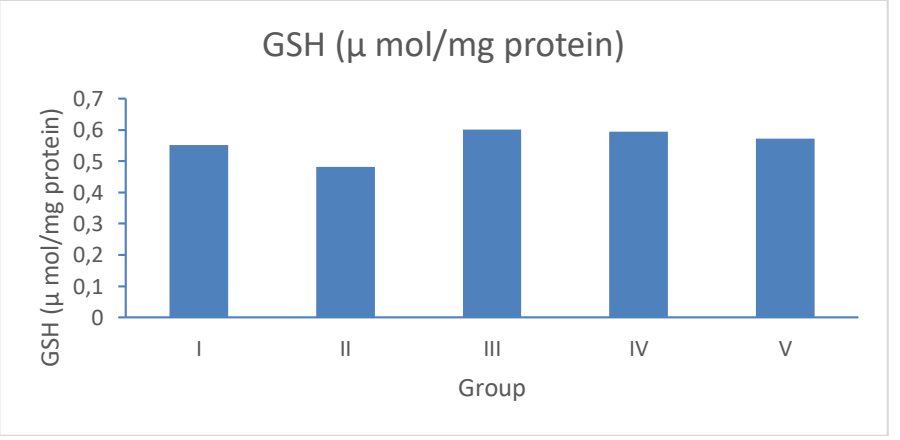

Fig. 8: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on GSH level in tissue homogenate

Superoxide Dismutase

Table 10: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on SOD level in tissue homogenate

Group	Treatment	SOD (units/mg protein)
I	NORMAL SALINE	5.021 ± 0.0005
II	CARRAGEENAN	3.700 ± 0.0003****
III	INDOMETHACIN + CARRAGEENAN	5.210 ± 0.0006****
IV	AEOS 200 mg/kg + CARRAGEENAN	5.419 ± 0.0006****
V	AEOS 400 mg/kg + CARRAGEENAN	5.481 ± 0.0005****

Values (ng/ml) are expressed as mean ± SEM (n=6). Values comparison were made between Group I Vs Group II, III, IV, V (****p <0.0001, ***p<0.001, **p <0.01).

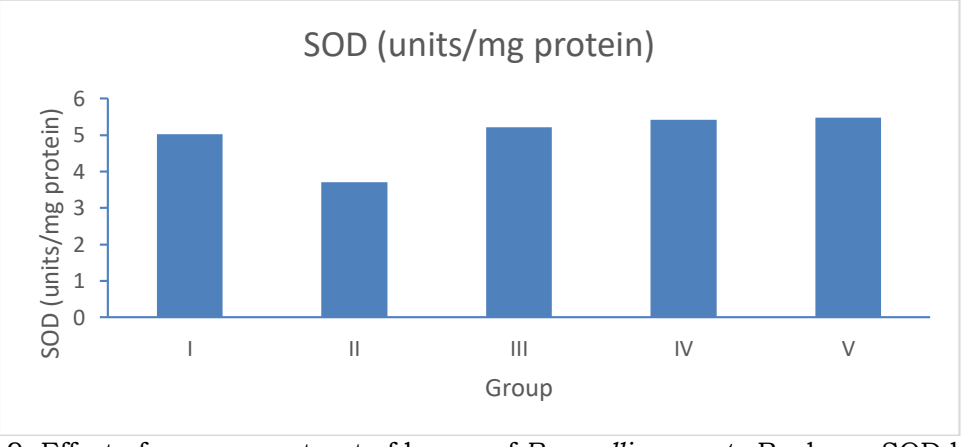

Fig. 9: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on SOD level in tissue homogenate

Catalase

Table 11: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on CAT level in tissue homogenate

Group	Treatment	CAT (μ mol H_2O_2 consumed/min/mg of protein)
I	NORMAL SALINE	49.58 ± 0.001
II	CARRAGEENAN	25.01 ± 0.001****
III	INDOMETHACIN + CARRAGEENAN	42.89 ± 0.0007****
IV	AEOS 200 mg/kg + CARRAGEENAN	45.21 ± 0.0005****
V	AEOS 400 mg/kg + CARRAGEENAN	47.10 ± 0.0005****

Values (ng/ml) are expressed as mean ± SEM (n=6). Values comparison were made between Group I Vs Group II, III, IV, V (****p <0.0001, ***p<0.001, **p <0.01).

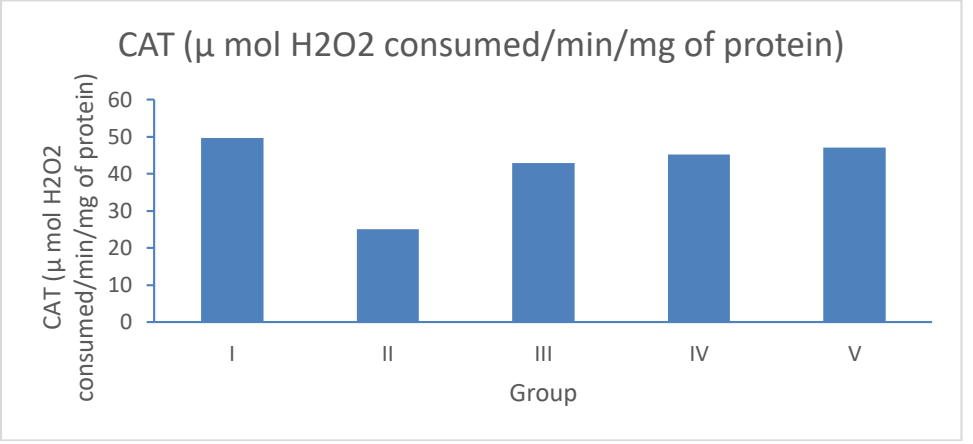

Fig. 10: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on CAT level in tissue homogenate

Glutathione Peroxidase

Table 12: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on GPx level in tissue homogenate

Group	Treatment	GPx
I	NORMAL SALINE	0.5711 ± 0.0006
II	CARRAGEENAN	0.3833 ± 0.0005****
III	INDOMETHACIN + CARRAGEENAN	0.5643 ± 0.0005**
IV	AEOS 200 mg/kg + CARRAGEENAN	0.5823 ± 0.0005****
V	AEOS 400 mg/kg + CARRAGEENAN	0.5950 ± 0.001***

Values (ng/ml) are expressed as mean ± SEM (n=6). Values comparison were made between Group I Vs Group II, III, IV, V (****p <0.0001, ***p<0.001, **p <0.01).

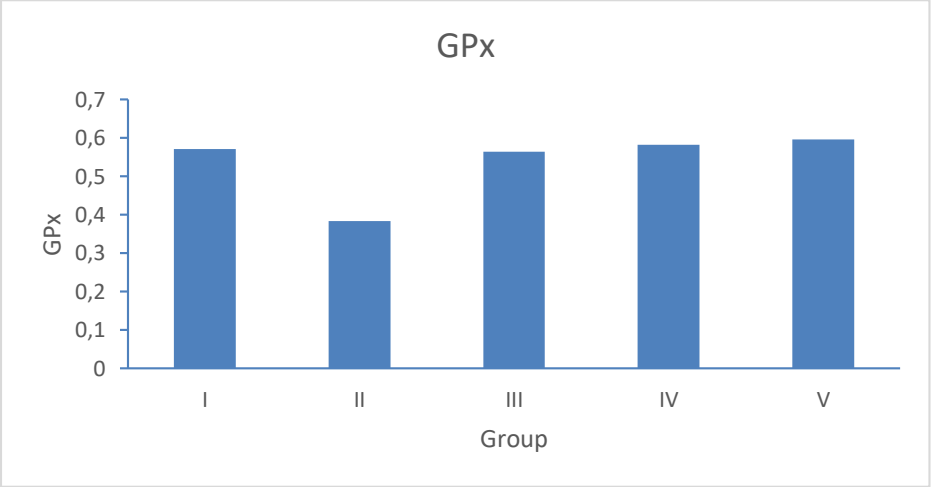

Fig. 11: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on GPx level in tissue homogenate

NA⁺/K⁺ ATPase

Table 13: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on Na+/K+ ATPase level in tissue homogenate

Group	Treatment	Na^+/K^+ ATPase (µ mol H_2O_2 consumed/min/mg of protein)
I	NORMAL SALINE	0.00543 ± 0.0001
II	CARRAGEENAN	0.00361 ± 0.0003^{ns}
III	INDOMETHACIN + CARRAGEENAN	0.00553 ± 0.0003^{ns}
IV	AEOS 200 mg/kg + CARRAGEENAN	0.00513 ± 0.0001^{ns}
V	AEOS 400 mg/kg + CARRAGEENAN	0.00523 ± 0.0002^{ns}

Values (ng/ml) are expressed as mean ± SEM (n=6). Values comparison were made between Group I Vs Group II, III, IV, V ($^{****}p < 0.0001$, $^{***}p < 0.001$, $^{**}p < 0.01$).

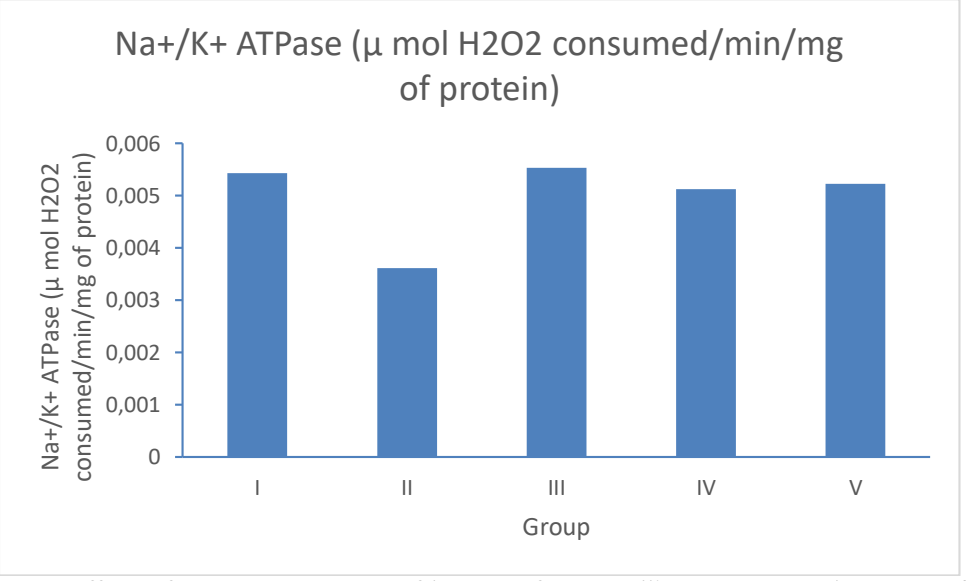

Fig. 12: Effect of aqueous extract of leaves of *Boswellia serrata* Roxb. on Na^+/K^+ ATPase level in tissue homogenate

Conclusion

The findings of this research provide support for the use of Boswellia serrata Roxb. in the treatment of acute inflammatory illnesses, and the carrageenan-induced inflammation model provides a strong prediction test for anti-inflammatory medicines acting via the mediators of acute inflammation. Pretreatment with Boswellia serrata Roxb. aqueous extract of leaf (400 mg/kg) significantly reduced paw edema in Group IV. Its preventive action against inflammation is shown by the fact that the extract reduced paw edema more effectively than the gold-standard medication Indomethacin. The current investigation verified the anti-inflammatory effects of a 400 mg/kg dose of Boswellia serrata Roxb. leaf aqueous extract. The findings also provide credence to the plant's historic use in the management of inflammatory disorders.

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