ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 11,Nov 2022

Evaluation of Anti-inflammatory Activity *Solanum lycopersicum* (Tomato)

Akhila A[1] and Keshamma E[2*]

[1]Associate Professor, Department of Zoology, Govt. First Grade College, Vijayanagar, Bengaluru, Karnataka, India

[2]Associate Professor, Department of Biochemistry, Maharani Science College for Women Maharani Cluster University, Palace Road, Bengaluru, Karnataka, India

***Corresponding Author**
Dr. Keshamma E
Associate Professor
Department of Biochemistry,
Maharani Science College for Women, Maharani Cluster University,
Palace Road, Bengalur-560 001,
Karnataka, India
Email: keshamma.blr76@gmail.com

Abstract

Tomato (*Solanum lycopersicum*) belonging to the Solanaceae family and the genus Solanum is one of the most important vegetable crops after potato. Because of its widespread and health-promoting compounds, it is the model organism for research. Non-steroidal antiinflammatory drugs (NSAIDs) that are mainly used in the treatment of pain and inflammation with side effects like gastrointestinal irritation. Therefore, there is a resurgence to search for alternative anti-inflammatory drugs and medicines from natural sources. Hence, we aimed to evaluate anti-inflammatory potential of tomato (*S. lycopersicum*). Anti-inflammatory activity of tomato (S. lycopersicum) extract at doses of 50 mg/kg, 100 mg/kg and 200 mg/kg was evaluated in Wistar albino rats in carrageenan induced paw edema animal model test. Inflammation was produced by administering 0.1 ml of 1% carrageenan into sub-plantar surface of rat hind paw to negative control group; 50 mg/kg (Group-I), 100 mg/kg (Group-II), 200 mg/kg (Group-III) tomato (*S.*

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lycopersicum) extracts and Aspirin 100 mg/kg (positive control) was administered intraperitoneally respectively. Results depicted that there was a dose dependent inhibition of hind paw edema volume following treatment with tomato (*S. lycopersicum*) extract. Furthermore, the anti-inflammatory effect of tomato (*S. lycopersicum*) extract at the dose level of 200 mg/kg was comparable with that of standard drug *viz.* Aspirin. Moreover, maximum inhibition of paw edema volume was observed at 12 h time interval at all the dose levels of tomato (*S. lycopersicum*) extract. In conclusion, this preliminary study proved anti-inflammatory potential of tomato (*S. lycopersicum*) extract. Therefore tomato (*S. lycopersicum*) extract could be considered for development natural anti-inflammatory drugs.

Keywords: Tomato, *Solanum lycopersicum*, Anti-inflammatory, Inflammation

Introduction

The growing incidence of cardiovascular, immunosuppressive and chronic inflammatory diseases due to the rapid pace of industrialization poses a serious threat for the well-being of mankind. The increased amounts of social, personal, and workplace stress cannot be ignored as factors predisposing humans to premature aging, mental illnesses and early deaths.[1] Inflammation is an essential aspect of host response that leads to infection and injury, and is required to maintain healthy state against bacterial and viral infections. However, excessive or aberrant inflammation contributes to many acute and chronic human diseases.[2] However, inflammatory response is characterized by the abundant productions of prostaglandin E2 (PGE2) and thus, these pro-inflammatory mediators are important anti-inflammatory targets.[3]

Non-steroidal antiinflammatory drugs (NSAIDs) that are mainly used in the treatment of pain and inflammation related to a large variety of pathologies have been prepared and marketed. These have been of immense help in the management of various inflammatory conditions like rheumatism, arthritis and breast pain. However, these drugs are known to provoke gastrointestinal irritation. This makes them widely unacceptable, especially in the

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elderly where the disease is more prevalent, hence the search for alternative anti-inflammatory drugs and medicines among the bounties of natural herbs. Hence, there is much hope in finding anti-inflammatory drugs from traditional and medicinal plants without side-effects.[4]

Tomato (*Solanum lycopersicum*) belonging to the Solanaceae family and the genus Solanum is one of the most important vegetable crops after potato. Because of its widespread and health-promoting compounds, it is the model organism for research.[5] Many plants in the Solanaceae family, such as tomatoes, potatoes and eggplant, possess steroidal alkaloids based on a C27 cholestane skeleton, such as tomatidine and solasodine. These compounds are essentially nitrogen analogues of steroid saponins such as diosgenin, which is a precursor of steroidal hormones and anti-inflammatory steroids.[4]

Tomato is widely consumed as fruit and vegetable all over the world. The anti-oxidant, anti-inflammatory, anti-diabetic, and anti-lipidemic activities of the tomato have been studied extensively in the past and currently.[6,7] The protective properties of tomato are mainly attributed to the carotenoid, lycopene, which is present in great quantities within the fruit. There is much ongoing research on the tomato as a whole fruit, or isolated lycopene, which is the most abundant and active component of the tomato. Lycopene administration alleviated prostitis in a manner comparable to that of ciprofloxacin.[8] Furthermore, it reduced the chemical and histological symptoms in iodoacetamide induced colitis in rats.[9] Anthocyanins from tomatoes have also been shown to exhibit inhibitory effects on inducible nitric oxide synthase (iNOS) and cyclooxygenase-2 (COX-2).[10] With this scenario, present study was designed with the objective of evaluation of anti-inflammatory potential of tomato (*Solanum lycopersicum*)

Materials and Methods

Collection of Tomato

The fresh tomatoes (*S. lycopersicum*) were purchased from local market of Chikkaballapura and washed thoroughly with running tap water and dried at room temperature.

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Sample Preparation

Five to six washed and dried tomatoes were grinded to sauce form and taken in to beaker. The tomato sauce was heated to remove excess water. The extract was mixed with double distilled water at the final concentration of 2 mg/mL and was used as sample extract for determination of anti-inflammatory activity.

Ethical Approval

The study was conducted by authorized, qualified and trained scientists & technicians in compliance with the guidelines laid down by the Institutional Animal Ethics Committee (IAEC) approved by the Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA), India. All applicable international, national, and/or institutional guidelines for the care and use of animals were followed.

Experimental Animals

Healthy Wistar albino rats weighing between 150-200 g were used. They were maintained at 25ºC with relative humidity of 45 to 50% and under standard environmental conditions with 12:12 h light/dark cycle in polypropylene cages for one week before the experiments. The animals were fed with standard pellet feed and water was given *ad libitum*. The animals were deprived of food for 24 hours before experimentation, but had free access to drinking water. All experiments were performed in the morning.

Anti-inflammatory Activity

Carrageenan-induced inflammatory model:

Inflammation was produced by administering 0.1 ml of 1% carrageenan into sub-plantar surface of rat hind paw. Albino rats of either sex weighing 150-250 g were fasted overnight with *ad libitum* access to water.[11] The animals were divided in to five groups as follows;

Study Design

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Groups	Treatment	No. of Animals / Group
Negative Control	Distilled water (10 ml/kg) + Carrageenan (0.1ml of 1% in normal saline)	6
Positive Control	Aspirin (100 mg/kg, i.p.) + Carrageenan (0.1 ml of 1% w/v in saline solution)	6
Group-I	Extract of Tomato (*S. lycopersicum*) (100 mg/kg, i.p.) + Carrageenan (0.1 ml of 1% w/v in saline solution)	6
Group-II	Extract of Tomato (*S. lycopersicum*) (200 mg/kg, i.p.) + Carrageenan (0.1 ml of 1% w/v in saline solution)	6
Group-III	Extract of Tomato (*S. lycopersicum*) (300 mg/kg, i.p.) + Carrageenan (0.1 ml of 1% w/v in saline solution)	6

Selected doses of extract of tomato (*S. lycopersicum)* was given intraperitonially. One hour after drug treatment all animals were injected with 0.1 ml of 1% carrageenan solution in the sub-plantar aponeurosis of left hind paw and the paw volume was measured plethysmometrically. Recordings were taken up to 12 hours at 1h, 2 h, 4 h, 6 h, and 12 h intervals. The % inhibition in paw volume was calculated by using following formula;[12]

% inhibition in paw volume = 100 × (1 – Vt/Vc)

Where,

Vt = mean paw volume in the drug treated group.

Vc = mean paw volume in negative control group

Statistical Analysis

The data are expressed as Mean.

Results and Discussion

The results of the anti-inflammatory effect of tomato (*S. lycopersicum*) extract and positive control drug was as represented in Figures 1, 2, 3, 4, and 5. Results depicted that there was a dose dependent inhibition of hind paw edema volume following treatment with tomato (*S.*

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lycopersicum) extract at the concentrations of 100 mg/kg (Group I), 200 mg/kg (Group II), and 300 mg/kg (Group III) at all the time intervals recorded i.e., 1 h, 2 h, 4 h, 6 h and 12 h. Furthermore, inhibition of hind paw edema volume of tomato (*S. lycopersicum*) extract was comparable with that standard drug i.e., Aspirin.

Figure 1: Effect of tomato (*S. lycopersicum*) extract on inhibition of carrageenan induced hind paw edema in rats at 1 h

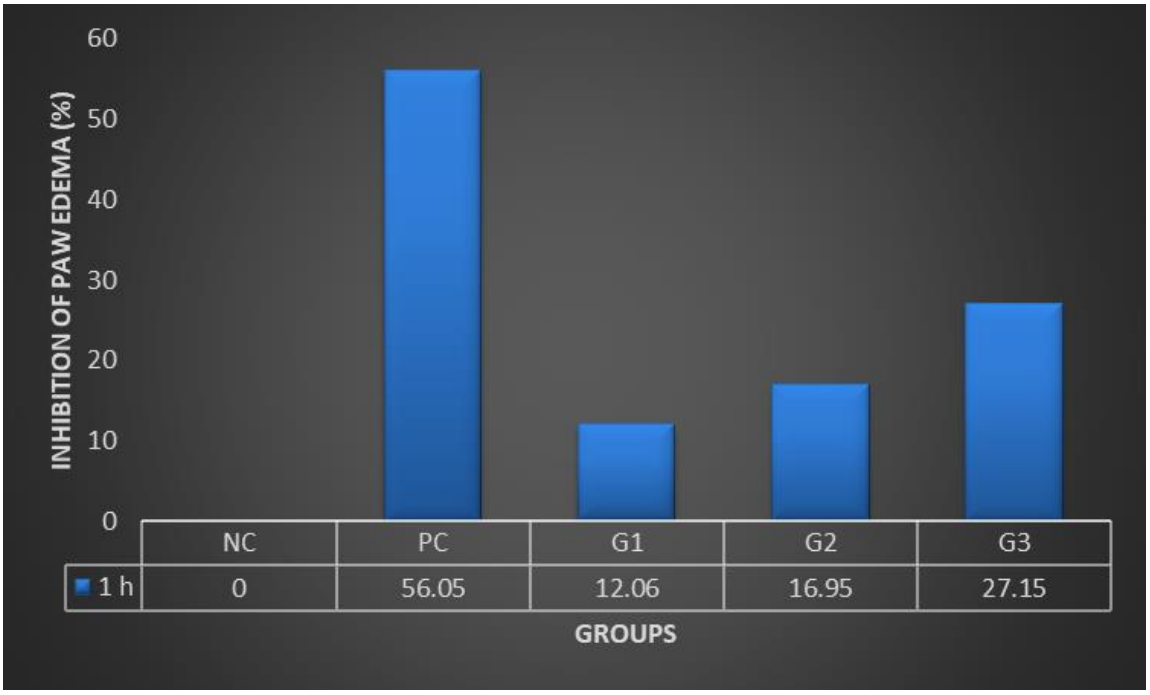

Figure 2: Effect of tomato (*S. lycopersicum*) extract on inhibition of carrageenan induced hind paw edema in rats at 2 h

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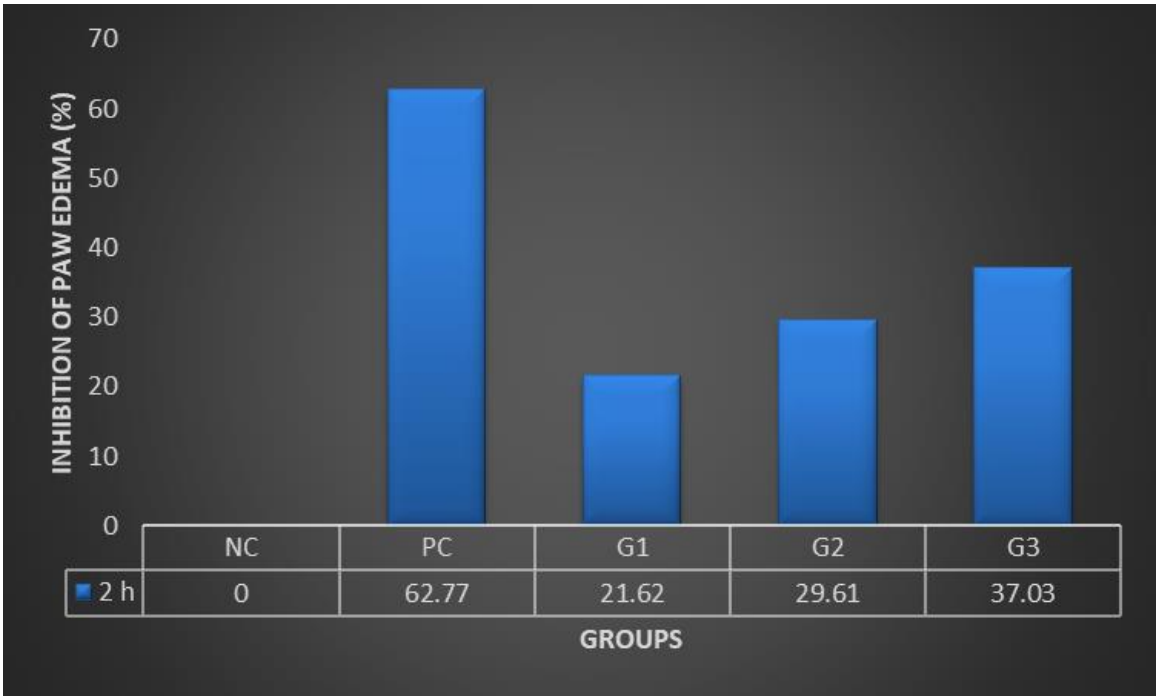

Figure 3: Effect of tomato (*S. lycopersicum*) extract on inhibition of carrageenan induced hind paw edema in rats at 4 h

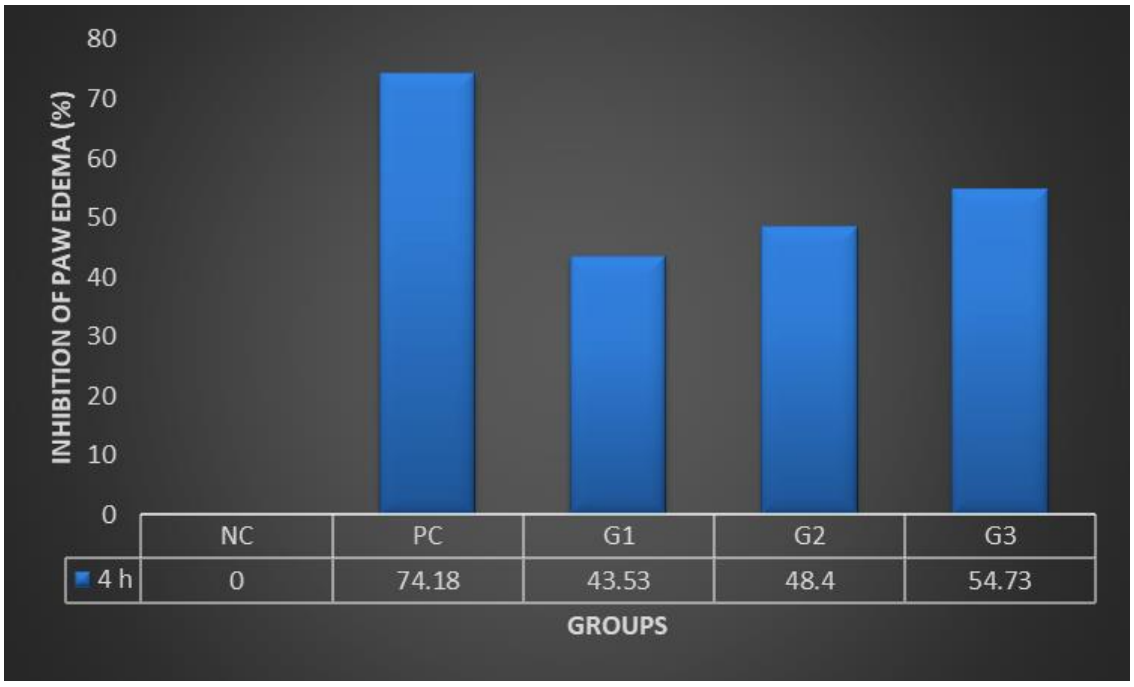

Figure 4: Effect of tomato (*S. lycopersicum*) extract on inhibition of carrageenan induced hind paw edema in rats at 6 h

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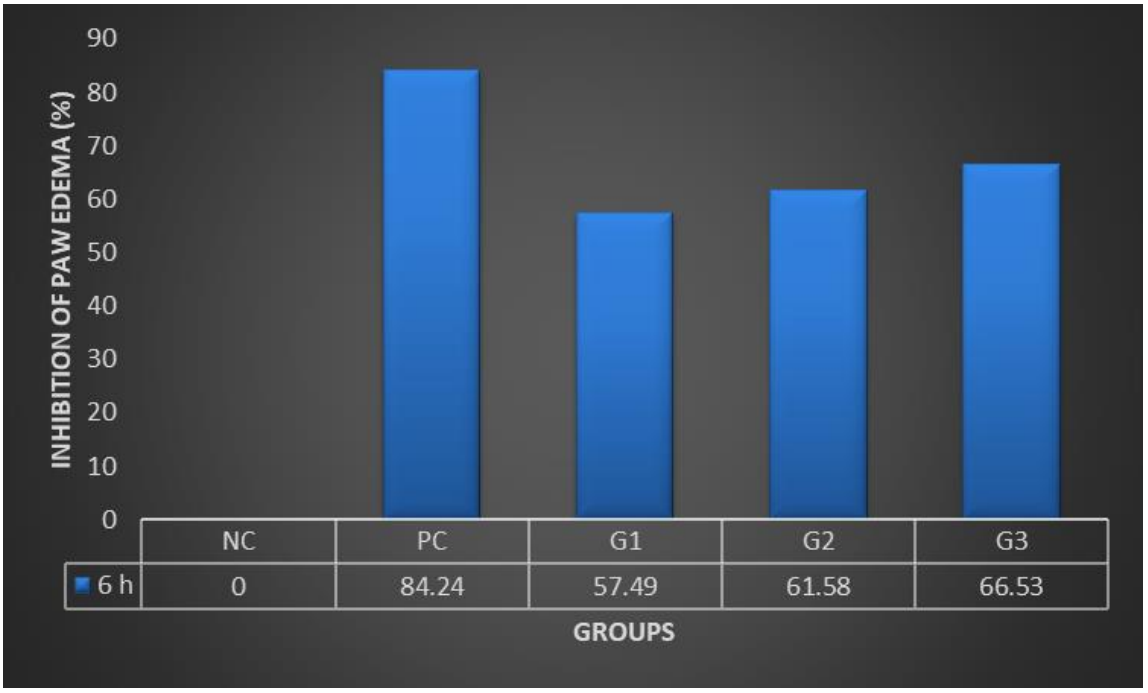
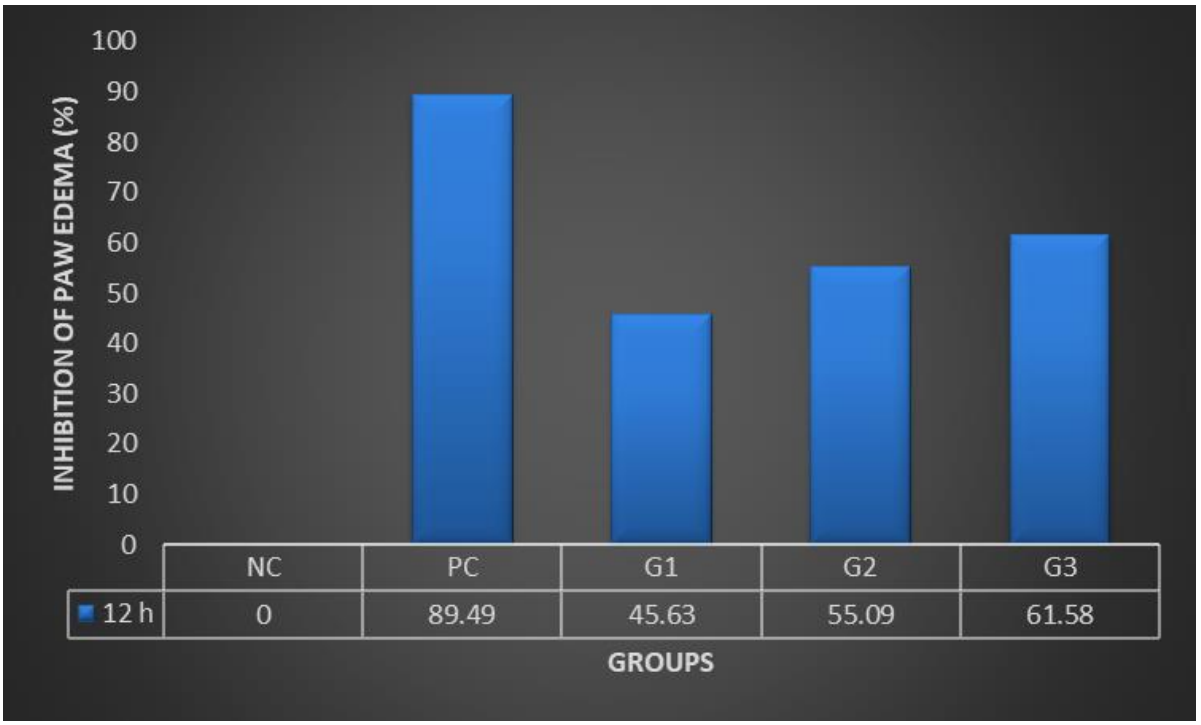


Figure 5: Effect of tomato (*S. lycopersicum*) extract on inhibition of carrageenan induced hind paw edema in rats at 12 h



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A number of events, including bacterial infection, chemical harm, and environmental pollution, can cause inflammation, which is a complicated process that can cause cell damage or death.[13,14] The most frequent inflammatory-related complaints are pain and fever and the most widely used medications in the world today are NSAIDs. The NSAIDs are used to treat inflammatory illnesses only alter the inflammatory response to the diseases, not the underlying cause of the disease. Market demand exists for orally active compounds that are more successful than currently available medications at treating the underlying causes of inflammatory disease as opposed to only the symptoms. Therefore, there is renewed interest in finding novel anti-inflammatory drugs.

Carrageenan induced paw edema has been widely used to screen natural products with anti-inflammatory potentials.[15] In our study, there was a dose dependent inhibition of hind paw edema volume following treatment with tomato (*S. lycopersicum*) extract. Furthermore, the anti-inflammatory effect of tomato (*S. lycopersicum*) extract at the dose level of 300 mg/kg was comparable with that of standard drug (Aspirin). Moreover, maximum inhibition of paw edema volume was observed at 12 h time interval at all the dose levels of tomato (*S. lycopersicum*) extract.

Saba et al., reported administration of ethanol extract of tomato possess anti-inflammatory effects in RAW 264.7 cells by suppressing the production of pro-inflammatory mediators and cytokines via the NF-κB and MAPK pathways. Moreover, ethanol extract of tomato increased the survival rates of mice with LPS induced septic shock.[16] In another study reported by Amid et al., demonstrated the anti-inflammatory activity of methanolic leaf extract of *S. lycopersicum* inhibition of LPS induced inflammatory mediator (PGE2) and reduction of the COX-2 gene expression.[17]

Carrageenan induced paw edema test model basically reflects the action of prostaglandins involved in the inflammation process induced by carrageenan. Oedema

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formation in paw is the result of a synergism between various inflammatory mediators that increase vascular permeability and/or mediators that increase blood flow.[18] Subplanter injection of carrageenan in the rat hind paw induces inflammation in two distinct phases namely: the first phase (0-2 h) which involves release of histamine and 5-hydroxytryptamine and second phase (2-6 h) which involves release of the inflammatory mediators like prostaglandins, leukotrienes, polymorphonuclear cells and bradykinins. These two phases are linked with kinin release.[19,20] However, synthetic anti-inflammatory agents such as aspirin, indomethacin and diclofenac are known to mediate their anti-inflammatory action via inhibition of second phase of inflammatory response. Since tomato (*S. lycopersicum*) extract showed maximum reduction in paw edema during second phase, it may be stated that tomato (*S. lycopersicum*) extract might have mediated its anti-inflammatory action by inhibiting the release of mediators like prostaglandins, leukotrienes, polymorphonuclear cells and bradykinins.[21]

Conclusion

In conclusion, this preliminary study proved anti-inflammatory potential of tomato (*S. lycopersicum*) extract. Therefore tomato (*S. lycopersicum*) extract could be considered for development natural anti-inflammatory drugs. However, further studies are warranted to elucidate the exact mechanism of action of anti-inflammatory action of tomato (*S. lycopersicum*) extract.

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