

Original Research Article

A Study to Evaluate Anti-Inflammatory Activity of Different Parts of Solanum Melongena Linn. In Experimental Animals

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ABSTRACT

Background: Solanum melongena Linn. (brinjal) is traditionally used in inflammatory conditions, bronchitis, asthma and cardiac debility. It contains bioflavonoid glycoside solanoflavone with reported pharmacological actions. This study aimed to evaluate anti-inflammatory activity of different parts of S. melongena in experimental animals.

Methods: Study was conducted at Pharmacology Dept., Assam Medical College (IAEC/AMC/11, dated 29/11/2016). Ethanolic extracts of leaves (AESML) and fruits (AESMF) were prepared by percolation with 95% ethanol. Acute oral toxicity was done as per OECD 425. Albino rats (100-200g, n=20) were divided into 4 groups (n=5): Control (normal saline 10 ml/kg), AESML 250 mg/kg, AESMF 250 mg/kg, and Standard aspirin 100 mg/kg, all p.o. Acute inflammation was induced by 0.1 ml 1% carrageenan in left hind paw after 1 hr of drug administration. Paw volume was measured by plethysmometer at 0-4 hr. Percentage inhibition was calculated. Data analyzed by ANOVA followed by Dunnett's test (p<0.01).

Results: No toxicity up to 2000 mg/kg. Both extracts showed significant (p<0.01) inhibition at all hours, maximum at 4th hour. Inhibition at 4th hr: AESML 60.93%, AESMF 73.43%, aspirin 78.12%. AESMF was more potent than AESML and comparable to aspirin.

Conclusion: Ethanolic extracts of S. melongena leaves and fruits possess significant acute anti-inflammatory activity, likely due to flavonoids inhibiting prostaglandin mediators.

Keywords: Anti-Inflammatory, Solanum Melongena, Carrageenan, Paw Oedema, Flavonoid.

ABBREVIATION

AESML: Alcoholic extract of Solanum melongena leaves (AESML) 250mg/kg, p.o.

AESMF: Alcoholic extract of Solanum melongena fruits (AESMF) 250mg/kg, p.o.

INTRODUCTION

Inflammation is a biological response of the immune system that can be triggered by a variety of factors, including pathogens, toxic compounds and damaged cells.¹

Inflammation had begun to be viewed as being an undesirable response that was harmful to the host at the end of the 19th century.² The famous 4 cardinal signs of inflammation as: rubor (redness); tumor (swelling); calor (heat); and dolor (pain) were named by Celsus in 1st century A.D. Later Virchow added the fifth sign

function laesa (loss of function).³

Traditional herbal medicine existed before the application of modern scientific method to health care and even today majority of the world population depends on herbal health care practices.⁴

Solanum melongena Linn. (garden egg) is an flowering plant belonging to the family Solanaceae. Members are mostly herbaceous plants, and are grown mainly for food and medicinal purposes.⁵ Various parts of the plant are useful in the treatment of inflammatory

conditions, cardiac debility, neuralgias, ulcer of nose, cholera, bronchitis and asthma.⁶ A bioflavonoid glycoside named solanoflavone is present in the leaves and fruits of *S. melongena*.⁷

Besides, having many traditional uses, *S. melongena* is reported to exhibit many important pharmacological actions. The present study was carried out to evaluate the Anti-inflammatory activity of different parts of *Solanum melongena* Linn. in experimental animals

MATERIALS AND METHODS

The study was carried out in the department of pharmacology at Assam Medical College in 2017 to 2018. Fresh *S. melongena* leaves and fruits were collected within Dibrugarh district of Assam. The leaves and fruits were air dried at room temperature and were ground to a fine powder. Ethanolic extracts were obtained by percolating the dried powder with 95% ethanol.⁸ All the animals used in the study were taken care of under ethical consideration with approval from the institutional ethics committee (IAEC/AMC/11. Dated 29/11/2016) Assam Medical College.

Toxicity studies: Alcoholic extract of *Solanum melongena* leaves (AESML) and Alcoholic

extract of *Solanum melongena* fruits (AESMF) were subjected to acute oral toxicity according to OECD Guidelines 425 (Organization for Economic Co-operation and Development).⁹ Mortality in the acute oral toxicity tests for both the extracts were not seen in the limit test up to dose 2000 mg/kg.

For testing acute anti-inflammatory activity: Materials Required

Drugs: Alcoholic extract of *Solanum melongena* leaves (AESML), Alcoholic extract of *Solanum melongena* fruits (AESMF), aspirin, 1% suspension of carrageenan, normal saline,

Equipment Required: Tuberculin syringe, plethysmometer,

Experimental Design: Twenty albino rats each, of either sex weighing 100-200 gm were taken for acute anti-inflammatory study. The animals were divided randomly into four groups of five animals per group. The rats were maintained on a standardized diet and water ad libitum. For experimental purpose, the animals were kept fasting overnight but allowed free access to water. Drugs in the study were administered orally or intraperitoneally.

The Groups and Treatment

Groups	Treatment
Group A (Control)	Normal saline 10ml /kg, p.o
Group B (Test 1)	Alcoholic extract of <i>Solanum melongena</i> leaves (AESML) 250mg/kg, p.o.
Group C (Test 2)	Alcoholic extract of <i>Solanum melongena</i> fruits (AESMF) 250mg/kg, p.o.
Group D (Standard)	Aspirin 100mg/kg, p.o.

Table 1

The volume of all medicaments was kept constant at 10ml/kg body weight of the animals

METHOD

Carrageenan induced paw oedema method in albino rats was applied for evaluating anti-inflammatory activity of Alcoholic extract of *Solanum melongena* leaves (AESML) and Alcoholic extract of *Solanum melongena* fruits (AESMF) on acute inflammation

One hour after administration of normal saline, AESML, AESMF and aspirin orally, acute inflammation was produced in all animals by injecting 0.1 ml of freshly prepared 1% carrageenan in normal saline in the left hind paw.

The paw volume was measured

plethysmometrically just before carrageenan injection i.e., 0 hr and then 1st, 2nd, 3rd and 4th hr after carrageenan injection.¹⁰

Increase in paw oedema was measured as the difference between the paw volume at 0 hr and paw volume at the respective hour. The percentage inhibition of the rat paw oedema was calculated after each hour of carrageenan injection upto 4 hours by the formula described by SudjarwoAgus.¹¹

$$\text{Percentage inhibition (\%)} = \frac{(\text{Control Mean} - \text{Treated mean})}{\text{Control mean}} \times 100$$

Care of the animal after the experiment:

After the experiment is over the animal were

sent to the Central Animal House, AMCH for proper care and rehabilitation. There was no sacrifice of the experimental animals this proposed study.

Statistical Analysis

The data obtained were subjected to statistical analysis using one way ANOVA followed by Dunnet's multiple comparison test. A probability level of $p < 0.01$ obtained and considered to be significant. The percentage of inhibition of paw oedema was calculated on 1st, 2nd, 3rd and 4th hours.

RESULTS

The present study showed that alcoholic extract of solanum melongena leaf, fruit and standard drug aspirin possessed significant antiinflammatory activity against acute inflammation induced by carrageenan. AESML, AESMF showed significant anti-inflammatory activity at the selected dose at 1st, hour, 2nd hour 3rd hour and 4th hour and maximum percentage of inhibition of paw oedema was observed at 4th hour after carrageenan injection. Standard drug aspirin also showed maximum percentage of inhibition of paw oedema at 4th after carrageenan injection.

Name of the group	Drug dose p.o.	Mean increase in Paw volume (Mean $\pm$ S.E.M) (ml) with Percentage Inhibition			
		1st hour	2nd hour	3rd hour	4th hour
Group A (Control)	Normal saline 10 ml/kg	0.26 $\pm$ 0.008	0.39 $\pm$ 0.008	0.61 $\pm$ 0.007	0.64 $\pm$ 0.024
Group B (Test Drug 1)	AESML 250mg/kg, p.o.	0.17 $\pm$ 0.005 (34.62%)	0.24 $\pm$ 0.006 (38.46%)	0.30 $\pm$ 0.003 (50.81%)	0.25 $\pm$ 0.003 (60.93%)
Group C (Test Drug 2)	AESMF) 250mg/kg, p.o.	0.14 $\pm$ 0.009 (46.15%)	0.16 $\pm$ 0.008 (58.97%)	0.21 $\pm$ 0.011 (65.57%)	0.17 $\pm$ 0.011 (73.43%)
Group D (Standard drug)	Aspirin 100mg/kg	0.11 $\pm$ 0.011 (57.69%)	0.15 $\pm$ 0.010 (61.53%)	0.17 $\pm$ 0.011 (72.13%)	0.14 $\pm$ 0.014 (78.12%)
One Way ANOVA	F	51.86	171.9	477.7	223.1
	df	16,3	16,3	16,3	16,3
	p	<0.01	<0.01	<0.01	<0.01

Table 2

n = 5 in each group; bp< 0.01when compared to Group A(control); ANOVA

DISCUSSION

The present study showed that alcoholic extracts of solanum melongena leaf and fruit at 250mg/kg possessed significant ($p < 0.01$) anti-inflammatory activity against acute inflammation induced by carrageenan. Paw oedema induced by carrageenan has two phases. In the first phase, mediators like histamine, serotonin and kinins are released. The second phase is mediated by prostaglandin-like substances that are released in 2-3 hours.¹²

Alcoholic extracts of Solanum melongena leaf and fruit at the dose 250mg/kg showed significant percentage of inhibition of carrageenan induced paw oedema when compared to the control which was maximum at 4th hour. The anti-inflammatory activity of ASEML and AESMF may be due to the inhibition of release of some mediators of inflammation which are released after carrageenan injection. Solanum melongena is a plant with many medicinal properties. The medicinal properties of the plant are derived from its chemical

constituents.¹³

A bioflavonoid glycoside named solanoflavone is present in the leaves and fruits of Solanum melongena.¹⁴

Anti-inflammatory activities of flavonoids have been reported. They are effective against both acute and chronic inflammation.¹⁵

The mechanism behind the anti-inflammatory activity of flavonoids is inhibition of eicosanoid generating enzymes including cyclooxygenases, phospholipase A2, and lipoxygenases that result the reduction of the concentrations of prostanoids and leukotrienes. Inhibition of phosphodiesterase, protein kinases, histamine release, and activation of transcriptase are other mechanisms by which they produce anti-inflammatory activity.¹⁶

The anti-inflammatory activity of alcoholic extracts of Solanum melongena leaf and fruit may be also due to its flavonoids. Both the AESML and AESMF showed significant anti-inflammatory activity in the experimental animals, however AESMF showed more anti-inflammatory activity than AESML.

After observing these results, further and detailed studies on this plant are required to confirm the true potential of this plant, for its anti-inflammatory activity, which would make it viable clinically in humans and also have cost effectiveness.

CONCLUSION

The present study demonstrates that the alcoholic extracts of Solanum melongena Linn. leaves (AESML) and fruits (AESMF) at a dose of 250 mg/kg p.o. possess significant anti-inflammatory activity against carrageenan-induced acute inflammation in albino rats. Both extracts showed time-dependent inhibition of paw oedema with maximum effect at 4th hour, indicating efficacy against the second phase of inflammation mediated by prostaglandins.

Among the two, AESMF (73.43% inhibition at 4th hr) showed greater activity than AESML (60.93% inhibition) and its effect was comparable to standard drug aspirin (78.12% inhibition). The anti-inflammatory action can be attributed to the presence of bioflavonoid glycoside solanoflavone and other flavonoids which inhibit eicosanoid generating enzymes, phospholipase A2, and histamine release.

Thus, Solanum melongena validates its traditional use in inflammatory conditions and may be a potential low-cost, safer alternative for inflammatory disorders. However, further detailed studies including chronic models, isolation of active principle, dose-response relationship and clinical trials are required to confirm its true therapeutic potential and safety for human use.

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