

Original Article

Anti-Inflammatory Effect of Methanolic Extract of *Solanum nigrum* Linn Berries

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Summary: The present study investigates the anti-inflammatory activity of methanolic extract of berries of *Solanum nigrum* Linn. The medicinal values of the berries of *Solanum nigrum* (Black night shades) have been mentioned in ancient literature as useful in disorders of inflammation. Dried pulverized berries of *Solanum nigrum* were extracted with methanol by using soxhlet apparatus. The effect of methanolic extracts of berries of *Solanum nigrum* were studied on carrageenan induced paw edema. The methanolic extract decreased the edema induced in hind paw. The methanolic extract of *Solanum nigrum* (375 mg/kg b.w.) has showed significant anti-inflammatory. It has been concluded that methanolic extract of berries of *Solanum nigrum* Linn (375 mg/kg b.w.) augments that it is having good anti-inflammatory activity against carrageenan induced paw edema.

Industrial relevance: The herbal medicines are getting more importance in the treatment of inflammation because of the toxic effect of the current therapy used to treat those inflammation using synthetic drugs. Herbal medicine are less toxic and less costly when compared to the synthetic drugs. The present study will help the industry to produce herbal drug with less side effect, less costly affordable and more effective in the treatment of inflammation. Finally the phytochemical screening or elucidation of the bioactive compounds from the plant would be effective drug against inflammation.

Key words: *Solanum nigrum*, anti-inflammatory activity, carrageenan, digital paw edema meter

Introduction

Nature has provided a complete store-house of remedies to cure all ailments of mankind (Kokate *et al.*, 2002). This is where, nature (Trees and Evans, 1983) provides us drugs in the form of herbs, plants and algae's to cure the incurable diseases without any toxic effect. Research on medicinal plants is an important fact of biochemical research (Chopra 1958) in India because of several reasons. Inflammation is a disorder involving localized increases in the number of leukocytes and a variety of complex mediator molecules. Prostaglandins are ubiquitous substances that indicate and modulate cell and tissue responses involved in inflammation. Their biosynthesis has also been implicated in the pathophysiology of cardiovascular diseases, cancer, colonic adenomas and Alzheimer's disease (Gupta *et al.*, 2006). Medicinal plants are believed to be an important source of new chemical substances with potential therapeutic effects. The research into plants with alleged folkloric use as pain relievers, antiinflammatory

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agents, should therefore be viewed as a fruitful and logical research strategy in the search for new analgesic and anti-inflammatory drugs (Gupta *et al.*, 2006). Because existing synthetic molecule like nonsteroidal anti-inflammatory drugs (NSAIDs) and selective COX-2 inhibitors that increase the incidence of adverse cardiovascular thrombotic effects (Chowdhury *et al.*, 2009). So, in order to overcome, there is need to focus on the scientific exploration of herbal drugs having fewer side effects.

The berries of *Solanum nigrum* (Solanaceae) has been reported in the ancient Indian medicinal literature with beneficial effects in inflammation, tuberculosis, diuretics etc (Chopra *et al.*, 1956). The present study was designed to investigate the anti-inflammatory effects of *Solanum nigrum* in anti-inflammatory activity in acute and chronic inflammation.

Material and Methods

Plant material

The berries of *Solanum nigrum* were collected in the month of January from the Southern part of India (Tanjore District, Tamil Nadu). The Herbarium Specimen of plant was deposited in the department of Pharmacognosy and it has been identified from Himalayan Pharmacy Institute, Majhitar. (No: 167)

Preparation of extracts

The shade-dried powders of berries extracted in a Soxhlet extractor with methanol gave 23% of extract.

Animals

Adult Wistar rats of both sexes weighing between 200-250 g were used for experiment. They were housed in standard environmental condition like, ambient temperature ($25^{\circ} \pm 1^{\circ}\text{C}$), relative humidity (55±5%) and 12/12h light dark cycle. Animals had free access to standard pellet diet and water *ad libitum*. All animal experiments were carried out in accordance with the guidelines of CPCSEA. The institute animal ethical committee gave the approval for conducting animal experiments.

Anti-inflammatory activity by Carrageenan induced rat paw edema method

Anti-inflammatory activity was assessed by the method described by (Winter *et al.*, 1962). Albino rats of either sex weighing 200 – 250 g were divided in 4 groups (N=6). Group-I received 0.5% CMC suspension (control), Group- II, III and IV received methanolic extract (125,250,375 mg/kg, P.O) of *solanum nigrum* respectively. Group-V received Diclofenac (reference standard 1mg/kg, P.O) (Brooks *et al.*, 1991). Animals were treated with drugs by oral route and subsequently 1 h after treatment; 0.1ml of 1% suspension of carrageenan in normal saline was injected into the subplanter region of left hind paw to induce edema. The paw volume was measured initially at 0, 1, 2, 3 and 4hr after carrageenan injection using digital paw edema meter (520-R, IITC Life Science - USA). The difference between the initial and subsequent values gave the actual edema volume which was compared with control.

The inhibition of inflammation was calculated using the formula, % inhibition = $100(1-V_t/V_c)$, Where 'Vc' represents edema volume in control and 'Vt' edema volume in group treated with test extracts.

Statistical analysis

Data analysis was carried out using one-way analysis of variance (ANOVA) followed by Dunnett's multiple comparison tests. P < 0.05 was considered statistically significant.

Result:

Carrageenan induced paw edema

The effect of methanolic extracts of *Solanum nigrum* (125, 250 & 375 mg/kg) in carrageenan induced paw edema in rats is shown in Table 1 and 2. The methanolic extract of *Solanum nigrum* (375mg/kg) prevented the formation of edema induced by carrageenan and thus showed significant anti-inflammatory activity (p<0.05). The methanolic extract of *Solanum nigrum* (375 mg/kg) reduced the edema induced by carrageenan by 23.45% after 3h injection of noxious agent as compared to the control vehicle treated group. Diclofenac sodium at 10mg/kg inhibited the edema volume by 12.60 %. On carrageenan induced acute inflammation model the methanolic extract (375 mg/kg) produced better inhibition of paw edema.

Anti inflammatory effect of *Solanum nigrum* Linn

Table: 1 Effect of methanolic extract of berries of *Solanum nigrum* on carrageenan induced paw edema in rats

Treatment groups (n=6)	Dose (mg/kg)	Oedema diameter(cm)				
		0hr	1hr	2hr	3hr	4hr
Normal Saline	10ml/kg	0.95 ± 0.002	0.98 ± 0.003	0.98 ± 0.003	1.01 ± 0.02	1.03 ± 0.01
Methanolic Extract	125	0.89 ± 0.01 ^a	0.86 ± 0.005 ^a	0.84 ± 0.008 ^a	0.83 ± 0.02 ^a	0.78 ± 0.03 ^a
Methanolic Extract	250	0.92 ± 0.008 ^b	0.90 ± 0.01 ^a	0.88 ± 0.008 ^a	0.85 ± 0.003 ^a	0.82 ± 0.003 ^a
Methanolic Extract	375	0.80 ± 0.008 ^a	0.79 ± 0.003 ^a	0.77 ± 0.006 ^a	0.75 ± 0.01 ^a	0.73 ± 0.003 ^a
Diclofenac	10	0.92 ± 0.003 ^b	0.91 ± 0.003 ^a	0.89 ± 0.003 ^a	0.86 ± 0.05 ^a	0.82 ± 0.003 ^a

Each value is mean ± SEM N=6 rats

^a P < 0.01

^b P < 0.05

One way ANOVA followed by Dunnet Multiple comparison test

Statistically significant when compared to control

Table: 2 Percentage inhibition of paw edema exhibited by methanolic extract of berries of *Solanum nigrum* Linn

Treatment	Percentage inhibition (%) at various times intervals				
	1hr	2hr	3hr	4hr	Mean of % inhibition
Methanolic Extract 125 mg/kg	10.24	12.28	18.82	27.00	17.08
Methanolic Extract 250 mg/kg	06.16	08.20	15.00	23.00	13.09
Methanolic Extract 375 mg/kg	17.38	19.42	25.00	32.00	23.45

Discussion

The most widely used primary test to screen new anti-inflammatory agents measure the ability of a compound to reduce local edema induced in the rat paw by injection of an irritant agent (Winter *et al.*, 1962). Carrageenan-induced oedema has been commonly used as an experimental animal model for acute inflammation and is believed to be biphasic. The early phase (1 – 2 h) of the carrageenan model is mainly mediated by histamine, serotonin and increased synthesis of prostaglandins in the damaged tissue surroundings. The late phase is sustained by prostaglandin release and mediated by bradykinin, leukotrienes, polymorphonuclear cells and prostaglandins produced by tissue macrophages (Brito and Antonio, 1998; Gupta *et al.*, 2006)

The significant inhibitory activity shown by the extract of *Solanum nigrum* berries (125, 250, and 375 mg/kg) over a period of 4 h in carrageenan-induced inflammation was quite similar to that exhibited by the group treated with diclofenac sodium. The highest percentage inhibition activity was found in the dose of 375 mg/kg with the mean percentage inhibition of 23.45 after 4 hours of extract administration. Previous study with some other plants like *Solanum trilobatum* (Pandurangan *et al.*, 2008; 2009), *Plumeria acuminata* (Gupta *et al.*, 2006) and *Thesium chinense* (Parveen *et al.*, 2007) also showed the same effect in this model. These results indicate that the extract acts in later phases in dose dependent manner, probably involving arachidonic acid metabolites, which produce an edema dependent on neutrophils mobilization (Just *et al.*, 1998). This anti-inflammatory effect of the extract observed might be due to the presence of flavonoids in the plant.

Conclusion

The result obtained from the experiment it is concluded that the methanolic extract of *Solanum nigrum* (375 mg/kg) having good anti-inflammatory activities and it shown dose dependent activities. The results support the traditional use of this plant in inflammatory conditions and suggest the presence of biologically active components which may be worth further investigation and elucidation.

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