Pharmacognosy Magazine [Phcog Mag]
Vol 5, Issue 19 (Suppl.), Jul-Aug, 2009 Page 109-118
(An Official Publication of Pharmacognosy Network Worldwide)
Received: 12 Dec, 2008
Modified: 04 Feb, 2009
Accepted: 04 Feb, 2009

PHCOG MAG.: Research Article

Evaluation of antiasthmatic activity of *Cassia sophera Linn.*

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ABSTRACT

Cassia sophera from the family caesalpiniaceae is being used in local traditional medicine for asthma and bronchitis. Powdered leaves of *C. sophera* was extracted with ethanol and subjected for sequential fractionation with chloroform, ethyl acetate and ethanol respectively. Phytochemical analysis demonstrated the presence of flavonoids and antraquinone glycosides in all of the fractions. In the present study, antiasthmatic activity of parent ethanol extract and chloroform, ethyl acetate and ethanol fractions of *C. sophera* were evaluated. For the evaluation, carrageenan induced paw edema, histamine induced bronchoconstriction, clonidine and haloperidol induced catalepsy, milk induced leukocytosis, and eosinophilia and passive paw anaphylaxis has performed. The paw edema significantly ($p<0.05$) inhibited by the parent extract, ethyl acetate, chloroform and ethanol fraction at 4th hr with the percent inhibition 54.2%, 50.4%, 44.3%, 60.7% respectively. In the present study *C. sophera* significantly ($P<0.05$) protected the bronchoconstriction in guinea pigs against histamine-induced bronchospasm. The parent extract, ethyl acetate, chloroform and ethanol fractions showed 62.7%, 60%, 55% and 64% protection at 4th hour respectively. The clonidine induced catalepsy was found to be inhibited significantly ($P<0.05$) by parent extract, ethyl acetate, chloroform and ethanol fraction at 120 min (144.00±4.830, 150.50±9.773 175.33, ±13.990, 142.50 ±4.233 sec). The parent extract, ethyl acetate, chloroform and ethanol fractions failed to revert the haloperidol induced catalepsy. In milk induced leukocytosis, milk treated group showed 4575.0 ±117.44 per cu mm leukocyte. The parent extract, ethyl acetate, chloroform and ethanol fractions reduced leukocyte count (1550.0±78.528, 2083.3±35.746, 2750.0±73.030, 1266.7±72.648 per cu mm resp.) and eosinophil count (38.333±2.216, 82.333±2.1246, 2.500±1.057, 40.500±2.078 per cu mm resp.) where milk treated group showed 137.50 ±3.471 per cu mm of eosinophils. The animals pretreated with parent extract, ethyl acetate, chloroform and ethanol fraction showed significant ($p<0.005$) inhibition in reducing paw edema in passive paw anaphylaxis with the percent inhibition 49.7%, 25.7%, 38.0%, 46.5% resp. In the present investigation, it can be concluded from the result obtained that *C. sophera* possesses significant antiasthmatic activity.

KEYWORDS: Antiasthmatic activity, Histamine, Carrageenan, *Cassia sophera*

INTRODUCTION

Asthma is chronic inflammatory disorder of the airways characterized by acute exacerbation of coughing, dyspnoea, wheezing and chest tightness particularly at night as well as in the early morning (1). Asthma is also widely recognized as a disease of lung characterized by reversible bronchoconstriction, elevated basal airway tone and lymphocyte (Eosinophilis) activation and accumulation, epithelial cell dysfunction and damage, smooth muscle and submucosal gland hypertrophy, submucosal fibrosis, airway wall edema, mucus overproduction and episodes of non-specific airway hyper-responsiveness to spasmogens (2). Asthma has been described as an obstructive disease of the respiratory tract caused by inflammation of the lower airways which involves the activation of many inflammatory and structural cells (3).

Cassia sophera (CS) is medicinally important plant belonging to family caesalpiniaceae. This plant was selected for this study, because of their use in local traditional medicine for asthma and bronchitis. It is reported to have expectorant and antiasthmatic activity. The decoction was was found effective in cases of bronchitis. Ethnobotanical literature of *C. sophera* is mentioned to be effective in the treatment of psoriasis, cough, arthritis, diabetes and convulsions of children (4). The chemical analysis of the seed of *C. sophera* revealed the presence of ascorbic acid, dehydroascorbic acid and β-sistosterol (5). *C. sophera* has shown inhibitory activity against ringworm (6). The seed extracts of *C. sophera* were reported to having hepatoprotective activity in rats (5). Aqueous and methanol extracts of seeds of *C. sophera* was shown to exhibit significant hypoglycemic activity against alloxan diabetic rabbits. Relatively, little work has been done on the phytochemistry of *C. sophera*. Antioxidant principles like Flavone-8-C-glycoside and anthraquinone have been identified in leaves of *C. sophera* (7–9).

2. MATERIALS AND METHOD

2.1 Plant material

The leaves of *C. sophera* were collected from Junner (Pune) district of Maharashtra state, India and identified at the Botanical serve of India, Pune. The sample of plant has been deposited in the department of Pharmacognocy at Dr. D.Y. Patil I.P.S.R., Pune. The voucher specimen no of plant is SSDH-1. Leaves were shade dried and coarsely grind to make powder. The powdered material was extracted with 95% ethanol, dried and then dried extract was adsorbed on silica gel (60–120) and then parent ethanol extract (CSEXT) fractionated successively with chloroform (CSCHR), ethyl acetate (CSEA) and finally with ethanol (CSETH) by using soxhlet apparatus.

2.2 Animals

Swiss albino mice (20–25 g), Wistar rat (200–250 g), Guinea pig (300–350) of either sex were used for present study. Animal were kept under a 12 h light/ 12 dark cycle, with free food and water ad libidum.

2.3 Chemicals

Ethanol, chloroform, ethyl acetate, carrageenan, indomethacin, clonidine, haloperidol, egg albumin, histamine etc.

2.4 Phytochemical studies

Parent extract and all the fractions were subjected for qualitative chemical estimation to for major phytochemical entity. The flavonoids and glycosides were fond to be present in *C. sophera*.

2.5 Anti inflammatory activity. Effect of C. sophera on carrageenan induced paw edema in mice

As per the previously described method of carrageenan-induced paw edema in mice, this work (10), the paw edema was induced in the hind paw of mice by the subplantar injection of 50 µL of carrageenan (1 % w/v). The contralateral paw injected with the same volume of the vehicle was used as control. The course of the edema was monitored by measuring the thickness of footpad swelling at 1, 2, 3 and 4 h after carrageenan injection by using a digital vernier caliper. 1hr before the carrageenan administration, animals received dose of CSEXT, CSCHR, CSEA and CSETH (250, 500 and 750 mg/kg p.o.), control group received distilled water (1 ml/kg, p.o.) While standard group received indomethacin (10 mg/kg, p.o.).

2.6 Bronchodilator activity
Effect of C. sophera n histamine induced bronchoconstriction in guinea pigs

As per the previously described method of histamine induced bronchoconstriction (11), fasted guinea pigs were divided into five groups each containing six animals. Each animal was placed in the histamine chamber and exposed to 0.2 % histamine aerosol. The preconvulsive time (PCT) was determined from the time of exposure to onset of dyspnoea leading to the appearance of preconvulsive dyspnoea (PCD). As soon as the PCD were noted, the animal were removed from the chamber and placed in fresh air. The animals of test group received treatment of CSEXT, CSCHR, CSEA and CSETH after 24 hours and standard group received chlorpheniramine maleate (2mg/kg p.o.). Next day the animals were again subjected to histamine aerosol at the interval of 1 hr, 4 hr and 24 hr of drug administration and PCT was recorded. The percent protection offered by treatment was calculated by using the following formula

Percentage Protection = $(1 -; T_1/T_2) \times 100$

Where,

T_1 = mean of PCT before administration of test drugs.

T_2 = mean of PCT after administration of test drugs at 1 hr, 4 hr and 24 hrs.

2.7 Adaptogenic activity
Effect of C. sophera on leukocytosis and eosinophilia

In this model boiled and cooled milk (4 ml/kg s.c.) was administered and leukocyte and eosinophil count

was taken before and after administration of milk was calculated (13–14). Mice were divided into six groups, six animals in each group. Animals belonging to control group received distilled water (1 ml/kg, p.o.). Animals belonging to test group received boiled and cooled milk (4 ml/kg, s.c) 1hr after administration of CSEXT, CSCHR, CSEA and CSETH (750 mg/kg, p.o.). Blood samples were collected from each mouse from the retro orbital plexus. Total leukocyte and eosinophilia count was done in each group before drug administration and 24 hr after milk injection. Difference in Total leukocyte and eosinophilia count before and 24 hr after drug administration was calculated.

2.8 Antiallergic activity

2.8.1 Effect of C. sophera n passive paw anaphylaxis in rat

This model was used to evaluate the protective effect of *C. sophera* against allergen-induced passive paw anaphylaxis and thus to study the effect of *C. sophera* on antigen-antibody reaction mediated inflammatory response (20). Anti serum to egg albumin was raised in rats using aluminum hydroxide gel as an adjuvant. Animals were given three doses of (100 mcg) egg albumin (s.c.) adsorbed on 12 mg of aluminum hydroxide gel prepared in 0.5 ml of saline on 1st, 3rd and 5th day. The blood was collected from the retro orbital plexus on 10th day of sensitization. The collected blood was allowed to clot and the serum was separated by centrifugation at 1500 rpm. Animals were divided into six groups each containing six animals. Animals belonging to control group were administered with the distilled water (1 ml/kg, p.o.). Animals belonging to standard group received dexamethasone (0.5 mg/kg, i.p.). Test groups received CSEXT, CSCHR, CSEA and CSETH (750 mg/kg, p.o.) The animals were passively sensitized with 0.1 ml of the undiluted serum into the left hind paw. The right hind paw received an equal volume of normal saline. 1 hr after test drug administration, the animals was challenged in the left hind paw with 10 μg of egg albumin in 0.1 ml of saline and the paw inflammation was measured by using a Plethysmometer. The percent inhibition of edema was calculated by using the following formula,

Percent inhibition = $[1-(T / C)] \times 100$

T- Mean relative change in paw volume in test group.

C- Mean relative change in paw volume in control group.

2.8.2 Effect of C. sophera on clonidine-induced catalepsy

Bar test was performed to study the Effect of *C. sophera* treatment on clonidine induced catalepsy (12). Mice were divided into six groups, six animals in each group. Animals of control group were administered the distilled water (1 ml/kg, p.o.). Animals of standard group received chlorpheniramine maleate (10 mg/kg, i.p.) Animals belonging to test groups received CSEXT, CSCHR, CSEA and CSETH (750 mg/kg p.o.). All the groups received clonidine (1 mg/kg, s.c.) 1 hr after the test drug administration .The forepaws of mice were placed on a horizontal bar (1 cm in diameter, 3 cm above the table) and the time required to remove the paws from bar was noted for each animal and the duration of catalepsy were measured at 15, 30, 60, 90, 120, 150 and 180 min.

2.8.3 Effect of C. sophera n haloperidol-induced catalepsy in mice

*Bar test wa*s performed to study the effect of *C. sophera* fractions on haloperidol induced catalepsy (12). Mice were divided into six groups, six animals in each group. Animals belonging to control group were administered the distilled water (1 ml/kg, p.o.). Animals of standard group received chlorpheniramine maleate (10 mg/kg, i.p.) Animals belonging to test groups received CSEXT, CSCHR, CSEA and CSETH (750 mg/kg p.o.). All the groups received haloperidol (1 mg/kg, s.c.), 1 hr after the test drug administration The forepaws of mice were placed on a horizontal bar (1 cm in diameter, 3 cm above the table) and the time required to remove the paws from bar was noted for each animal, and the duration of catalepsy were measured at 15, 30, 60, 90, 120, 150 and 180 min.

2.8.4 Mast cell degranulationEffect of C. sophera on clonidine -induced mast cell degranulation in mice

Mice were divided into six groups, six animals in each group. Animals belonging to control group were administered the distilled water (1 ml/kg/ day, p.o.). Animals of standard group received disodium cromoglycate (50 mg/kg/day, p.o.) Animals belonging to test groups received CSEXT, CSCHR, CSEA and CSETH (750 mg/kg/day p.o.). The treatment schedule was followed for three days. On day fourth each animal were injected with 4 ml/kg, 0.9% NaCl solution into peritoneal cavity. By gentle massage, peritoneal fluid was collected after 5 min. and transferred into siliconised test tube containing 7-10 RPMI- 1640 buffer medium (pH 7.2- 7.4). This solution was then centrifuged at 400- 500 rpm. Pellets of mast cell were washed with same buffer medium twice by centrifugation, discarding supernatant. The cells were challenged with clonidine (50 μg) incubated at 37 °C in a water bath for 10 min. Followed by staining with 1 % toluidine blue and observed under microscope (45 X). Total 100 cells were counted from different visual area. Percent protection against degranulation was calculated using method described by Lakdawala (21).

3. RESULTS

3.1 Anti inflammatory activity.
Effect of C. sophera on carrageenan induced paw edema in mice

CSEXT, CSCHR, CSEA and CSETH at all the doses (250 mg/kg, 500mg/kg and 750mg/kg), significantly (P<0.05) inhibited paw edema. Indomethacin (10mg/kg, p.o.) showed the significant (P<0.05) inhibition percent inhibition up to 65.4%. CSEXT, CSCHR, CSEA and CSETH showed maximum percent inhibition at dose of 750mg/kg, which was 54.2 %, 50.4 %, 44.3 %, and 60.7% respectively. Hence 750mg/kg dose of parent extract and chloroform, ethyl acetate and ethanol fraction was chosen for further pharmacological evaluation.

3.2 Bronchodilator activity
Effect of C. sophera on histamine induced bronchoconstriction in guinea pigs

The guinea pigs when exposed to histamine aerosol showed signs of progressive dyspnoea leading to convulsions. CSEXT, CSCHR, CSEA and CSETH (750mg/kg, p.o.) significantly prolonged (p<0.05) the latent period of convulsions as compared to control following exposure to histamine aerosol at 1st and 4th hour. CSETH (750 mg/kg, p.o.) showed highest activity followed by other fractions.

3.3 Adaptogenic activity
Effect of C. sophera on milk-induced leucocytosis and eosinophilia in mice

Subcutaneous injection of milk (4 ml/kg) produced a significant ($p < 0.05$) increase in the leucocytes and eosinophils count after 24 hr. The groups of mice pretreated with CSEXT, CSCHR, CSEA and CSETH (750 mg/kg, p.o.) showed significant (p<0.05) inhibition in milk-induced Leucocytosis.

3.4 Antiallergic activity
3.4.1 Effect of C. sophera on passive paw anaphylaxis in rats.

Antiserum to egg albumin was injected to rat paw, 24 hr before administration of the test drugs or standard. Egg albumin was injected after the administration of CSEXT, CSCHR, CSEA and CSETH and dexamethasone. In the vehicle or distilled water treated groups, egg albumin increased the paw volume in the sensitized animals, which was measurable up to the time period of 4 hrs. Pretreatment with CSEXT significantly reduced (p<0.05) the paw volume at 0.5, 1, 2, 3, and 4 hr time interval and the percentage inhibition was 43.6%, 51.1%, 49.7%, 46.5% and 42.8% respectively. CSEA (750 mg/kg, p.o.) significantly reduced (p<0.05) the paw volume at 0.5, 1, 2, 3 and 4hr time interval and the percentage inhibition was 39.8%, 43.7%, 41.2%, 38.0and 35.7% respectively. CSCHR(750 mg/kg, p.o.) significantly reduced (p<0.05) the paw volume at 0.5, 1, 2, 3 and 4 hrs time interval and the percentage inhibition was 30.2%, 32.2%, 30.6%, 25.7%, and 22.1% respectively. CSETH (750 mg/kg, p.o.) significantly reduced (p<0.05) the paw volume at 0.5, 1, 2, 3 and 4hr time interval and the percentage inhibition was 50.4%, 51.4%, 50.6%, 48.8 and 49.7% respectively. Dexamethasone (0.5 mg/kg, i.p.) significantly reduced (p<0.05) the paw volume at 0.5, 1, 2, 3 and 4 hrs time intervals and the percentage inhibition was 50.6%, 55.5%, 60.9%, 61.5% and 71.5% respectively.

3.4.2 Effect of C. sophera on clonidine-induced catalepsy

Clonidine (1 mg/kg, s.c.) produced catalepsy in mice, which remained for 120 min. There was significant inhibition ($p < 0.05$) of clonidine induced catalepsy in the animals pretreated with CSEXT, CSCHR, CSEA and CSETH (750 mg/kg, p.o.) and the duration of catalepsy was found to be 144.00 ±4.830, 150.50 ±9.773, 175.33 ±13.990, and 142.50 ±4.233 seconds respectively at 120 minute after the administration clonidine. Chlorpheniramine maleate (10 mg/kg, i.p.) significantly inhibited ($p< 0.05$) clonidine induced catalepsy in mice at 120 minute after the administration clonidine.

3.4.3 Effect of C. sophera on haloperidol-induced catalepsy in mice

Mice pretreated with CSEXT, CSCHR, CSEA and CSETH (750 mg/kg, p.o.) did not show any significant decrease in the duration of catalepsy induced by haloperidol. The group treated with chlorpheniramine maleate (10 mg/kg, i.p.), did not showed inhibition of the haloperidol-induced catalepsy in mice.

3.4.4 Mast cell degranulation
Effect of C. sophera on clonidine -induced mast cell degranulation in mice

Clonidine challenge resulted in significant degranulation of mast cell. Pretreatment of sensitized animal with CSEXT, CSCHR, CSEA and CSETH (750mg/kg, p.o.) showed protection against mast cell degranulation. The percent protection offered was 38.20, 42.33, 55.10 and 58.28% respectively. . CSETH (750 mg/kg, p.o.) showed highest activity followed by other fractions.

4. DISCUSSION

Asthma is an inflammatory disease involving immunity. Treatment involves many facets which have ability to

manage asthma. The present study was planned to evaluate the action of *C. sophera* on various aspects of asthma like bronchoconstriction, eosinophilia and allergy associated with inflammation using various in vitro and in vivo animal models.

Anti inflammatory activity:

Asthma is categorized by characteristic edema of the airways. Carrageenan induced inflammation model was done for the evaluation of anti-inflammatory activity. In the present study, CSEXT, CSCHR, CSEA and CSETH exhibited significant anti-inflammatory activity in mice.

Bronchodilator activity:

In the CSEXT, CSCHR, CSEA and CSETH significantly protected the guinea pigs against histamine-induced bronchospasm. *C. sophera* significantly prolonged the latent period of convulsions as compared to control following the exposure of histamine aerosol. The protection offered by *C. sophera* is probably due to the H_1 antihistaminic activity.

Adaptogenic activity:

A blood eosinophilia is hallmark of both allergic and non-allergic asthma. Activated eosinophil cause desquamation and damage to respiratory epithelial cells. The eosinophil count increases in body fluids and tissues, emphasis is placed on the number of eosinophils in blood. A recurrent milk aspiration produces changes in airway mechanics; lung eosinophilia in animal model.

The leukocyte count particularly eosinophils, increases after parenteral administration of milk (17), and this stress full condition can be normalized by administration of an adaptogenic drug. In the this study the control group of mice, after administration of milk showed significant increase in leukocyte and particularly eosinophils count, whereas the groups in which *C. sophera* were administered, have shown normalization of both count. This indicates the adaptogenic activity of the *C. sophera*

Antiallergic activity:

In the present study, subcutaneous administration of egg albumin to rat raises the antiserum to egg albumin in the plasma and sub plantar injection of plasma containing these antibodies, then challenged with egg albumin leads to passive paw anaphylaxis in rats (18). Study revealed that there was significant reduction in the paw edema volume in the animals pretreated with *C. sophera*. The protective effect of *C. sophera* in reducing paw edema in passive paw anaphylaxis may be due to inhibition of antigen-antibody reaction. CSETH showed highest protection amongst all the fractions. The antianaphylactic and antiallergic activity shown by *C. sophera* is probably due to the flavonoids present. The flavonoids have long been recognized to possess anti-allergic, anti-inflammatory activities (19). Recently, the biphasic allergic reactions have become of interest because of the similarity to the clinical manifestations of chronic asthma. After challenge with the relevant antigen, sensitized animals exhibit immediate responses, such as bronchoconstriction of the airways, and late phase responses, such as edema and mucus overproduction which usually persist over a 6 to 24 h period (20) Flavonoids are found to be active at both the phases of allergic response .

The α_2 adrenoreceptor agonist like clonidine induces dose dependent catalepsy in mice. This type of catalepsy is inhibited by histamine H_1 receptor antagonists. H_2 receptor antagonists do not play any role (15). In the present study, pretreatment with *C. sophera* significantly inhibited the clonidine-induced catalepsy in mice. The effect of *C. sophera* on clonidine-induced catalepsy may be due to its antihistaminic (H_1 receptor antagonist) activity.

Haloperidol induces catalepsy by inhibiting dopamine D_2 receptor in substantia nigra (16). The present study demonstrated that there was no inhibition of haloperidol-induced catalepsy in the groups pretreated with all fractions of *C. sophera.*

Mast cell stabilization:

Intensive research has highlighted the role of lymphocytes, immunoglobulins, mast cells and various autacoids in the pathogenesis of allergic conditions. The disruption of mast cells is an important feature of anaphylaxis. Both clonidine and compound 48/80 act through the dynamic expulsion of granules without causing any damage to the cell wall (22). Lakadawala (21) have shown that clonidine releases histamine from mast cells in a similar manner to a selective liberator like compound 48/80. It is known that disodium cromoglycate a standard mast cell stabilizer prevents degranulation of mast cells by raising the cyclic adenosine monophosphate (23). It has been known that all pharmacological agents that increase intracellular levels of AMP relax airway smooth muscle and inhibit the release of autocoids from the tissue and basophils. Present study shows statistically significant stabilization of mast cell by CS.

5. CONCLUSION

It can be concluded in the present investigation that *C. sophera* possesses significant anti-asthmatic activity. The anti-asthmatic activity of leaves of *C. sophera* can be

attributed to bronchodilating, antihistaminic, antiallergic, anti-inflammatory, and adaptogenic activity, suggestive of its potential in prophylaxis and management of asthma.

From the results obtained it was concluded that ethanol fraction showed highest activity apart from other fractions and parent extract. It may be due to presence of flavonoids. Hence further study is required to be conducted to

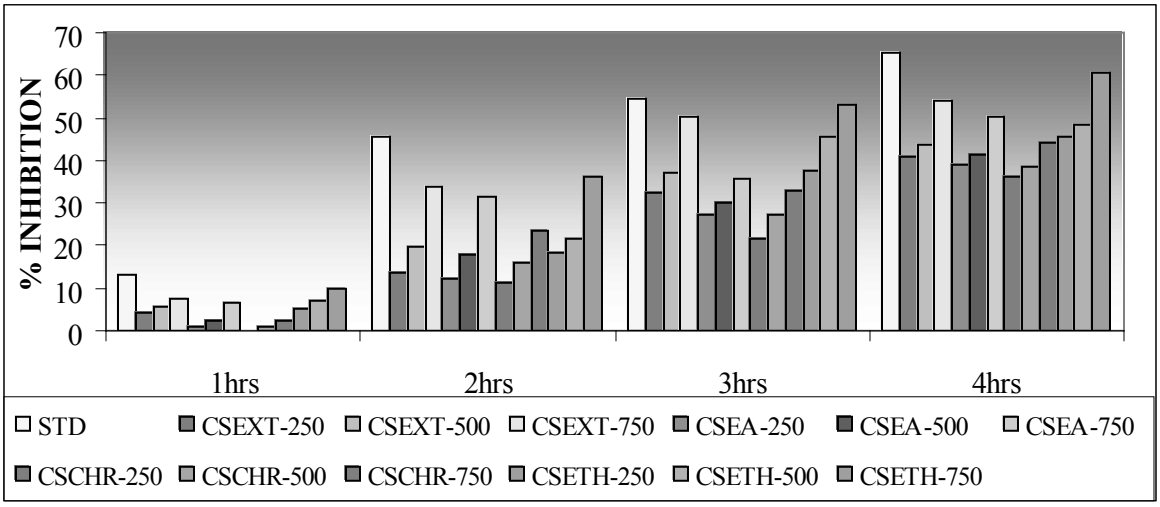

Figure 3.1: Percent inhibition of inflammation caused by carrageenan in mice.
Where, n-6,
STD = Indomethacin (10 mg/kg, p.o.).
CSEXT = Parent ethanol extract of CS (250, 500 and 750 mg/kg, p.o.)
CSEA = Ethyl acetate fraction of CS (250, 500 and 750 mg/kg, p.o.)
CSCHR = Chloroform fraction of CS (250, 500 and 750 mg/kg, p.o.)
CSETH = Ethanol fraction of CS (250, 500 and 750 mg/kg, p.o.)
Statistical analysis done by ANOVA followed by Dunnett's test.

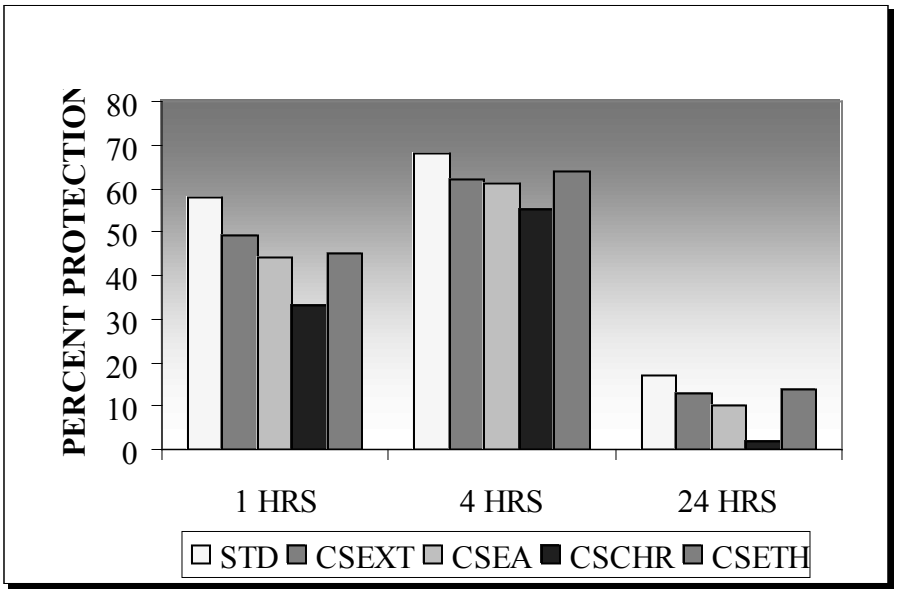

Figure 3.2: Percent protection against histamine induced bronchoconstriction in guinea pig.
Where, n = 6
STD = Chlorpheniramine maleate (2 mg/kg, p.o.).
CSEXT = Parent ethanol extract of CS (750 mg/kg, p.o.)
CSEA = Ethyl acetate fraction of CS (750 mg/kg, p.o.
CSCHR = Chloroform fraction of CS (750 mg/kg, p.o.)
CSETH = Ethanol fraction of CS (750 mg/kg, p.o.)

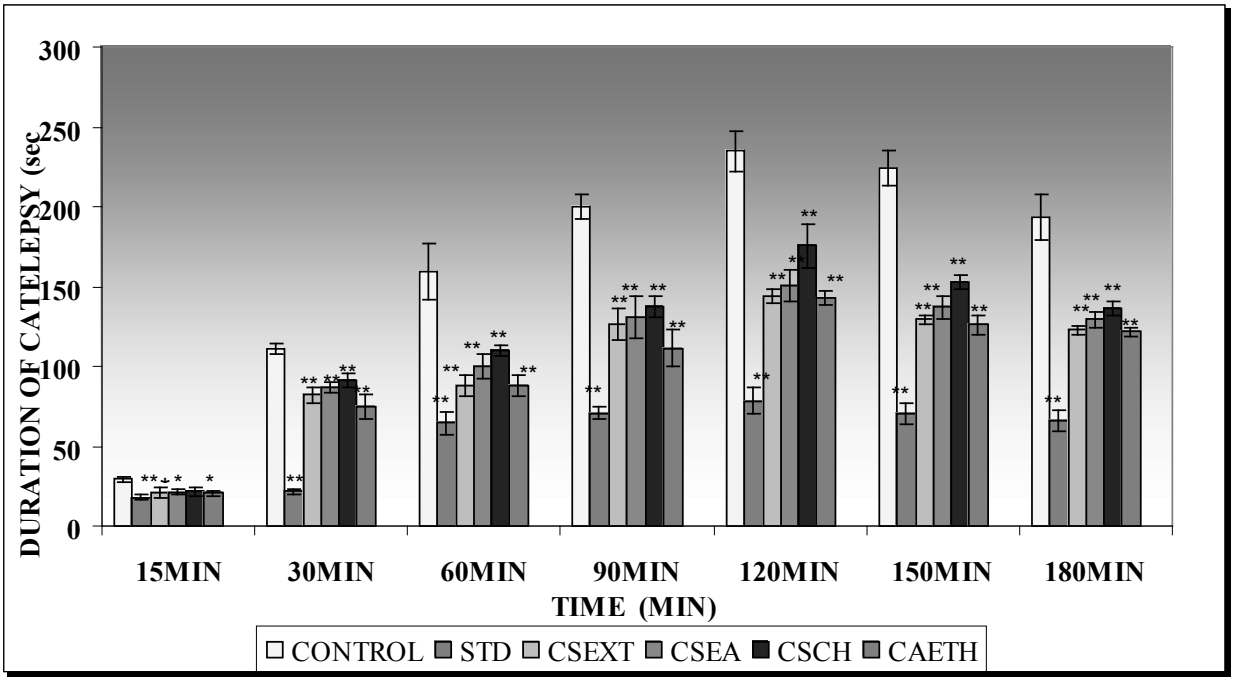

Figure 3.3: Effect of CS on clonidine-induced catalepsy in mice.
Values in Mean ± SEM
Where, n = 6
CONTROL = Distilled water (10 ml/kg, p.o.)
STD = Chlorpheniramine maleate (10mg/kg, i.p.).
CSEXT = Parent ethanol extract of CS (750 mg/kg, p.o.)
CSEA = Ethyl acetate fraction of CS (750 mg/kg, p.o.
CSCHR = Chloroform fraction of CS (750 mg/kg, p.o.)
CSETH = Ethanol fraction of CS (750 mg/kg, p.o.)
Statistical analysis done by ANOVA followed by Dunnett's test. *P<0.05 and ** P<0.01 when compared with control.

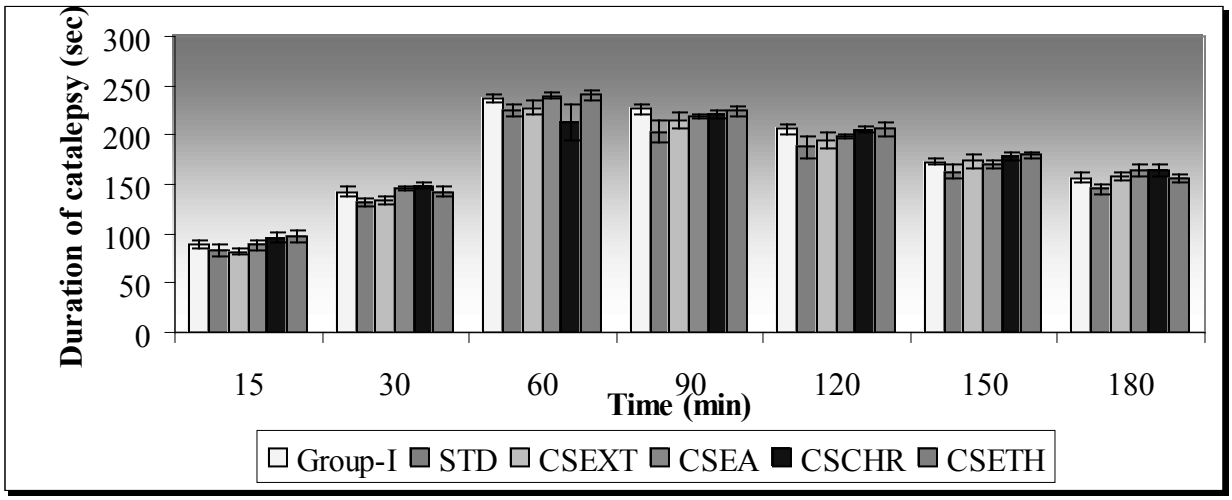

Figure 3.4: Effect of CS on haloperidol-induced catalepsy in mice.
Value in mean ± SEM
Where, n = 6
CON = Distilled water (10 ml/kg, p.o.)
STD = Chlorpheniramine maleate (10 mg/kg, i.p.)
CSEXT = Parent ethanol extract of CS (750 mg/kg, p.o.)
CSEA = Ethyl acetate fraction of CS (750 mg/kg, p.o.
CSCHR = Chloroform fraction of CS (750 mg/kg, p.o.)
CSETH = Ethanol fraction of CS (750 mg/kg, p.o.)
Statistical analysis done by ANOVA followed by Dunnett's test.

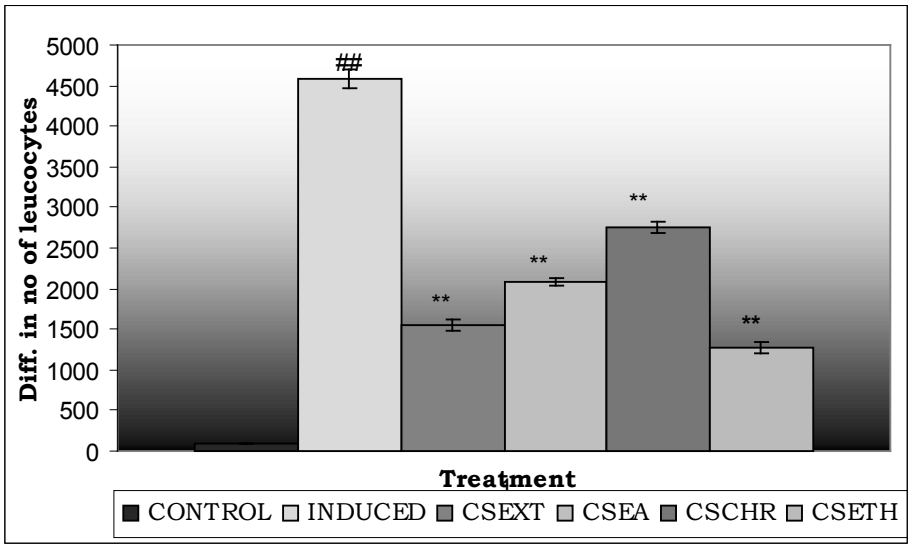

Figure 3.5: *Effect of CS on milk-induced leucocytosis in mice*
Value in mean ± SEM
Where, n = 6,
CON = Distilled Water (10 ml/kg, p.o.)
INDUCED = Distilled water (10 ml/kg, p.o.) + Milk (4 ml/kg, s.c.)
CSEXT = Parent ethanol extract of CS (750mg/kg, p.o.) + Milk (4 ml/kg, s.c.)
CSEA = Ethyl acetate fraction of CS (750 mg/kg, p.o.) + Milk (4 ml/kg, s.c.)
CSCHR = Chloroform fraction of CS (750 mg/kg, p.o.) + Milk (4 ml/kg, s.c.)
CSETH = Ethanol fraction of CS (750 mg/kg, p.o.) + Milk (4 ml/kg, s.c.)
Statistical analysis done by ANOVA followed by Dunnett's test. $^{\#\#}p < 0.01$ when compared with control, $^{**}p < 0.01$ when compared with Induced.

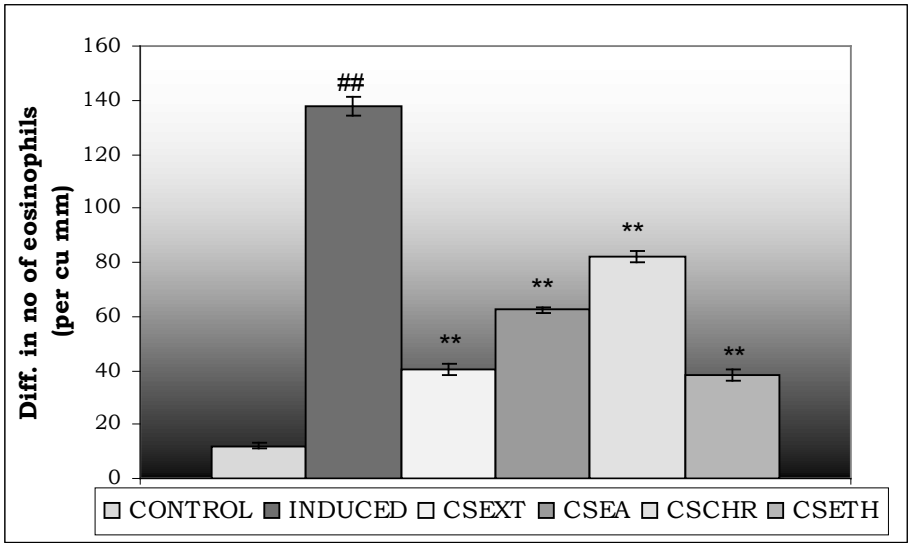

Figure 3.6: Effect of CS on milk-induced eosinophilia in mice.
Value in mean ± SEM
Where, n = 6
CON = Distilled Water (10 ml/kg, p.o.)
INDUCED = Distilled water (10 ml/kg, p.o.) + Milk (4 ml/kg, s.c.)
CSEXT = Parent ethanol extract of CS (750mg/kg, p.o.) + Milk (4 ml/kg, s.c.)
CSEA = Ethyl acetate fraction of CS (750 mg/kg, p.o.) + Milk (4 ml/kg, s.c.)
CSCHR = Chloroform fraction of CS (750 mg/kg, p.o.) + Milk (4 ml/kg, s.c.)
CSETH = Ethanol fraction of CS (750 mg/kg, p.o.) + Milk (4 ml/kg, s.c.)
Statistical analysis done by ANOVA followed by Dunnett's test.
$^{\#\#}p < 0.01$ when compared with control, $^{**}p < 0.01$ when compared with Induced.

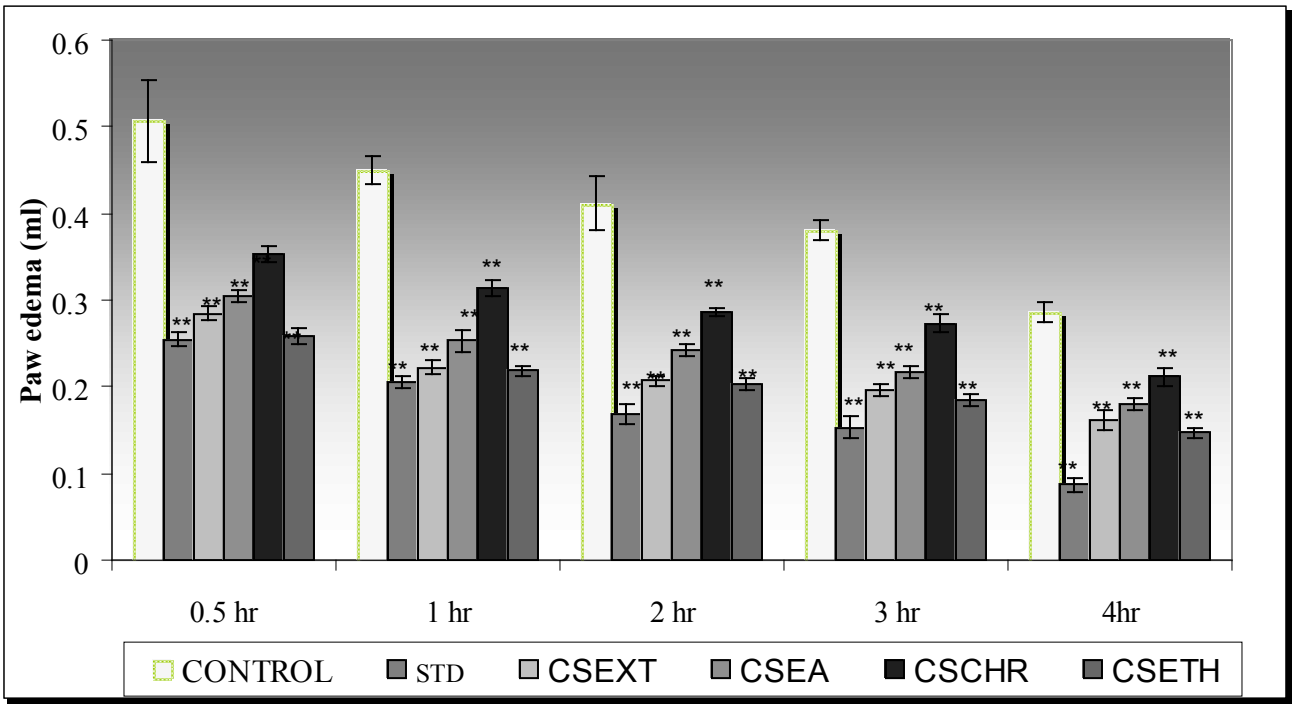

Figure 3.7: Effect of CS on passive paw anaphylaxis in rats.
Where, n = 6
CONTROL = Distilled water (5 ml/kg, p.o.)
STD = Dexamethasone (0.5 mg/kg, i.p.)
CSEXT = Parent ethanol extract of CS (750 mg/kg, p.o.)
CSEA = Ethyl acetate fraction of CS (750 mg/kg, p.o.
CSCHR = Chloroform fraction of CS (750 mg/kg, p.o.)
CSETH = Ethanol fraction of CS (750 mg/kg, p.o.)
Statistical analysis done by ANOVA followed by Dunnett's test. **p < 0.01 when compared with control.

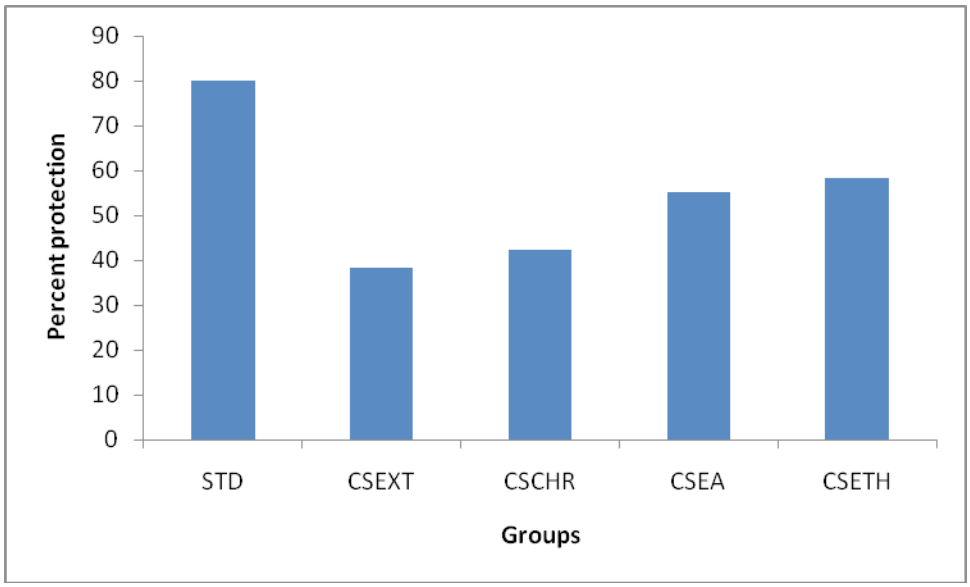

Figure 3.8: Effect of C. sophera on clonidine -induced mast cell degranulation in mice
Where, n = 6
STD = Disodium chromoglycate (50 mg/kg, p.o.).
CSEXT = Parent ethanol extract of CS (750 mg/kg, p.o.)
CSEA = Ethyl acetate fraction of CS (750 mg/kg, p.o.
CSCHR = Chloroform fraction of CS (750 mg/kg, p.o.)
CSETH = Ethanol fraction of CS (750 mg/kg, p.o.)

evaluate the active principles present in ethanol fraction and mode of action of the active constituents. Clinical efficacy in the treatment of asthmatic patients needs to be evaluated.

REFERENCES

1. Rang H.P., Dale M.M., Ritter J.M. *Pharmacology*. 4th ed., Churchill Livingston Publication London: 342–343.
2. Lynette B.F., Roy G.G. The single mediator approach to asthma therapy is it so unreasonable? *Curr Opin Pharmacol* **3**: 251–258. (2003)
3. Kay A.B. Immunomodulation in asthma: Mechanisms and possible pitfalls. *Curr. Opin Pharmacol* **3**: 220–226. (2003).
4. Nadkarni A.K. "*Indian Materia Medica*", Volume I, 3rd edition, Popular Prakashan, Mumbai, 596–99. (1976)
5. Khan N., Gufran A., Hepotoprotective effect of seeds of cassia sophera . Var. purpurea, roxb. Against CCl4 induced hepatic damage in albino mice, *Pharmacognosy mag*. **11**: 68–69, (2005)
6. Sharma M. C., Joshi C., Plant used in skin diseases of animal. *Natural product radians* **3**: 293–299(2004)
7. Anonymous. 1992. *The wealth of India*, published by CSIR, New Delhi, vol-**3** (ca-ci): 366
8. Malhotra S., Mishra K., A new antraquinone from Cassia sophera heartwood. *Planta Medica* **46**: 247–249(1982)
9. Tiwari R. D., Bajpai M. A new flavonol-8-C-glycoside from the leaves of Cassia sophera *Phytochemistry* **5**: 437–438 (1980)
10. Castelucci S., Alexandre De P. P., Ambrosia S. R., Arakawa N. S., De lara S. P., Faccioli L. H., De costa F. B., Anti-inflammatory activity of Dasyphyllum Brasilliensis (Asreraceae) on acute peritonitis induced by ?-glucan from Histoplasma capsulatum. *Journal of Ethnopharmacology* **112**: 192–198 (2007)
11. Tripathi R. M., Das P.K. Studies on Antiasthmatic and antianaphylactic activity of Albizzia lebbeck. *Indian Journal of Pharmacology* **9**: 189–194 (1977)
12. Taur D. J., Nirmal S. A., Patil R.Y., Effect of various extracts of Ficus bengalensis bark on clonidine and haloperidol-induced catalepsy in mice. *Pharmacologyonline* **3**: 470–77. (2007)
13. Brekhman I.I., Dardymov I.V. New substances of plant origin which increases non specific resistance. *Ann. Rev. Pharmac* **9**: 419–430. (1969)
14. Vadnere G.P., Somani R.S., Singhai A.K., Studies on Antiasthmatic activity of aqueous extract of Clerodendron phlomidis. *Pharmacologyonline* **1**: 487–494. (2007)
15. Jadhav J.H., Balsara J.J., Chandorkar A.G., Involvement of histaminergic mechanisms in the cataleptogenic effect of clonidine in the mice. *J. Pharm. Pharmacol.* **35**: 671–73. (1983).
16. Tripathi K. D.; *Essentials of Medical Pharmacology*; 4th edition; Jaypee Brothers Medical Publisher (p) Ltd.; New Delhi. 173–176: 222–238, & 381–393. (2003)
17. Bhargava K. P., Singh N. Antistress activity of Ocimum sanctum. *Indian J. Med. Res* **73**: 443–451 (1981)
18. Pungle P., Banavalikar M., Suthar A., Mengi S., Immunomodulatory activities of boswellic acids of Boswellic serrata Roxb. *Indian J. Exp Biol* **41**: 1460–62. (2003)
19. Middleton E.J., Kandaswami C.; *The Flavonoids*, Harborne JB, ed.,: pp. 619±652, Chapman & Hall, London 1993.
20. Charlesworth E.N.; *J. Allergy Clin. Immunol.*; **94**: 1240–1250 (1994)
21. Lakadawala AD, Dadkar MK, Dohadwala AN. Action of clonidine on mast cells of rat. *J Pharm Pharmacol*, **32**:790–791.(1980)
22. Stanworth DR, Immediate Hypersensitivity, In: *The molecular basis of allergic response*, edited by Neuberger A, Tatum EL, North Holland Publishing Company, Amersterdam, 73.(1973)
23. Geetha VS, Viswanathan S, Kameswaran L, Comparison of total alkaloids of Tylophora indica and effect of disodium cromoglycate on mast cell stabilization. *Indian J Pharmacol*, **13**:199–201.(1981)