Acta Poloniae Pharmaceutica – Drug Research, Vol. 68 No. 6 pp. 897–904, 2011 ISSN 0001-6837
Polish Pharmaceutical Society

NATURAL DRUGS

PHARMACOLOGICAL STUDIES ON SEEDS OF *ALANGIUM SALVIFOLIUM* LINN.

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Abstract: The seeds of *Alangium salvifolium* Linn. have been traditionally reported to exhibit a variety of biological activities, including antidiabetic, anticancer, diuretic, anti-inflammatory, antimicrobial, laxative, and antiepileptic activities. The objective of this study was to verify the traditional claims and to evaluate the seeds of *Alangium salvifolium* in various organic extracts to screen the antidiabetic, antiepileptic, analgesic and anti-inflammatory activities. The chloroform, ethanol, and water extracts of *Alangium salvifolium* seeds were obtained and subjected for phytochemical screening and evaluated for their pharmacological activities. From the acute toxicity study it was observed that chloroform, ethanol, and aqueous extracts of *Alangium salvifolium* seeds are non-toxic at a fixed dose of 2000 mg/kg. Among all three extracts ethanol extracts exhibited significant ($p < 0.01$) antidiabetic, antiepileptic, analgesic and anti-inflammatory activities. The phytochemical analysis revealed the presence of alkaloids, glycosides, terpenoids, steroids and tannins. The results of present study verified the traditional claims made by ayurvedic practitioner. However, the chemical constituents responsible for the pharmacological activities remain to be investigated.

Keywords: antidiabetic, analgesic, anti-inflammatory, *Alangium salvifolium*, alloxan

The *Alangium salvifolium* (Alangeaceae) also called as Ankola is extensively cultivated in India. It is a popular folk medicine and has been studied for its anti-inflammatory, antimicrobial, antifertility and cardiotonic activities (1–4). Its dried seeds, has traditionally been used to treat various ailments in Asia (5). Traditionally, *Alangium salvifolium* seeds have been reported to exhibit a variety of biological activities, including antidiabetic, anticancer, diuretic, anti-inflammatory, antimicrobial, laxative, and antiepileptic activity (6, 7). To the best of our knowledge no report is available on the antidiabetic, antiepileptic, analgesic and anti-inflammatory activities of *Alangium salvifolium* seeds. The present study was undertaken to verify the claim and evaluate the pharmacological activities of the seeds of *Alangium salvifolium* by preparing its various organic extracts.

MATERIALS AND METHODS

Plant materials

Alangium salvifolium seeds, collected from local market of Lucknow, in month of December 2008 and authenticated in the Taxonomic Division, National Botanical Research Institute, Lucknow (U.P.) and a voucher specimen (NBRI/CIF/Re/08/2008/32) was deposited in the National Botanical Research Institute, Lucknow, for future reference.

Preparation of extracts

The seeds were dried under shade, powdered and passed through a 44 mesh sieve, then they were extracted with chloroform, ethanol and water for 48 h. All the extracts were evaporated by Büchi rotary evaporator using vacuum and stored in desiccators for further studies.

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Physicochemical and phytochemical screening of organic extracts

Physicochemical investigations of plant extracts were carried out to determine the amount of inorganic and moisture content and to estimate the net dry weight of the crude drug. The parameters studied on the basis of methods described in Indian Pharmacopoeia (1996), included determination of ash values (total ash value, acid insoluble ash and water soluble ash), loss on drying and determination of extractive values (water and alcohol soluble extractive values) (8). Freshly prepared organic extracts were also tested for the presence of alkaloids, steroid and/or triterpenoids and their glycosides, tannins, flavonoids and their glycosides, carbohydrates and cardiac glycosides using standard procedures.

Animals

Healthy male or female albino Wistar rats (150–200 g) and Swiss albino mice (25–40 g) were used for studies of the acute toxicity and pharmacological activity. The animals were stabilized for 1 week; they were maintained in standard conditions at room temp., 60 ± 5% relative humidity and 12 h light/dark cycle. They had been given standard pellet diet and water *ad libitum* throughout the course of the study. The animals were handled gently to avoid giving them too much stress, which could result in an increased adrenal output. All animal experiments were carried out according to CPCSEA (Committee for the Purpose of Control and Supervision of Experiments on Animals) and IAEC (Institutional Animal Ethical Committee) approved guidelines (BBDNITM/IAEC/Clear/02/2009).

Acute toxicity study

The acute toxicity study was carried out in adult Swiss albino mice by "fix dose" method according to OECD (Organization for Economic Co-operation and Development) Guideline No. 420. Test procedure with fixed dose of 2000 mg/kg b.w. was adopted. The animals were fasted overnight and on the next day extracts of the plant *Alangium salvifolium* (suspended in 0.5 % w/v sodium CMC) were administered orally at dose level of 2000 mg/kg. Then, the animals were observed continuously for 3 h for general behavioral, neurological, autonomic profiles and then every 30 min for next 3 h and finally for mortality after 24 h till 14 days (9, 10).

Table 1. Effect of *Alangium salvifolium* seeds extracts on blood glucose level in oral glucose tolerance test (OGTT).

Treatment (mg/kg *p.o.*)	Blood glucose level (mg/dL)				
	0 min	30 min	60 min	120 min	180 min
Normal control	56.78 ± 0.04	150.43 ± 1.86	148.46 ± 2.2	157.67 ± 1.2	141.34 ± 0.9
Metformin (11.3)	58.78 ± 0.07	134.56 ± 1.45**	122.45 ± 1.5**	108.67 ± 0.9**	98.76 ± 0.8**
Chloroform extract (500)	60.46 ± 0.06	145.35 ± 1.51	141.98 ± 1.6*	123.98 ± 1.3**	107.67 ± 0.9
Ethanolic extract (500)	59.34 ± 1.15	142.76 ± 1.34*	127.84 ± 1.7**	118.6 ± 1.4**	102.34 ± 0.8**
Aqueous extract (500)	57.47 ± 0.06	148.67 ± 1.45	142.38 ± 1.8*	126.72 ± 0.6**	122.45 ± 1.1**

Data are the mean ± SD values for six mice in each group. *$p < 0.05$, **$p < 0.01$ as compared to the control.

Table 2. Effect of *Alangium salvifolium* seeds extracts on blood glucose level of alloxan-induced diabetes in rats.

Treatment (mg/kg *p.o.*)	Blood Glucose Level (mg/dl)			
	0 day	3rd day	5th day	7th day
Normal control	86.11 ± 1.27	85.67 ± 1.14	84.68 ± 0.88	86.23 ± 1.28
Diabetic control	192.34 ± 1.34	210.44 ± 1.45	232.42 ± 1.22	247.68 ± 1.10
Metformin (11.3)	188.45 ± 1.56	156.88 ± 0.96**	125.77 ± 1.34**	104.10 ± 1.32**
Chloroform extract (500)	191.18 ± 0.98	208.58 ± 1.76	198.57 ± 1.12*	178.45 ± 1.38**
Ethanol extract (500)	186.17 ± 1.08	198.23 ± 1.44**	162.47 ± 1.08**	109.45 ± 1.67**
Aqueous extract (500)	194.99 ± 1.43	207.45 ± 1.24*	189.64 ± 1.04**	172.38 ± 1.76**

Data are the mean ± SD values for six mice in each group. *$p < 0.05$, **$p < 0.01$ as compared to the control.

Table 3. Effect of *Alangium salvifolium* seeds extracts on body weight.

Treatment (mg/kg *p.o.*)	Initial weight	Final weight
Normal control	162.47 ± 2.54	179.67 ± 2.42
Diabetic control	165.24 ± 3.44	125.8 ± 5.24
Metformin (11.3)	164.34 ± 1.98	158.23 ± 2.34**
Chloroform extract (500)	168.54 ± 4.56	141.21 ± 4.20
Ethanolic extract (500)	162.56 ± 3.42	150.91 ± 3.56**
Aqueous extract (500)	166.87 ± 4.52	146.19 ± 4.42*

Data are the mean ± SD values for six mice in each group. *p < 0.05, **p < 0.01 as compared to the control.

Table 4. Effect of *Alangium salvifolium* seed extracts on biochemical parameter of the liver.

Treatment (mg/kg *p.o.*)	Serum bilirubin (mg/dL) (total)	Serum bilirubin (mg/dl) (direct)	SGOT (IU/L)	SGPT (IU/L)	ALP (U/L)
Normal control	0.28 ± 0.04	0.14 ± 0.04	123.08 ± 10.28	88.75 ± 3.45	205.39 ± 8.45
Diabetic control	1.24 ± 0.04	0.47 ± 0.03	272.34 ± 9.87	158.45 ±3.45	293.56 ± 13.32
Metformin (11.3)	0.34 ± 0.03**	0.10 ± 0.02**	156.340 ± 7.89**	98.67 ± 11.21**	222.34 ± 14.42**
Chloroform extract (500)	1.05 ± 0.02*	0.26 ± 0.03*	216.230 ± 12.45	137.65 ± 6.24	247.86 ± 14.24*
Ethanolic extract (500)	0.98 ± 0.01**	0.18 ± 0.01**	178.76 ± 6.68**	114.56 ± 5.67**	234.65 ± 14.56**
Aqueous extract (500)	1.12 ± 0.02	0.36 ± 0.03	225.440 ± 7.80	135.54 ± 5.65*	254.76 ± 17.35

Data are the mean ± SD values for six mice in each group. *p < 0.05, **p < 0.01 as compared to the control. SGOT = serum glutamic oxaloacetic transaminase, SGPT = serum glutamic pyruvic transaminase, ALP = alkaline phosphatase.

Table 5. Effect of *Alangium salvifolium* seed extracts on lipid profile.

Treatment (mg/kg *p.o.*)	Serum			
	Cholesterol (mg/dL)	Triglycerides (mg/dL)	HDL (mg/dL)	LDL (mg/dL)
Normal control	111.72 ± 4.67	85.96 ± 6.85	33.22 ± 2.24	88.45 ± 11 22
Diabetic control	160.87 ± 6.78	160.67 ± 8.85	25.430 ± 4.56	198.56 ± 14.56
Metformin (11.3)	85.98 ± 6.24**	85.67 ± 7.56**	44.45 ± 2.24**	95.20 ± 11.45**
Chloroform extract (500)	107.87 ± 8.43*	102.23 ± 8.45*	41.23 ± 1.98*	158.78 ± 14.56*
Ethanolic extract (500)	98.78 ± 8.20**	91.23 ± 6.23**	47.34 ± 3.45**	116.0 ± 13.67**
Aqueous extract (500)	125.87 ± 6.43	112.32 ± 3.42	40.23 ± 3.65*	145.540 ± 11.26**

Data are the mean ± SD values for six mice in each group. *p < 0.05, *p < 0.01 as compared to the control. HDL = High density lipoprotein, LDL = Low density lipoprotein.

Pharmacological activity

Antidiabetic activity

Effect of *Alangium salvifolium* seed extracts on glucose tolerance in rats

All the animals were fasted overnight before experimentation but allowed free access to water. Fasted rats were divided into five groups of six rats each. Group I served as a control and received vehicle only. Group II received metformin which was used as standard. Groups III–V received chloroform, ethanol and aqueous extracts, respectively, at a dose of 500 mg/kg b.w. as a fine aqueous suspension (suspended in 0.5 % w/v sodium CMC) orally. The rats of all groups were given glucose (2 g/kg b.w., *p.o.*) 30 min after administration of the drug. Blood samples were collected from the tail vein just prior

Table 6. Effect of *Alangium salvifolium* seed extracts on serum creatinine, urea and protein.

Treatment (mg/kg *p.o.*)	Serum creatinine (mg/dL)	Serum urea (mg/dL)	Serum protein (g/dL)
Normal control	0.48 ± 0.10	24.31 ± 1.23	7.54 ± 1.14
Diabetic control	1.450 ± 0.34	54.56 ± 2.34	4.05 ± 0.90
Metformin (11.3)	0.52 ± 0.12**	30.25 ± 1.57**	6.92 ± 0.64**
Chloroform extract (500)	0.78 ± 0.09*	48.56 ± 1.88*	5.65 ± 0.48*
Ethanolic extract (500)	0.61 ± 0.13**	42.35 ± 2.24**	6.57 ± 0.68**
Aqueous extract (500)	0.75 ± 0.20*	49.66 ± 1.56*	4.98 ± 0.84

Data are the mean ± SD values for six mice in each group. *$p < 0.05$, **$p < 0.01$ as compared to the control.

to glucose administration and at 30, 60, 120 and 180 min after the glucose loading. Blood glucose levels were measured by glucometer (Accu Chek) (Table 1) (11, 12).

Effect of *Alangium salvifolium* seed extracts on alloxan-induced diabetic rats

Male Wistar rats (180–200 g) were made diabetic by a single *i.p.* injection of 120 mg/kg body weight of alloxan monohydrate in sterile normal saline. The rats were maintained on 10% glucose solution for next 24 h to prevent hypoglycemia. Three days later, blood samples were drawn from tail vein and glucose levels were determined to confirm the development of diabetes (175–350 mg/dL). The diabetic rats were divided into six groups, each containing six animals. Group I served as normal control and received the vehicle only. Group II served as a disease control and received alloxan only. Group III served as a positive control and received metformin (11.3 mg/kg), while *Alangium salvifolium* chloroform, ethanol, and aqueous extracts of seeds were given to groups IV–VI, respectively, at a dose of 500 mg/kg, *p.o*. The blood glucose concentrations of the animals were measured at the beginning of the study and the measurements were repeated on 0, 3rd, 5th and 7th day after the start of the experiment. On day 7, blood was collected by cardiac puncture under mild ether anesthesia. The inference was made by determining blood glucose level, body weight, serum creatinine, serum urea, serum triglycerides, serum total cholesterol, serum glutamic oxaloacetic transaminase (SGOT), Serum glutamic pyruvic transaminase (SGPT), bilirubin (total and direct) and alkaline phosphatase (ALP) with positive control (metformin) and negative control (alloxan treated) group (13–16) (Tables 2–6).

Anti-inflammatory activity

Animals were divided in five groups. Group 1 served as control received 0.1 mL of 1% carrageenan (Merck), into the plantar region of the left hind paw of rat. Groups 2, 3 and 4 received chloroform, water and ethanol extracts at 500 mg/kg, respectively, one hour prior to carrageenan treatment as in group 1. Group 5 received diclofenac sodium *p.o.* at 30 mg/kg, one hour prior to carrageenan treatment. The anti-inflammatory effects of all the extracts were evaluated by measuring the paw volume after 0, 1, 2, 3 and 4 h of carrageenan administration by using a plethysmometer (17).

Analgesic activity

Eddy's hot plate method

Animals (Swiss mice) were selected one day prior to each test and were divided into five groups of six mice each. One group served as control and was treated with 10 mL/kg of saline *p.o.*. The second group was given ibuprofen (30 mg/kg) by the same route, as a reference drug. The remaining groups were treated with seed extracts at a dose of 500 mg/kg *p.o*. Analgesic activity was studied by using the following two well established models: The reaction time of animals was noted down on hot plate at 0, 60, 120 and 180 min after the treatment. The basal reaction was the time taken by observing hind paw licking or jump response (whichever appeared first) in animals while placed on hot plate, which was maintained at constant temperature 55°C. A cut off period of 10 s was observed to avoid damage to the paws. The percentage increase or decrease in reaction time (as index of analgesia) at each time interval was calculated (18):

$$\text{Percentage increase in reaction time} = \left(\frac{R_t}{R_c} - 1\right) \times 100$$

where R_t is reaction time in treated group and R_c is reaction time in control group.

Acetic acid induced writhing method

Male albino mice weighing between 20–25 g were selected for the study. The animals were divided into 5 groups (n = 6 in each group). All animals received 0.1 mL of acetic acid 0.6% v/v. *i.p.* and the first group served as a control. Group II served as a positive control and received diclofenac. The groups III, IV and V received 100, 200 and 400 mg/kg b.w. of hydro-ethanolic extract of *Alangium salvifolium*, respectively, 30 min prior to the administration of acetic acid *i.p.* The writhing effect was indicated by the stretching of abdomen with simultaneous stretching of at least one hind limb. This was observed for 30 min and change in number of writhing in the test group compared with standard treated and control treated groups (19) was noted. The percentage inhibition was calculated by using the formula:

Percentage inhibition = $1 - (N_T/N_C) \times 100$

where N_T is average number of writhing in treated group and N_C is average number of writhing in control group.

Anticonvulsant activity

Maximal electroshock (MES)-induced seizures

The animals were chosen by preliminary screening. Mice which showed extension of hind limb were included in the study. The seizures were induced by MES in Swiss mice with the help of electroconvulsiometer by passing current of 45 mA for 0.2 s using ear clip electrodes. The ethanolic extract (250 and 500 mg/kg b.w.), standard drug (diazepam, 5 mg/kg b.w.) and distilled water were given one hour prior to induction of convulsions. The animals were observed for the various phases. The abolition of extensor (tonic phase) in drug treated group was taken as criteria for anticonvulsant activity (20, 21).

Statistical analysis

All data were presented as the mean ± SD. Statistical comparison of data was made by means of one way ANOVA using Dunnett's test; $p < 0.05$ was considered as significant.

RESULTS AND DISCUSSION

Physicochemical parameters were determined and it was found that seeds of *Alangium salvifolium* showed total ash value 3.20%, acid insoluble ash 1.20%, water soluble ash 1.0%, moisture content 16.30%, alcohol soluble extractives 11.70% and water soluble extractives 26.70%. Phytochemical screening showed the presence of alkaloids, steroids, triterpenoids and flovanoids. The acute toxicity study showed that the test animals at fixed dose of 2000 mg/kg b.w. level did not showed significant changes in behavior before and after the administration of an oral dose of extracts of seeds of *Alangium salvifolium*. In acute toxicity, there was no mortality recorded in all the groups, i.e., chloroform, ethanol, and aqueous extracts treated groups, at fixed dose of 2000 mg/kg b.w.

The extracts of *Alangium salvifolium* seed extracts have shown a significant ($p < 0.01$) increase in glucose tolerance (Table 1). The chloroform, ethanol and aqueous extracts reduced the glucose levels to normal. Maximum effect was observed for ethanol extract. These results indicate that the extracts which show significant activity, may have the capacity to block glucose absorption through the GIT, similar to acarbose and other molecules. Treatment of alloxan induced diabetic animals with standard drug (metformin), chloroform, ethanol and water extracts of seeds of plant *Alangium salvifolium* Linn. showed significant reduction in blood glucose level, increased body weight and impaired serum biochemical parameters as compared to disease control group.

Alangium salvifolium seed extracts significantly inhibited diabetes induced by alloxan. For ethanolic extract and metformin, the antidiabetic activity was significant ($p < 0.01$) in all respects as compared to chloroform and aqueous extracts (Table 2). Alloxan treatment caused permanent destruction of β-cells. It can therefore be said conclusively that the responses shown by various extracts exert their effect by extra pancreatic mechanism to normalize alloxan-induced hyperglycemia. This mechanism may act by affecting appropriate changes at the cellular levels by stimulating glucose reuptake and metabolism by specific cells (22). The ethanolic extract as well as the chloroform and aqueous extracts showed significant ($p < 0.01$) restoration of the body weight in diseased animals to normal level (Table 3).

Hypercholestrolemia, hypertriglyceridemia and hyperuricemia have been reported to occur in alloxan diabetic rats and a significant increase observed in our experiment was in accordance to these studies. Repeated administration of *Alangium salvifolium* extracts had decreased the blood glucose, urea, total cholesterol and triglycerides significantly, whereas increased the HDL-cholesterol level (23, 24). Serum SGOT, SGPT, ALP and bilirubin levels were elevated significantly ($p < 0.01$) in alloxan-induced diabetes rats as compared to normal rats. In alloxan diabetic rats when treated with seed

Table 7. Effect of *Alangium salvifolium* seed extracts on carrageenan induced paw edema in rats.

Treatment (mg/kg, *p.o.*)	Edema volume (mL) Time interval 0 h	1 h	2 h	3 h	4 h
Control	1.05 ± 0.01	2.28 ± 0.02	3.34 ± 0.06	3.52 ± 0.04	4.12 ± 0.02
Chloroform extract (500)	0.98 ± 0.03	2.03 ± 0.05 (10.96)	2.12 ± 0.05 (36.52)*	2.12 ± 0.02 (39.77)*	2.85 ± 0.07 (30.82)
Ethanol extract (500)	1.23 ± 0.01	1.44 ± 0.08 (36.84)	1.44 ± 0.06 (56.88)**	1.58 ± 0.06 (55.11)**	1.42 ± 0.08 (65.53)**
Water extract (500)	1.08 ± 0.09	2.16 ± 0.07 (5.26)	2.85 ± 0.08 (14.67)	3.01 ± 0.04 (14.48)	2.98 ± 0.07 (27.67)*
Diclofenac sodium (30)	0.97 ± 0.08	1.25 ± 0.04* (45.17)	1.46 ± 0.04* (56.28)	1.27 ± 0.05** (63.92)	1.24 ± 0.04** (69.90)

Data are the mean ± SD values for six mice in each group. *p < 0.05, **p < 0.01 as compared to the control.

Table 8. Analgesic activity of seeds extracts of *Alangium salviifolium* by using acetic acid induced writhing in mice.

Treatment (mg/kg, *p.o.*)	No. of writhing in 10 min	Percentage inhibition
Vehicle	34.45 ± 2.24	
Ibuprofen (30)	18.56 ± 2.68	46.12**
Chloroform extract (500)	28.32 ± 2.80	17.79
Ethanol extract (500)	20.30 ± 2.56	41.07**
Water extract (500)	25.00 ± 2.36	27.43*

Data are the mean ± SD values for six mice in each group. *p < 0.05, **p < 0.01 as compared to the control.

Table 9. Analgesic activity of seeds extracts of *Alangium salviifolium* by using hot plate method.

Treatment (mg/kg, *p.o.*)	Reaction time (in s) (mean ± SD) 0 min	60 min	120 min	180 min
Vehicle	3.46 ± 0.82	4.34 ± 0.80	4.56 ± 0.52	4.72 ± 0.48
Ibuprofen (30)	3.15 ± 0.42	4.78 ± 0.92	6.56 ± 0.48**	7.85 ± 0.62**
Chloroform extract (500)	3.54 ± 0.11	4.64 ± 0.84	5.40 ± 0.32	5.70 ± 0.58
Ethanolic extract (500)	3.75 ± 0.98	4.62 ± 0.48	5.84 ± 0.88*	6.25 ± 0.50**
Water extract (500)	3.56 ± 0.86	4.24 ± 0.68	5.86 ± 0.90*	6.05 ± 0.90**

Data are the mean ± SD values for six mice in each group. *p < 0.05, **p < 0.01 as compared to the control.

Table 10. Anticonvulsant activity by maximal electroshock method.

Treatment	Duration in various phases (time in s) (mean ± SD) Flexor	Extensor	Clonic	Stupor	Recovery or death	Inhibition %
Control	1.70 ± 0.23	27.64 ± 0.92	–	–	Death	-
Ethanolic extract (250 mg/kg)	1.84 ± 0.87	6.86 ± 0.72**	9.58 ± 0.90	95.58 ± 1.08	Recovery after 113.86 ± 0.54 s	75.18%
Ethanolic extract (500 mg/kg)	2.85 ± 0.70	4.35 ± 0.50**	13.24 ± 1.12	25.35 ± 1.04	Recovery after 45.79 ± 0.84 s	84.26%
Diazepam (5 mg/kg)	1.42 ± 0.80	3.26 ± 0.84**	7.15 ± 0.92	21.54 ± 1.02	Recovery after 33.37 ± 0.54 s	88.20%

Data are the mean ± SD values for six mice in each group. *p < 0.05, **p < 0.01 as compared to the control.

extracts of *Alangium salvifolium*, there was a significant ($p < 0.01$) reduction in the elevated levels of SGOT, SGPT, ALP and bilirubin levels. Increased urea and creatinine formation in the diabetic conditions may be due to increased protein catabolism, which results in increased elimination of urea, nitrogen and creatinine (25). Administration of *Alangium salvifolium* seed extracts to diabetic rats reduced the elevated levels of urea and creatinine to normal, thus showing the normalizing effect of extracts on the synthesis of urea and creatinine (Tables 4–6).

Phytochemical analysis revealed that the major chemical constituents of the extract were alkaloids, flavonoids, steroids and phenolic compounds. Over 150 plant extracts and some of these active principles including flavonoids are known to be used for the treatments of diabetes. Hence on the basis of the above evidences, it is possible that the presence of flavonoids and alkaloids are responsible for the observed antidiabetic activity. The possible mechanism by which seeds bring about a decrease in blood sugar level may be by potentiation of the insulin effect of plasma by increasing either the pancreatic secretion of insulin from β-cells of the islets of Langerhans or its release from the bound form (26–28).

The ethanolic extract of *Alangium salvifolium* exhibited significant anti-hyperglycemic activities in alloxan-induced diabetic rats. This extract has showed improvement in parameters like body weight, liver function and lipid profile by enhancing effect on cellular antioxidant defenses to protect against oxidative damage. The results of our study suggest that the seeds of *Alangium salvifolium* has beneficial effects on blood glucose levels, carbohydrate metabolizing enzymes and in protein metabolism (urea, creatinine, and bilirubin). Thus, the claim made by the traditional practitioner of Indian system of medicine regarding the use of seeds of this plant in the treatment of diabetes is confirmed. Further pharmacological and biochemical investigations are in progress to elucidate the exact mechanism of action.

Table 7 shows the results of anti-inflammatory activity of *Alangium salvifolium* in carageenan induced paw edema in rats. The percent inhibition in paw volume of rats at 0, 1, 2, 3 and 4 h was calculated. The ethanolic extract (500 mg/kg) was found to be more effective than all other treatments ($p < 0.05$) and showed 36.84, 56.88, 55.11 and 65.53% inhibition in paw volume at 1, 2, 3 and 4 h, respectively. In acetic acid-induced writhing in mice, ethanolic extract (41.07%) and water extract (27.43%) showed significant analgesic activity, whereas the chloroform extract (17.79%) was ineffective. All three extracts showed analgesic activity but out of these extracts for the ethanol extract it was the most significant. Ibuprofen, the reference drug, inhibited 46.12% of the number of writhing elicited by acetic acid (Table 8). The results of hot plate method also indicated that the ethanol extracts (500 mg/kg) of the seeds of *Alangium salviifolium* Linn. has significant analgesic activity ($p < 0.05$), which might be mediated by peripheral effect (Table 9).

The ethanolic extract of *Alangium salviifolium* at a dosage of 250 and 500 mg/kg showed 67.77% and 80.70% inhibition of convulsions produced by MES. The ethanolic extract at the dose of 500 mg/kg showed activity comparable to that of standard drug diazepam (83.01% inhibition). The effect of MES was dose-dependent. It increased the time to the onset of seizures from 36.53 ± 4.1 min to 47.32 ± 8.0 min at the dose of 250 mg/kg *i.p*. and from 37.54 ± 4.5 min to 61.23 ± 10.24 min at the dose of 500 mg/kg *i.p*. At this dose MES was nearly as efficacious as diazepam, 10 mg/kg.

In conclusion, the results of present study revealed that the ethanol extract (500 mg/kg) showed significant anti-inflammatory, analgesic and anti-epileptic activity as compared to water and chloroform extracts. This study emphasizes the need to carry out in-depth pharmacological evaluations of traditional medicines and ascertain their therapeutic potentials, which may be tapped for better use as alternate and safe herbal drugs. Our study supports the folklore claim of the use of the plant as an analgesic and anti-inflammatory agent.

The preliminary phytochemical analysis of the plant showed the presence of flavonoids, phytosterols, tannins, alkaloids and glycosides as a major phytoconstituents. The ethanolic extract exhibited significant antidiabetic, anti-inflammatory, anticonvulsant and analgesic activities, which might be due to the bioactive compounds and thus seems to be a promising plant for further research to explore its exact mechanism of action and isolation of active constituents responsible for the activity.

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Received: 15. 09. 2010