TO EVALUATE THE ANTI-INFLAMMATORY ACTIVITY OF THE METHANOL EXTRACT OF THE LEAVES OF *ABUTILON HIRTUM*

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ABSTRACT
The different experimental models used for the evaluation of anti-inflammatory are Carrageen induced paw edema; Histamine induced paw edema. The methanol extract of the leaf of *Abutilon hirtum* showed significant decreased inflammation in both the models selected for screening of anti-inflammatory activity. In both the models the p value of the extract II is p< 0.001 and extract I is p<0.01. From the above results it is concluded that the methanol extract of the leaves of *Abutilon hirtum* confirms the anti-inflammatory activity by its phyto-constituent, biological and histo-pathological observations.

KEYWORDS: *Abutilon hirtum*, anti-inflammatory activity.

INTRODUCTION
In 1948, World Health Organization defined health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. Since the earlier time man is trying to find the sources in order to preserve the health. [1] According to World Health Organization traditional medicine is defined as diverse health practices, approaches, knowledge and beliefs in incorporating plant, animal and/or mineral based medicines, spiritual therapies, manual techniques and exercises applied singularly or in combination to maintain well-being as well as to treat, diagnose or prevent illness. [2] Traditional medicines involve the use of herbal medicines, animal parts and minerals. They are intended particularly to serve as a reference source for researchers, health care providers, manufacturers, traders and health authorities. [3] Developed countries in recent times, are turning to the use of herbal drugs and remedies. Approximately about 1400 herbal preparations are in current medical use, according to a recent survey in member states of European Union. [4] In olden days,
traditional practitioners were used to collect the material directly from the wild, but presently everything is available in markets. This commercialization has led to the problem of adulteration. Plants are the essential and integral part in complementary and alternative medicine and contain many secondary metabolites like proteins, flavonoids, alkaloids, steroids and phenolic substances which are used to restore health and heal many diseases. \[^{5}\] The natural remedies are more acceptable in the belief that they are safer with fewer side effects than the synthetic one. It is estimated that approximately 50% Western drugs today contain plant materials in their medical practice. Many commercially proven drugs used in modern medicine were initially used in crude form in traditional or folk healing practices. The primary benefits of using plant derived medicines are that they are relatively safer than synthetic alternatives, offering profound therapeutic benefits and more affordable treatment. \[^{6}\]

**Inflammation**

The word inflammation is derived from the Latin "inflammare" (to burn). It is one of the most important processes involved in the defense of an organism against local injury and infections; however it often progresses to painful or chronically harmful diseases requiring pharmacological treatment. \[^{7}\]

Inflammation is the local response of living mammalian tissue to injury due to any agent. The cardinal signs of inflammation are redness, warmth, swelling, and pain. The process itself is not considered a disease, but failure to contain it, results in exacerbation of tissue damage and modulation of cell signaling pathways. \[^{8,9}\]

Typical inflammatory diseases such as rheumatoid arthritis, asthma, colitis and hepatitis are among the leading causes of death and disability in the world. \[^{10}\] Inflammatory response is a series of well-coordinated dynamic mechanism consisting of specific vascular, humoral and cellular events that is characterized by the movement of fluids, plasma and inflammatory cells like leukocytes (neutrophils, eosinophil, basophils and macrophages) to site of inflammation. \[^{11}\] A variety of chemical mediators or signaling molecules such as histamine, serotonin, leukotrienes, prostaglandins and oxygen derived free radicals are produced by inflammatory and phagocytic cells predominantly in the sequences which participate in onset of inflammation. \[^{12}\]
Inflammation can also occur due to allergy. Allergy is a genetic condition that causes the body to respond to some substances in the environment as even though they are harmless to the body. This response produces symptoms that range from mild to life threatening episodes in susceptible people. Allergy is an adverse immune reaction produced by the body to a protein or allergen in our environment that is normally harmless to the non–allergic individual. There are so many methods and inflammatory agents are available to screen inflammation. Carrageen is one of the chemical agent which is most widely used to induce inflammation.\textsuperscript{13-14}

**METHODOLOGY**

**Materials**

I. Collection of plant material and extraction

The leaves of the plant of *Abutilon hirtum* was collected at flowering stage from the areas of Chittor district, Andhra Pradesh, India and authenticated by Dr. B. Jyothi, Lecturer in Botany, Sri Padmavathi Women’s Degree and PG College, Tirupathi, Andhra Pradesh. The leaves were separated from the fresh stem and dried on filter paper sheets under shade at room temperature. The shade-dried leaves were coarsely powered and extracted with petroleum ether (60\textdegree-80\textdegree) for 48 hours in Soxhlet apparatus to remove fatty matter. The defatted marc was then dried and subjected for extraction with chloroform to obtain chloroform extract. The dried marc was then refluxed with methanol to obtain methanol extract. The methanol extract was evaporated under reduced pressure at low temperature. The extract so obtained was labeled, weighed and the yield was calculated in terms of grams percent of the weight of the powdered leaves. Later extract is stored in desiccators in a tightly packed container for further experimental studies.\textsuperscript{15}

**Phytochemical investigation of leaf extract of Abutilon hirtum**\textsuperscript{16,17}

The preliminary phytochemical analysis was carried out on pet ether, chloroform and methanol extracts of the leaves of *Abutilon hirtum* which were subjected to the following chemical tests in order to identify the presence of various phyto-constituents. The results and the observations were tabulated in the Table No. 4.1.

II. EXPERIMENTAL ANIMALS

Healthy Wistar rats weighing between 150-200 gm. were procured from the animal house of Dayanada Sagar College of Pharmacy, Bangalore, India where the animals were kept in well ventilated spacious animal house with 12± 1 hour day/night schedule. The animals were
lodged in large and spacious hygienically maintained cages during the course of the experimental period. The temperature was maintained at $25 \pm 1^0\text{C}$. The animals were fed with standard rat feed (VRK’S Nutritional solutions, Bangalore) and water *ad libitum*. The experiments were conducted as per the guidelines of CPCSEA, Chennai, India and Institutional Ethical Clearance Registration No. IAEC/95/13-14.

**Determination of acute toxicity (LD$_{50}$)**

Animals were fasted prior to dosing (mouse food was withheld for 3-4 hour but not water). Methanol extract was dissolved in 1% CMC and was administered to animals through oral feeding syringe. Animals were observed individually after dosing at least once during the first 30 min, periodically during the first 24 hour, with special attention given during the first 4 hour and daily thereafter, for a total of 14 days. The observations include evaluation of skin and hair, eyes, mucous membranes, somatomotor activity and behavior pattern. Particular attention was directed towards tremors, convulsions, salivation, diarrhoea, coma and mortality.

When testing a dose of 5000 mg/kg, b.w only one step (i.e. three animals) is required. First dosing is given to one animal. If the first animals die, then dosing proceeds to 2000 mg/kg b.w. If the first animal survives, further two animals were dosed. If only one of the three animals dies, the LD$_{50}$ value is expected to exceed 5000 mg/kg, as per OECD guidelines 423 annexure 3. If both animals die, then dosing proceeds to 2000 mg/kg as per OECD guidelines 423(2d). [18]

**III. EVALUATION OF ANTI-INFLAMMATORY ACTIVITY OF THE METHANOL EXTRACT OF THE LEAVES OF ABUTILON HIRTUM:**

a. Carrageen induced paw edema:

**Preparation of test samples**

Suspensions of crude extract of methanol were prepared in water so as obtain the dosage form of 250 and 500 mg/kg body weight. These suspensions were administered orally to the animals.

**Preparation of standard drug formulation**

Diclofenac (5mg) was suspended in water and administered orally to the animals at the dose of 5 mg/kg b.w.
Procedure

Group I - Control receives the vehicle

Group II - Standard group receives Diclofenac at a dose (5mg/kg, p.o)

Group III - Lower dose of methanol extract of *Abutilon hirtum* (250mg/kg, p.o)

Group IV - Higher dose of methanol extract of *Abutilon hirtum* (500mg/kg, p.o)

Male albino rats weighing between 150 - 200 g were used for the study and fasted overnight prior and during the experiment but have free access to water. The rats were divided into 4 groups of 6 animals each. A mark was made on the hind paw just below the tibio-tarsal junction so that every time the paw could be dipped in the mercury column of the Plathysmograph up to the mark to ensure constant paw volume. After 1 hour of above treatment, paw inflammation was induced by injecting 0.1 ml of 1% of carrageenan in 0.9% sodium chloride into plantar surface of the right hind paw of all the animals. Paw volumes were measured using a Plathysmograph at different time intervals of 0, 30, 60, 120 and 240 minutes. The reduction in the paw volume was calculated. The percentage inhibition of edema was calculated using the following formula:

\[ \text{% Inhibition of Edema} = \left[ 1 - \left( \frac{V_t}{V_c} \right) \right] \times 100. \]

Where Vt is edema volume of the drug treated group and Vc is the edema volume of the control group. \(^{[19-21]}\)

b. Histamine induced paw edema

Group I - Control receives the vehicle

Group II - Standard group receives Diclofenac at a dose (5mg/kg, p.o)

Group III - Lower dose of methanol extract of *Abutilon hirtum* (250mg/kg, p.o)

Group IV - Higher dose of methanol extract of *Abutilon hirtum* (500mg/kg, p.o).

Male albino rats weighing between 150 - 200 g were used for the study and fasted overnight prior and during the experiment but have free access to water. The rats were divided into 4 groups of 6 animals each. A mark was made on the hind paw just below the tibio-tarsal junction so that every time the paw could be dipped in the mercury column of the Plathysmograph up to the mark to ensure constant paw volume. After 1 hour after administration of above treatment, paw inflammation was induced by injecting 0.1 ml of 1% of histamine into sub-plantar surface of the right hind paw of all the animals. Paw volumes were measured using a Plathysmograph at different time intervals of 0, 30, 60, 120 and 240 minutes. The reduction in the paw volume was calculated. The percentage inhibition of edema was calculated using the following formula.
\% Inhibition of Edema = [1 - (V_t / V_c)] \times 100.
Where \( V_t \) is edema volume of the drug treated group and \( V_c \) is the edema volume of the control group. \(^{[20,21]}\)

RESULTS
In the preliminary phytochemical studies, experiments were conducted to determine the pharmacognostic features of the selected plant *Abutilon hirtum*. In the present study, the pharmacognostic features of pet ether, chloroform, methanol and aqueous extracts have been analyzed. The percentage yield of methanol is 25.75\% which is maximum. The details of the quantity of the powder taken for extraction and nature of the extracts are given in Table No.5.1.

Table No. 5.1: Nature and yield of the various extracts of the leaves of *Abutilon hirtum*

<table>
<thead>
<tr>
<th>Extracts</th>
<th>Quantity used for extraction</th>
<th>Nature of the extract</th>
<th>Percentage yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petroleum ether</td>
<td>Powder (gm) Solvent (ml)</td>
<td>Slightly yellowish sticky mass</td>
<td></td>
</tr>
<tr>
<td>(60-80\°)</td>
<td>100 250</td>
<td></td>
<td>12.25%</td>
</tr>
<tr>
<td>Chloroform</td>
<td>100 250</td>
<td>Dark-green semi solid</td>
<td>18.75%</td>
</tr>
<tr>
<td>Methanol</td>
<td>100 250</td>
<td>Dark-green sticky solid</td>
<td>25.75%</td>
</tr>
</tbody>
</table>

Table No. 5.2: Phytochemical investigation of leaf extract of *Abutilon hirtum*

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Tests for phytochemicals</th>
<th>Petroleum ether extract</th>
<th>Chloroform extract</th>
<th>Methanol extract</th>
<th>Aqueous extract</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Alkaloids</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mayer’s test</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Wagner’s test</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Dragendorff’s test</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Hager’s test</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>Glycosides</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Borntrager’s test</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Legal’s test</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>Carbohydrates</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mohlisch test</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Fehling’s test</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Barfoed’s test</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Benedict’s test</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>4</td>
<td>Gums</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>5</td>
<td>Mucilage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>6</td>
<td>Proteins and Amino acids</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Millon’s test</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Biuret test</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Ninhydrin test</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
In table no 5.2. Preliminary phytochemical investigation of the extracts i.e., Pet. ether, chloroform, methanol and aqueous extracts of the leaves of *Abutilon hirtum* taken for analysis contain some of the important pharmacologically active constituents such as, alkaloids, carbohydrates, proteins, amino acids, glycosides, phenolic compounds, tannins, flavonoids, gums, mucilage and saponins. From the above investigations it is clear that the methanol extract of the plant contain major pharmacologically active constituents like alkaloids, glycosides, phenolic compounds and flavonoids. Hence methanol extract was considered further investigation on anti-inflammatory and wound healing activity in rats.

**Pharmacological investigations:**

a. **Acute toxicity studies**

An acute toxicity study was conducted for methanol extract. The maximum tolerated dose was found to be 5000 mg/kg b.w. Treatment with the above extract the animals did not show any changes in the following indicators viz., body weight, behavioral pattern, hypothermia /hyperthermia. The weights of the vital organs (Liver, Kidney, Brain and spleen) were also found to be unaltered. By observing the above parameters the dose selected will not interfere with any of the body functions. As per OECD guidelines the maximum therapeutic dose is 1/10th of the maximum tolerated dose, hence the therapeutic dose selected were 500 mg/kg, b.w and 250 mg/kg b.w.

b. **Anti-inflammatory**

Inflammation is caused by local response of prostaglandin, histamine, and bradykinin. Carrageen induces the inflammation through the release of inflammatory mediators like
prostaglandin, histamine, bradykinin, whereas 5-hydroxytryptamine additionally increases the permeability of blood vessels for various collagen. [33]

**Carrageen induced paw edema**

The animals were pre treated with the methanol extract of the leaves of *Abutilon hirtum* at the doses of 250mg/kg, 500mg/kg and standard Diclofenac 5mg/kg b.w. respectively. Among the selected doses extract II (500mg/kg) showed maximum reduction in the paw volume induced by carrageen which is 1.061±0.0020 when compared to the control 1.169±0.0055. Extract I (250mg/kg) showed a little reduction in the paw volume of 1.1186±0.0094. The results are tabulated in Table No. 5.3 and Fig. No. 5.1. The results were significant at P<0.001.

**Table No. 5.3: Anti-inflammatory activity of the methanol extract of the leaves of *Abutilon hirtum* on Carrageenan (1%) induced paw edema.**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Dose (mg/kg oral)</th>
<th>Difference in paw edema volume (Mean ±SEM)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0Min.</td>
</tr>
<tr>
<td>Control</td>
<td>10ml/kg</td>
<td>1.15±0.006</td>
</tr>
<tr>
<td>Standard (Diclofenac)</td>
<td>5</td>
<td>0.99±0.008 ***</td>
</tr>
<tr>
<td>Extract-I</td>
<td>250</td>
<td>1.08±0.003 *</td>
</tr>
<tr>
<td>Extract-II</td>
<td>500</td>
<td>1.05±0.011 **</td>
</tr>
</tbody>
</table>

All the values are expressed as Mean ± S.E.M (n=6) by one way ANOVA followed by Tukey’s multiple comparison test. ***p<0.001, **p<0.01, *p<0.05 when compared to normal control group.

**Fig. No. 5.1: Anti-inflammatory activity of the methanol extract of the leaves of *Abutilon hirtum* on Carrageenan (1%) induced paw edema.**
Histamine induced paw edema
The animals were pretreated with the extracts of the leaves of *Abutilon hirtum* at the doses of 250mg/kg, 500mg/kg and Diclofenac 5mg/kg b.w. respectively. Among the two doses extract II (500 mg/kg) showed maximum reduction in the paw volume induced by histamine which is 0.944±0.0108 as compared to control 1.151±0.0058. Extract I (250mg/kg) showed little reduction in the paw volume of 1.046±0.0095 as compared to control. The results were significant at P<0.001 and are tabulated in Table No. 5.4 and Fig. No. 5.2.

**Table No. 5.4: Anti-inflammatory activity of methanol extract of the leaves of *Abutilon hirtum* on Histamine (1%) induced paw edema.**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Dose (mg/kg oral)</th>
<th>Difference in paw edema volume (Mean ±SEM)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0 Min.</td>
</tr>
<tr>
<td>Control</td>
<td>10ml/kg</td>
<td>1.133±0.0088</td>
</tr>
<tr>
<td>Standard</td>
<td>5</td>
<td>0.793±0.0088***</td>
</tr>
<tr>
<td>Extract I</td>
<td>250</td>
<td>1.03±0.0152*</td>
</tr>
<tr>
<td>Extract II</td>
<td>500</td>
<td>0.926±0.0338***</td>
</tr>
</tbody>
</table>

All the values are expressed as Mean ± S.E.M (n=6) by one way ANOVA followed by Tukey’s multiple comparison test. ***p<0.001, **p<0.01, *p<0.05 when compared to normal control group.

**Fig. No. 5.2:** Anti-inflammatory activity of methanol extract of the leaves of *Abutilon hirtum* on Histamine (1%) induced paw edema.
DISCUSSION

Anti-inflammatory activity

Inflammation is caused by the release of local hormones like prostaglandin, histamine and bradykinin. Carrageen induces inflammation through the release of prostaglandin, bradykinin and histamine whereas hydroxytryptamine additionally increase the permeability of total blood vessels for various collagens.[22] The most widely used primary test to screen new anti-inflammatory agents is to measure the ability of a compound to reduce local edema induced in the rat hind paw by injection of an irritant substances. Edema is due to the exudation of fluids and plasma proteins and the migration of leucocytes, most notably neutrophils and macrophages into the injured area.[23]

Carrageenan induced paw edema has been commonly used as an experimental model for the determination of acute inflammation. The early phase (1-2 hr) of inflammation in the carrageenan model is mainly attributed to the release of histamine, serotonin and increased synthesis of prostaglandins into the surrounding area of damaged tissue. The late phase is the accelerated phase of swelling, due to sustain release of prostaglandins and other mediators of inflammation like bradykinin, protease, leukotriene and infiltration of PMNS (polymorphonuclear neutrophils) and macrophages.[24] It has been reported that the second phase of edema is sensitive to both steroidal and anti-inflammatory drugs, which is generally used to access the edematous effect of natural products.[25] Prostaglandins play a major role in the development of secondary phase of reaction, which is measured at around 3 hr of time.[26] Edema and pain are the characteristic signs of an inflammatory response where the role of prostaglandins and histamine is well established.[27]

Cyclooxygenase (COX) is a key enzyme in the biosynthesis of prostaglandin from arachidonic acid and has two iso-types. COX-1 is responsible for producing the basal levels of prostaglandin needed for gastrointestinal tract homeostasis, whereas COX-2 is an inducible enzyme which is involved in inflammatory events. Well known non-steroidal anti-inflammatory drugs (NSAIDS) such as aspirin, ibuprofen and naproxen inhibit COX-2. [28] The carrageen induced paw edema in rats is known to be sensitive to Cyclooxygenase (COX-2) and has been used to evaluate the effect of anti-inflammatory agents against PGE-2 production and on COX-2 protein and mRNA expression.

The development of carrageenan induced inflammatory reaction in rats results from the activation of Kinin system, the accumulation of leucocytes and release of several
inflammatory mediators such as prostaglandin and cytokines.\(^{[29]}\) Pro-inflammatory cytokines, tumor necrosis factor α (TNF-α), interleukin-1β and interleukin-6 (IL-6) are sequentially released in the pleural exudates induced by carrageenan in rats. These cytokines cause chemotaxis and attracts granulocytes and monocytes to the site of inflammation. The migrated leukocytes in turn produce cytokines such as TNF-α and IL-6 and other pro-inflammatory mediators.\(^{[30]}\) IL-6 has been proposed as a crucial mediator for the development of carrageenan induced edema and further accumulation of leukocytes at the inflammatory sites.

In the present study methanol extract of the leaves of *Abutilon hirtum* exhibits maximum protection against carrageen and histamine induced paw edema and is almost nearing to the normal values when compared to control. (Table No. 5.3 & 5.4). The methanol extract significantly reduce the inflammation due to the inhibition of the enzyme cyclooxygenase which is the basic substance for the synthesis of prostaglandins. From the result, it is observed that there is reduction in the paw volume at the second stage i.e. after 60 min of administration of carrageenan and histamine.\(^{[22]}\) It is claimed that the inhibitory effects of inflammatory agents that act on the first stage of carrageenan induced hind paw inflammation are attributed to inhibition second stage of hind paw edema may be related to arachidonic acid metabolites, since it is inhibited by aspirin and other arachidonate cyclooxygenase inhibitors.\(^{[31]}\) Therefore, it is predicted that methanol extract reduce the carrageenan and histamine induced paw volume largely in the later phase, which may be due to the inhibition of enzyme arachidonate cyclooxygenase. In present study, the phytochemical investigation showed the presence of flavonoids, and phenolic acids in the methanol extract which may be attributed to the maximum reduction in the paw volume(Table No. 5.2). As these compounds are potent antioxidants and anti-inflammatory agents may act in a similar way as that of the standard non-steroidal anti-inflammatory agents (NSAIDS) such as aspirin, ibuprofen and naproxen.\(^{[32]}\)

**SUMMARY**

The herbal medicines are gaining lot of importance these days due to the several advantages over synthetic drugs. The traditional medicinal system is mainly depending upon medicinal properties of plants for thousands of years. These have made a great contribution in maintaining human health. The main merits of natural products as a source of active principles is the tremendous molecular diversity found in nature.
The phytochemical screening and evaluation of anti-inflammatory and wound healing activities of the methanol extract of the leaves of *Abutilon hirtum* L. have yielded positive results. This plant has been widely reported to have several medicinal properties in traditional form of medicine mainly antibacterial, antifungal, antispasmodic, bitter, ulcers, cough, diuretic, astringent, analgesic, laxative.

Pharmacological experiments were designed to screen the crude extracts of leaves of *Abutilon hirtum* L. for anti-inflammatory and wound healing activities.

The leaves of *Abutilon hirtum* L. were subjected for successive extraction using different solvents (petroleum ether, chloroform, methanol and water) and subsequently subjected to the qualitative phytochemical analysis which indicates the presence of flavonoids, alkaloids, tannins, carbohydrates, gums and saponins. Further, methanol extract was found be stronger in terms of the presence of polyphenolic compound.

In anti-inflammatory activity study, the acute inflammation model the carrageenan induced paw edema was significantly reduced in the animals pretreated with methanol extract of leaves *Abutilon hirtum* which was in dose and time-dependent manner. The percentage inhibition of paw edema in methanol extract-II treated animals was found to be significant when compared to control group of animals. Whereas, the rats treated with methanol extract-I exhibited moderate anti-inflammatory activity. The significant anti-inflammatory activity of the extract may be related to their inhibitory effect on the enzyme cyclooxygenase leading to the inhibition of mediators of inflammation such as histamine, kinin, serotonin and prostaglandin. Further, it may also be due to their inhibitory effect on lipoxygenase pathway.

**CONCLUSION**

The present studies provide the scientific evidence for the presence of anti-inflammatory properties in the plant material *Abutilon hirtum* belonging to the family Malvaceae. Among the two extracts of the methanol, extract II was shown to possess significant anti-inflammatory properties. These activities in the methanol extract may be due to the presence of phenolic compounds and flavonoids in the extract which is confirmed by the phytochemical tests. Thus, the studies carried out provide a supportive scientific evidence for the medicinal use of *Abutilon hirtum* against inflammation, thereby justifying its use in the Indian traditional system of medicine.
REFERENCES


