EVALUATION OF ANTI-ULCER ACTIVITY OF PLATYCODON GRANDIFLORUM A.DC ON MUCOSAL LESION IN RAT

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ABSTRACT
The study was designed to evaluate the anti-ulcer activity of methanolic extract of Platycodon grandiflorum A.DC plant. The plant material successively extracted with methanol and was subjected for phytochemical screening to identify different phytochemical constituents. LD_{50} studies for methanolic extract were conducted up to the dose level of 2000 mg/kg by following OECD guidelines No.423. The anti-ulcer activity was tested by Aspirin plus pylorus ligation induced gastric ulcer model in rats and Ethanol induced mucosal damage. Preliminary phytochemical studies revealed the presence of amino acids, flavonoids and tannins, Saponin and steroids in the methanolic extract of Platycodon grandiflorum A.DC. The mortality was observed in animals treated with methanolic extract of Platycodon grandiflorum A.DC at dose of 2000 mg/kg body weight. The administration of extract at doses of 200 mg/kg, 400 mg/kg, by oral administration, significantly (p<0.05-0.01) reduce the ulcer score, ulcer index, free acidity, total acidity and gastric juice volume where as pH was significantly (p<0.05, p<0.01) increased, in the Aspirin plus pylorus ligation induced gastric ulcer model in rats and Ethanol induced mucosal damage. The experimental data demonstrated that methanolic extract of roots of Platycodon grandiflorum A.DC possess remarkable anti-ulcer activity.

KEYWORDS: Platycodon grandiflorum, anti-ulcer activity, ethanol induced mucosal damage.

INTRODUCTION
Peptic ulcer\textsuperscript{[1-4]}: Formations of sores or erosions in the lining of stomach or duodenum are...
referred to as peptic ulcers. Ulcers probably due to an imbalance between the aggressive (acid, pepsin, bile and H. pylori) and defensive (gastric mucus and bicarbonate secretion, prostaglandins, nitric acid, innate resistance of the mucosal cells.) factors. Aetiology of ulcer is infection caused by Helicobacter pylori, excessive use of NSAIDs. Excess secretion of gastric acid, stress conditions, diet. Common signs of peptic ulcers are pain in the abdomen with burning sensation, pain after 2-3 hrs of food consumption, heart burn and indigestion, nausea, vomiting, loss of appetite and weight loss, blood vomiting and pain during night time. Various medicinal plants available for treatment of ulcers. The *Platycodon grandiflorum A.DC* is one of the medicinal plant belongs to family Campanulaceae, commonly known as Ballon flower. It is distributed in India, China, Korea, Japan and East Siberia. The plant growing to 60cm tall by 30cm in wide. Balloon flower is an herbaceous perennial with dark green leaves, blue flowers and suitable for sunny to light shaded places. Propagation can be done by seed or division. A notable feature of the plant is the flower bud which swells like balloon before fully opening. The five petals are fused together into a bell shape at the base. Flowering in blue, pink, white or multi colored. The root contains saponins, pectin, inulin, oils, sterols and vitamins. The flower contains platycodon, poly acetylenes and anthocyanins The seeds contains luteolin-7-o-glucoside, flavoplatycoside, quercetin-7-o-rutinoside, grandoside, taxifolin, quercetin, poly phenolic compounds, flavonoids, saponins, aminoacids, fattyacids, inorganic compounds. The ballon flower used as expectorant, diuretic, anti phlogistic, anti-ulcer activity, hepatoprotective activities. The roots of the species used extensively anti-inflammatory cough and cold.\(^2\)

**MATERIALS AND METHODS**

**Collection and authentication of plant**\(^5\)

The *Platycodon grandiflorum A.DC* plant was collected from Tirupati, Andhra Pradesh, India during the month of March 2014. The plant material was taxonomically identified and authenticated by Dr.K.Madhava chetty, Department of botany, Sri Venkateswara University, Tirupati, A.P, India.

**Preparation of the Plant Extract**

The *Platycodon grandiflorum A.DC* plant was shade dried and made into coarse powdered which was passed through a# 40 mesh sieve to get uniform particle size and was extracted using methanol by continuous hot percolation process using soxhlet apparatus. The extract was cooled at room temperature and evaporated to dryness under reduced pressure in a rotary
evaporator. The crude extract was kept in vacuum desiccators until use. The crude extract was dissolved in normal saline to required concentrations and used for the experiments. [6]

**Preliminary Phytochemical Analysis [7]**

The extract of *Platycodon grandiflorum A.DC* was subjected to preliminary phytochemical analysis to detect the presence or absence of various phytochemical constituents by the following methods.

**Test for reducing sugars**

**Fehling’s test**: 1ml Fehling’s A and 1ml Fehling’s B solutions was mixed and boiled for one minute. Added equal volume of test solution. Heated in boiling water bath for 5 minute. Brick red precipitate was not observed, indicates absence of reducing sugars.

**Test for gums**: Hydrolyze test solution using dilute HCl. Perform Fehling’s or Benedict’s test. Red color was not observed, indicates absence of gums.

**Test for proteins**

**Biuret test (General test)**: To 3ml test solution add 4% NaOH and few drops of 1% CuSO₄ solution. Violet color was not observed, indicates absence of proteins.

**Test for amino acids**

**Test for tyrosine**: Heated 3ml test solution and 3 drops Million’s reagent. Dark red color was observed, indicates presence of tyrosine.

**Test for cardiac glycosides**

**Legal’s test (test for cardenoloides)**: To extract, add 1ml pyridine and 1ml of sodium nitro prusside. Red color was not observed, indicates absence of cardiac glycosides.

**Test for flavonoids**

**Lead acetate test**: 2 ml extract were treated with few drops of 5% lead acetate solution. A yellow precipitate was observed, indicates presence of flavonoids.

**Test for tannins**: To 2 ml of extract were treated with few drops 5%FeCl₃ solution. A deep blue – black color was observed, indicates presence of tannins.

To 2ml of extract were treated with few drops lead acetate solution. A white precipitate was observed, indicates presence of tannins.
TEST FOR STARCH

**Iodine test:** Mix 3 ml test solution and few drops of dilute iodine solution. Blue color was not observed, indicates absence of starch.

**Test for alkaloids:** The extract were treated with dilute HCL and filtered. The filtrate was treated with various alkaloidal agents.

**Dragendorff’s test:** 2-3 ml filtrate was treated with Dragendorff’s reagent, orange brown precipitate was not observed, indicates absence of alkaloids.

**Hager’s test:** 2-3 ml filtrate was treated with Hager’s reagent, yellow precipitate was not observed, indicates absence of alkaloids.

**Wagner’s test:** 2-3 ml filtrate was treated with Wagner’s reagent, reddish brown precipitate was not observed, indicates absence of alkaloids.

**Test for saponin glycosides.**

**Foam test:** Shake the drug extract vigorously with water. Foam was observed, indicates presence of saponin glycosides.

**Test for steroid**

**Salkowsk reaction:** To 2 ml of extract, added 2 ml chloroform and 2 ml con.H2So₄,Shake well. Chloroform layer was observed indicates presence of steroid.

**Animals**

Adult Wister albino rats weighing between 150-200g of either sex were used for the experiment. The animals housed in poly ethylene walled cages with free access to rat food and water. The animal house temperature was maintained at 23±3°C and relative humidity of 45-55% under 12h light/ 12h dark cycles. The animals were habituated to laboratory conditions for 48 hrs prior to experimental protocol to minimize any nonspecific stress. The protocol for the study was approved by Committee for the Purpose of Control and Supervision on Experimental animals (CPCSEA). The CPCSEA approval number is 1447/PO/a/11/CPCSEA.

**ACUTE TOXICITY STUDY**

Acute oral toxicity study was performed for methanolic extract *Platycodon grandiflorum A.DC* of according to Organization for Economic Co-operation and Development (OECD) -
423 guidelines. Female mice were used for this study. The animals were fasted prior to dosing. Initially, methanolic extract of *Platycodon grandiflorum A.DC* was administered orally at the dose of 5mg/kg body weight. The animals were observed 24hrs for mortality with special attention during first 2hr and then intermittently for 14 days. No mortality was observed at the dose of 5mg/kg body weight. The procedure was repeated for further higher doses such as 50, 300, 2,000 mg/kg body. During acute oral toxicity study, mortality was observed in animals treated with methanolic extract of *Platycodon grandiflorum A.DC* at dose of 2000mg/kg body weight. This dose was considered as lethal dose.

**ANTI - ULCER ACTIVITY**\(^{[9,10]}\)

Evaluation of anti-ulcer activity of *Platycodon grandiflorum A.DC* plant in ulcer induced rats by following methods.
1. Aspirin plus pylorus ligation induced gastric ulcer model.
2. Ethanol induced mucosal damage

Aspirin plus pylorus ligation induced gastric ulcer model:

**Grouping of animals**

Wistar albino rats are divided into five groups, either of sex.
Normal group (without treatment) [6]
Control group [6]
Standard group [6]
Test group -1 [6]
Test group-2 [6]
Total number of animals required 30.
Weight of animals between 150 to 200 gms

**Doses for each group**

Normal group (with out treatment) [6]: Not given any drug to the animals.
Control group [6]: Normal saline 10ml/kg body weight p.o route.
Standard group [6]: Ranitidine 50mg/kg body weight. p.o. route.
Test group 1 [6]: Methanolic extract of *Platycodon grandiflorum A.DC* plant 200 mg/kg body weight. p.o.route.
Test group2 [6]: Methanolic extract of *Platycodon grandiflorum A.DC plant* 400mg/kg body weight. p.o. route.
Procedure

Aspirin plus pylorus ligation induced gastric ulcer model \[11, 12\]
All the animals were received 200 mg/kg of aspirin once daily for three days\[13\]. The various groups were treated with vehicle, standard drug and extract. On the fourth day, pylorus part was ligated, following 18 hr fasting. The animals were anaesthetized using thiopentone sodium (35 mg/kg.i.p)\[13\], the abdomen was opened and pylorus ligation was done without causing any damage in its blood supply. The abdomen was then sutured, at the end of 4hrs of ligation the animals were sacrificed by cervical dislocation. The abdomen was opened and their stomachs were dissected out. Gastric juice collected in to centrifuge tubes was centrifuged at 1000 rpm for 10 min and volume was noted. The pH of the gastric juice was recorded by digital pH Meter. The gastric content was subjected for analysis of free and total acidity. The stomachs were washed with 5 ml of with water with help of disposable syringe. The stomachs were opened along its grater curvature, pinned on a cork plate and inner surface examined for ulceration with a simple microscope.

Ethanol induced gastric ulcer model \[14\]

Grouping of animals
Wistar albino rats are divided into five groups, either of sex.
Normal group (with out treatment) [6]
Control group [6]
Standard group [6]
Test group -1 [6]
Test group-2 [6]
Total number of animals required 30.
Weight of animals between 150 to 200 gms
Doses for each group:
Normal group (with out treatment) [6]: Not given any drug to the animals
Control group [6]: Normal saline 10 ml/kg body weight p.o. route
Standard group [6]: Ranitidine 10 mg/kg body weight. p.o. route.
Test group 1 [6]: Methanolic extract of Platycodon grandiflorum A.DC plant 200 mg/kg body weight. p.o. route.
Test group2 [6]: Methanolic extract of Platycodon grandiflorum A.DC plant 400 mg/kg body weight. p.o. route.
**Procedure**\(^{[15]}\)

Ethanol induced gastric ulcer model: The ulcer was induced by administering ethanol. All the animals were fasted for 18 hours before the study. All groups were treated with respective drugs. After 1hr of drug treatment, all the animals were treated with absolute ethanol (5 ml/kg) to induce lesion. They were kept in specially constructed cages to prevent coprophagia during and after the experiment. The animals were sacrificed after 1hr. The abdomen was opened and their stomachs were dissected out. Gastric juice collected in to centrifuge tubes was centrifuged at 1000 rpm for 10 min and volume was noted. The pH of the gastric juice was recorded by digital pH Meter. The gastric content was subjected for analysis of free and total acidity. The stomachs were washed with 5 ml of with water with help of disposable syringe. The stomachs were opened along its grater curvature, pinned on a cork plate and inner surface examined for ulceration with a simple microscope.

**Evaluation**

Determined the volume of gastric juice, pH of gastric juice, free acidity, total acidity, ulcer index and percentage of ulcer inhibition.

Bio chemical estimation of free acidity and total acidity:

Reagents for Bio chemical estimation of free acidity and total acidity:

- Freshly prepared 0.01N oxalic acid solution was used to standardize 0.01N sodium hydroxide.
- Freshly prepared 0.01N sodium hydroxide.
- Topfer’s reagent. It is dimethylamino azo benzene 0.5% in absolute ethanol available in 100ml package.
- Freshly prepared 1% phenolphthalein solution prepared in 50% absolute ethanol.

**Method for Bio chemical estimation of free acidity and total acidity**

Gastric content collected from pylorus ligated rats was centrifuged and the volume of gastric juice as well as pH of gastric juice was noted. The gastric juice was subjected to biochemical estimation as follows.

**Determination of free and total acidity**\(^{[16-18]}\)

1 ml of gastric juice was pipetted into 100 ml conical flask, 2 or 3 drops of Topfers reagent was added and titrated with 0.01 N sodium hydroxide until all traces of red color disappears and the color of the solution turns to yellowish orange. The volume of alkali added was
noted. This volume corresponds to free acidity. Then 2 or 3 drops of phenolphthalein solution was added and titration was continued until a definite red tinge appears. Again the total volume of alkali added was noted now this volume corresponds to total acidity.

\[
\text{Acidity} = \frac{\text{volume of NaOH} \times \text{Normality of NaOH} \times 100}{0.1} \text{ mEq/lit /100 g.}
\]

The ulcer index was determined as follows.

**Table 1: A score for the ulcer was made as follows.**

<table>
<thead>
<tr>
<th>S. No</th>
<th>Stomach colour</th>
<th>Ulcerscore</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Normal color</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Red colour</td>
<td>0.5</td>
</tr>
<tr>
<td>3</td>
<td>Red spots</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Hemorrhagic streaks</td>
<td>1.5</td>
</tr>
<tr>
<td>5</td>
<td>Ulcer &gt;3mm but&lt;5mm</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Ulcer &gt;5mm</td>
<td>3</td>
</tr>
</tbody>
</table>

Mean ulcer score for each animal was expressed as ulcer index.

The percentage of ulcer inhibition was determined as follows:

\[
\text{Percentage inhibition of ulcer} = \frac{\text{Control mean ulcer index} - \text{Test mean ulcer index}}{\text{Control mean ulcer index}} \times 100
\]

**Statistical analysis**

Statistical analysis was done using one way analysis of variance (ANOVA) followed by Dunnett’s test and results are expressed as Mean± SEM.

**RESULTS AND DISCUSSION**

Preliminary phytochemical analysis of methanolic extract of *Platycodon grandiflorum A.DC* plant: The revealed results of the preliminary phyto chemical analysis of *Platycodon grandiflorum A.DC* plant extract results were shown below Table: 2.

**Table: 2 Preliminary phytochemical analyses.**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Compound</th>
<th>Test</th>
<th>Methanolic extract</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reducing agents</td>
<td>Fehling’s</td>
<td>_</td>
</tr>
<tr>
<td>2</td>
<td>Test for Gums</td>
<td>Hydrolyze with HCl &amp; performed Fehling’s test</td>
<td>_</td>
</tr>
<tr>
<td>3</td>
<td>Test for proteins</td>
<td>Biuret</td>
<td>_</td>
</tr>
<tr>
<td>4</td>
<td>Test for Amino acids</td>
<td>Million’s</td>
<td>+</td>
</tr>
<tr>
<td>5</td>
<td>Test for Cardiac glycosides</td>
<td>Legal</td>
<td>_</td>
</tr>
<tr>
<td></td>
<td>Test for</td>
<td>Lead acetate</td>
<td>5% FeCl₃</td>
</tr>
<tr>
<td>---</td>
<td>---------------------------</td>
<td>-------------</td>
<td>----------</td>
</tr>
<tr>
<td>6</td>
<td>Test for flavanoids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Test for Tannins</td>
<td>Lead acetate</td>
<td>+</td>
</tr>
<tr>
<td>8</td>
<td>Test for Starch</td>
<td>Iodine</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Test for Alkaloids</td>
<td>Dragendorff’s</td>
<td>_</td>
</tr>
<tr>
<td>10</td>
<td>Test for Saponin Glycosides</td>
<td>Foam</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Test for Steroids</td>
<td>Salkowski</td>
<td>+</td>
</tr>
</tbody>
</table>

+ = Present, - = absent,

**Acute toxicity**

In acute toxicity study, mortality was observed in animals treated with methanolic extract of *Platycodon grandiflorum A.DC* at dose of 2000 mg/kg body weight.

**Anti-ulcer activity**

**Aspirin plus pylorus ligation induced gastric ulcer model**

As shown in Table: 2 & Fig: 12, 13, 14, 15 and 16, the methanolic extract of *Platycodon grandiflorum A.DC* (200 mg/kg and 400 mg/kg) showed significantly (P<0.05, P<0.01) decrease in gastric juice volume, free acidity, total acidity and ulcer index, where as pH of gastric juice was significantly (p<0.05, p<0.01) increased when compared with control group. In this model, the methanolic extract of *Platycodon grandiflorum A.DC* at a dose of 200mg/kg and 400mg/kg showed the protective effect 45.13%, and 48.24% respectively, where as Ranitidine showed the protection index of 61.08% at dose of 10 mg/kg body weight. Percentage inhibition difference was observed at the dose of 500mg/kg of methanolic extract of *Platycodon grandiflorum A.DC* as compared to with the dose of 200mg/kg of methanolic extract of *Platycodon grandiflorum A.DC*. So methanolic extract of *Platycodon grandiflorum A.DC* possess better anti ulcer activity at dose of 400 mg/kg

**Aspirin plus pylorus ligation induced gastric ulcer model**

Fig: 10. Effect of methanolic extract of *Platycodon grandiflorum A.DC plant* on Aspirin plus pylorus ligation induced gastric ulcer model in rats
Fig 1: Normal group (without treatment). Fig 2: Control group (Normal saline 10ml/kg)

Fig: 3 Standard group (Ranitidine 50mg/kg).

Aspirin plus pylorus ligation induced gastric ulcer model

Fig: 4 Test group 1(200mg/kg). Fig: 5 Test group 2 (400 mg/ kg).
Table: 3 Effect of methanolic extract of *Platycodon grandiflorum A.DC* plant on aspirin plus pylorus ligation induced gastric ulcer model in rats.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Dose (mg/kg)</th>
<th>Volume of gastric juice (mL/4hr)</th>
<th>pH</th>
<th>Free acidity (mEq/L)</th>
<th>Total Acidity (mEq/L)</th>
<th>Ulcer Index</th>
<th>% Inhibition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (Normal saline)</td>
<td>10</td>
<td>3.86±0.12</td>
<td>2.26±  0.14</td>
<td>30.16 ± 1.16</td>
<td>57.33 ± 2.77</td>
<td>2.16 ± 0.27</td>
<td></td>
</tr>
<tr>
<td>Test-1</td>
<td>200</td>
<td>2.95±0.11**</td>
<td>2.83±  0.09**</td>
<td>22.33 ± 1.40**</td>
<td>43.16 ± 2.61**</td>
<td>1.33 ± 0.24*</td>
<td>38.45</td>
</tr>
<tr>
<td>Test-2</td>
<td>400</td>
<td>2.48±0.14**</td>
<td>3.30±  0.10**</td>
<td>16.83 ± 0.94**</td>
<td>27± 0.96**</td>
<td>1.25± 0.21*</td>
<td>42.12</td>
</tr>
<tr>
<td>Standard (Ranitidine)</td>
<td>50</td>
<td>1.76±012**</td>
<td>4.12±  0.08**</td>
<td>11.5± 0.76**</td>
<td>21.83± 0.83**</td>
<td>0.83± 0.16**</td>
<td>61.57</td>
</tr>
<tr>
<td>Normal (without treatment)</td>
<td></td>
<td>1.45±0.09**</td>
<td>4.28±  0.12**</td>
<td>8.66 ± 0.49**</td>
<td>14.83 ± 0.94**</td>
<td>0.75± 0.11**</td>
<td>–</td>
</tr>
</tbody>
</table>

n=6. The observations are mean ± SEM. *P<0.05, **P<0.01, as compare to control. (ANOVA followed by Dunnett’s test).

Test = Methanolic extract of *Platycodon grandiflorum A.DC*

**Fig 6:** Anti-ulcer effect of methanolic extract of *Platycodon grandiflorum A.DC* on volume of gastric juice (ml) in Aspirin plus pylorus ligation induced ulcer models in rats.

n=6. The observations are mean ± SEM. *P<0.05, **P<0.01, as compare to control. (ANOVA followed by Dunnett’s test).

Test = Methanolic extract of *Platycodon grandiflorum A.DC*
Fig 7: Anti-ulcer effect of methanolic extract of *Platycodon grandiflorum* A.DC on pH of gastric juice in Aspirin plus pylorus ligation induced ulcer models in rats. 

n=6. The observations are mean ± SEM. * P<0.05, ** P<0.01, as compare to control. (ANOVA followed by Dunnett’s test).

Test = Methanolic extract of *Platycodon grandiflorum* A.DC

Fig 8: Anti-ulcer effect of methanolic extract of *Platycodon grandiflorum* A.DC on Free acidity in Aspirin plus pylorus ligation induced ulcer models in rats.

n=6. The observations are mean ± SEM. * P<0.05, ** P<0.01, as compare to control. (ANOVA followed by Dunnett’s test).
Test = Methanolic extract of Platycodon grandiflorum A.DC

Fig: 9 Anti-ulcer effect of methanolic extract of Platycodon grandiflorum A.DC on Total acidity in Aspirin plus pylorus ligation induced ulcer models in rats.

n=6. The observations are mean ± SEM. * P<0.05, ** P<0.01, as compare to control. (ANOVA followed by Dunnett’s test).

Test = Methanolic extract of Platycodon grandiflorum A.DC

Fig: 10 Anti-ulcer effect of methanolic extract of Platycodon grandiflorum A.DC on ulcer index in Aspirin plus pylorus ligation induced ulcer models in rats.

n=6. The observations are mean ± SEM. * P<0.05, ** P<0.01, as compare to control. (ANOVA followed by Dunnett’s test).

Test = Methanolic extract of Platycodon grandiflorum A.DC
Ethanol induced mucosal damage model in rats

As shown in Table: 3 & Fig: 11, 12, 13, 14 and 15, the methanolic extract of *Platycodon grandiflorum A.DC* (200 mg/kg and 400mg/kg) showed significantly (P<0.05, P<0.01) decrease in gastric juice volume, free acidity, total acidity and ulcer index, whereas pH of gastric juice was significantly (p<0.05, p<0.01) increased when compared with control group. In this model, the methanolic extract of *Platycodon grandiflorum A.DC* at a dose of 200 mg/kg and 400 mg/kg showed the protective effect 45.13%, and 48.24% respectively, whereas Ranitidine showed the protection index of 61.08% at dose of 10 mg/kg body weight. Percentage inhibition difference was observed at the dose of 500 mg/kg of methanolic extract of *Platycodon grandiflorum A.DC* as compared to with the dose of 200 mg/kg of methanolic extract of *Platycodon grandiflorum A.DC*. So methanolic extract of *Platycodon grandiflorum A.DC* possess better anti ulcer activity at dose of 400 mg/kg.

Ethanol induced gastric ulcer model

![Fig 11.1 Normal groups (without treatment).](image1)

![Fig: 11.2 Control group (Normal saline 10ml/kg)](image2)

Fig: 11. Effect of methanolic extract of *Platycodon grandiflorum A.DC plant* on ethanol induced mucosal damage model in rats.
Fig: 11.3 Standard group (Ranitidine 10mg/kg).

Fig: 11.4 Test group 1 (200 mg/kg).

Fig: 11.5 Test group 2 (400 mg/kg).
Table: 3 Effect of methanolic extract of *Platycodon grandiflorum* A.DC plant on ethanol induced mucosal damage model in rats.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Dose (mg/kg)</th>
<th>Volume of gastric juice (ml/4hr)</th>
<th>pH</th>
<th>Free acidity (mEq/L)</th>
<th>Total Acidity (mEq/L)</th>
<th>Ulcer Index</th>
<th>%Inhibition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (Normal saline)</td>
<td>10</td>
<td>3.95±0.13</td>
<td>2.18±0.10</td>
<td>30.33±1.25</td>
<td>55.66±2.45</td>
<td>2.58±0.27</td>
<td></td>
</tr>
<tr>
<td>Test-1</td>
<td>200</td>
<td>2.9±0.15**</td>
<td>2.88±0.07**</td>
<td>23.33±1.11**</td>
<td>41.33±1.82**</td>
<td>1.41±0.23**</td>
<td>45.13</td>
</tr>
<tr>
<td>Test-2</td>
<td>400</td>
<td>2.25±0.11**</td>
<td>3.37±0.11**</td>
<td>18.33±1.11**</td>
<td>31.5±1.91**</td>
<td>1.33±0.24**</td>
<td>48.24</td>
</tr>
<tr>
<td>Standard (Ranitidine)</td>
<td>10</td>
<td>1.81±0.013**</td>
<td>4.11±0.07**</td>
<td>11.33±0.80**</td>
<td>20±1.15**</td>
<td>1.0±0.25**</td>
<td>61.08</td>
</tr>
<tr>
<td>Normal (without treatment)</td>
<td>–</td>
<td>1.31±0.04**</td>
<td>4.45±0.07**</td>
<td>9±0.57**</td>
<td>14.16±0.6**</td>
<td>0.75±0.11**</td>
<td></td>
</tr>
</tbody>
</table>

n=6. The observations are mean ± SEM. * P<0.05, ** P<0.01, as compare to control. (ANOVA followed by Dunnett’s test).

Test = Methanolic extract of *Platycodon grandiflorum* A.DC

![Fig: 12 Anti-ulcer effect of methanolic extract of *Platycodon grandiflorum* A.DC on volume of gastric juice (ml) in ethanol induced mucosal damage model in rats.](image)

n=6. The observations are mean ± SEM. * P<0.05, ** P<0.01, as compare to control. (ANOVA followed by Dunnett’s test).

Test = Methanolic extract of *Platycodon grandiflorum* A.DC
Fig: 13 Anti-ulcer effect of methanolic extract of *Platycodon grandiflorum A.DC* on pH of gastric juice in ethanol induced mucosal damage model in rats.

n=6. The observations are mean ± SEM. * P<0.05, ** P<0.01, as compare to control. (ANOVA followed by Dunnett’s test).

Test = Methanolic extract of *Platycodon grandiflorum A.DC*

Fig: 14 Anti-ulcer effect of methanolic extract of *Platycodon grandiflorum A.DC* on free acidity in ethanol induced mucosal damage model in rats.

n=6. The observations are mean ± SEM. * P<0.05, ** P<0.01, as compare to control. (ANOVA followed by Dunnett’s test).
Test = Methanolic extract of *Platycodon grandiflorum* A.DC

**Fig: 15** Anti-ulcer effect of methanolic extract of *Platycodon grandiflorum* A.DC on Total acidity in ethanol induced mucosal damage model in rats.

*n=6*. The observations are mean ± SEM. * P<0.05, ** P<0.01, as compare to control. (ANOVA followed by Dunnett’s test).

Test = Methanolic extract of *Platycodon grandiflorum* A.DC

**Fig: 16** Anti-ulcer effect of methanolic extract of *Platycodon grandiflorum* A.DC on ulcer index in ethanol induced mucosal damage model in rats.

*n=6*. The observations are mean ± SEM. * P<0.05, ** P<0.01, as compare to control. (ANOVA followed by Dunnett’s test).

Test = Methanolic extract of *Platycodon grandiflorum* A.DC
CONCLUSION
The methanolic extract of *Platycodon grandiflorum A.DC* was subjected for phytochemical investigation and LD$_{50}$ studies. It was found that methanolic extract contained amino acids, flavonoids, tannins, saponins and sterols. Flavonoids and tannins are responsible for anti ulcer activity. The extract was tested for their lethal effect up to the dose level of 2000 mg/kg. Mortality was observed in mice at dose of 2000mg/kg body weight. The oral administration of methanolic extract of *Platycodon grandiflorum A.DC* extract at doses of 200 mg/kg, 400 mg/kg, significantly (P<0.05- 0.01) reduce the gastric juice volume, free acidity, total acidity and ulcer index, where as pH of gastric juice was increased in the aspirin plus pylorus ligation induced gastric ulcer model in rats and ethanol induced mucosal damage model in rats.

It is concluded that, the methanolic extract of *Platycodon grandiflorum A.DC* possess anti-ulcer activity.

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REFERENCES


