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EVALUATION OF ANTI-ULCER, LAXATIVE AND ANTI-INFLAMMATORY ACTIVITIES OF TECOMELLA UNDULATA (ROXB.)

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Abstract

Tecomella undulata (Bignoniaceae) is a well-known medicinal plant used for the treatment of ulcers and constipation. The present study was carried out to determine phytochemical tests, FT-IR studies, heavy metal concentrations, anti-ulcer, laxative, and anti-inflammatory activities of the ethanolic extract of *T. undulata* leaves. Phytochemical tests were conducted to detect the presence of alkaloids, flavonoids, saponins, tannins, glycosides, anthraquinones, and terpenoids. FT-IR studies were performed to identify different functional groups. The concentration of heavy metals (Cu, Cr, Mn, Ni, Se, and Sb) was determined using atomic absorption spectroscopy. In the anti-ulcer activity, an ethanol-induced gastric ulcer model was employed. Laxative activity was evaluated using loperamide-induced constipation. In the phytochemical tests, the presence of glycosides, alkaloids, tannins, terpenoids, flavonoids, saponins, and anthraquinones was confirmed. FT-IR studies confirmed the presence of different functional groups (C–N, C-O, N=O, C=C, C=O, C-H, O-H). The concentration of Cu, Cr, Mn, Ni, and Se was within the permitted limits, while the concentration of Sb exceeded the permitted limits. The ethanolic extract of *T. undulata* exhibited protective effects against ethanol-induced gastric ulcers. The results showed a significant ($p<0.05$) decrease in the ulcerative index, reduction in inflammation, erythema, and edema in macroscopic

evaluation. In the laxative activity test, a significant ($p < 0.05$) increase in fecal volume, feed intake, and water intake was observed, indicating improved intestinal movement in constipated rats. In anti-inflammatory activities, *T. undulata* ethanolic extract demonstrated significant ($p<0.05$) anti-inflammatory effects in carrageenan and formalin-induced rat paw edema. The results of the present study indicate that the crude ethanolic extract of *T. undulata* possesses significant anti-ulcer, laxative, and anti-inflammatory activities.

Keywords: *Tecomella undulata,* anti-ulcer, Laxative, Anti-inflammatory, Balochistan.

Introduction

Gastrointestinal tract (GIT) diseases affect different digestive organs, i.e., intestines, pancreas, gall bladder, and the disorder may be acute or chronic depending on the severity of symptoms. The most common GIT disorders include peptic ulcers, heartburn, bloating, acidity, inflammatory bowel disease, and irritable bowel syndrome [1]. Every year, about 4 million people of different ages are affected by peptic ulcers worldwide, and the mortality rate is about 15%–40%. Factors such as regular use of NSAIDs, smoking, anxiety, and unhygienic food are reported to cause these disorders [2]

Globally, PPIs and H2 receptor blockers are successfully used for the effective management of ulcers, with the mechanism involving the inhibition of gastric reflux or an increase in mucosal production [3]. Various herbal formulations containing different plant parts have been reported to treat ulcers and digestive disorders effectively [4]. Constipation is a widespread condition prevalent throughout the world. Various research studies have revealed that 50% of people between the ages of 75-80 suffer from constipation. In this condition, individuals experience difficulty in defecation, and its severity depends on the symptoms [5]. Laxative drugs stimulate defecation and have a strong potential to relieve symptoms and effectively manage constipation [6]

Several herbal formulations containing Senna & Rhubarb are utilized to treat acute and chronic constipation, the reported mechanism involved by improving the motility of colon without affecting the consistency of stool [7]. Sennosides and aloe-emodin are the compounds responsible for laxative effects [8].

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Tecomella undulata (Roxb.), belonging to the Bignoniaceae family, is a well-known medicinal herb that grows throughout the world, especially in Pakistan and India [9]. In Balochistan, it grows wild in Khuzdar and Noshki districts, known locally as 'perpuk' in Brahui. In arid zones, *T. undulata* is extensively adapted and can thrive in dry regions. The plant, with its greyish-green leaves and odorless orange, yellow, and red flowers, grows well in the spring season, from March to May. People from different regions of the country have been using this plant for decades to treat various forms of allergies and wounds. Traditionally, females from different tribal areas have successfully used this plant for managing stomach pain, as an anti-allergic, anti-diabetic agent, and for the treatment of constipation [10]. Previous studies have reported various activities *of T. undulata*, including hepatoprotective, analgesic, and laxative activities [11]. The primary goal of the current research was to evaluate the anti-ulcer, laxative, and anti-inflammatory activities of *T. undulata* leaf extract.

Materials & methods

Plant Material

Fresh leaves of *T. undulata* were collected from Khuzdar, (Wadh, Wehr) in the Balochistan province in May 2019. The plant was identified, and a voucher specimen with the number H-1574/19 was deposited in the Pharmacognosy Department at the University of Balochistan, Quetta

Extract preparation

Fresh leaves of the plant were air-dried and crushed into small pieces. Afterward, the plants were macerated in ethanol solvent for 15 days, and the solvent was carefully filtered through Whatman filter paper No. 42 (70 mm) and evaporated with the assistance of a rotary evaporator (Bibby Sterlin Ltd, UK) at 40°C. A dark greenish-brown-colored semi-solid residue was obtained.

Animals

Wistar albino rats, weighing about 200 to 230g, of both sexes, were used for the pharmacological activities. The animals were purchased from Dow Medical University, Karachi. All the animals were kept in an animal house and were further placed in plastic cages at a temperature of 23 ± 1°C, where they were habituated for seven (07) days. The animals had free access to feed and water. Ethical approval was obtained from the Ethical Committee (Ref No. FoPHS/Res/E-02/20) of the Faculty of Pharmacy and Health Sciences, University of Baluchistan, Quetta, Pakistan.

Phytochemical studies

T. undulata ethanolic extract was evaluated for the presence of alkaloids, flavonoids, saponins, tannins, glycosides, anthraquinones, and terpenoids using standard protocols [12].

Fourier-transform infrared spectrophotometry (FT-IR)

It is an analytical technique used for determining various functional groups found in different compounds. The dried powder of the ethanolic plant extract was used. The sample was prepared by taking 10 grams of powder, which was then encapsulated in 100 grams of potassium bromide (KBr) pellet to create a semi-transparent sample disc. The sample was placed in the apparatus (Shimadzu IR Affinity, Japan) with a scanning range of 400 to 4000 cm-1 and a clear resolution of 4 cm-1[13].

Heavy metal detection

Standard preparation

The plant extract was assessed for the detection of different heavy metals. The sample solution for detecting various elements was prepared at concentrations of 3-5 in order to obtain a precise calibration curve. To prepare the solution, 25 ml of distilled water and 0.5 g of samples were taken in a 100 ml flask. The prepared solution was shaken using a shaker (Lap Companion (SLC) HR.120). After shaking, the solution was filtered and labeled for further analysis in bottles. The presence of heavy metals in the ethanolic extract of *T. undulata* was detected using Atomic Absorption Spectroscopy (Thermo Electron Corporation, United States). The concentrations (ppm) of Selenium (Se), Chromium (Cr), Cobalt (Co), Nickel (Ni), Antimony (Sb), and Manganese (Mn) were determined using the corresponding standard calibration curves [14].

Anti-ulcer activity

An ethanol-induced gastric ulcer model was carried out in rats to determine the anti-ulcer activity of *T. undulata* ethanolic extract. Rats were divided into 4 groups (n=5): the control group, *T. undulata* ethanolic extract-treated groups (250 mg/kg and 500 mg/kg), and the standard drug group (omeprazole 20 mg/kg, 5 ml/kg).

Gastric injury was induced in rats one hour after drug treatment. Ethanol (1 ml/100 g) was administered orally to each animal, and distilled water (5 ml/kg) was given to the control group rats. After one hour, the animals were anesthetized with an overdose of ketamine, and their stomachs were removed for further investigations. [15].

Macroscopic analysis

Macroscopic analysis of the collected samples of stomach were conducted after the diagnosis of marked ulcerative areas and the total length of effected ulcerative areas was measured. The ulcer spots severity was determined by using magnifying glass; the results were further described by using scoring system [16].

Laxative activity

Experimental Model

05 groups of animals consisting 06 animals in each group were selected. Group I: (normal control) received orally 05 ml/kg normal saline, while Group II: (constipated control) received 1ml loperamide (3mg/kg body weight for 3 days) orally. Group III: received 250mg/kg ethanolic extract of *T. undulata* orally. Group IV: received 500mg/kg ethanolic extract of *T. undulata* orally. Group V: positive control, received orally Lactulose (standard drug) 5ml/kg [17].

Induction of constipation

1ml loperamide (3mg/kg body weight in 0.9% sodium chloride) orally administered for 3 days to animals for induction of constipation. Normal saline 5ml/kg was administered in control group rats. Evacuation of dry, hard & reduced pallets indicates the induction of constipation [18].

Water content, weight and number of fecal pellets

The pallets of the rats were collected on a daily basis at 9:00am to analyze the presence of water content, weight of the pellet and number of pellets during the entire experiment. The difference between water contents of dry and wet pellets were calculated [19].

Carrageenan-induced acute paw edema

In this experiment 04 groups of rats (05 rats in each group) were used. Control group (received 0.5% CMC), Group II: received 250mg/kg ethanolic extract of *T. undulata* orally. Group III: received 500mg/kg of ethanolic extract of *T. undulata* orally. Group IV: received Indomethacin (10 mg/kg). After one (01) hour of treatment of extract, a 100µL sub-plantar injection of 1% solution of carrageenan was injected into the right hind paw of rats. Vernier caliper (Digital) was used to measure the acute paw edema [20].

Formalin-induced acute paw edema

This activity was used to determine the anti-inflammatory effects of the ethanolic extract of *T. undulata* in rats. Grouping of animals were followed as that of in carrageenan test. In each model, after one hour of drug administration, 0.05ml of 2.5 % formalin was injected into the left hind paw of each rat and acute paw edema was measured at 0, 1, 3 and 5th hour by using digital Vernier caliper after the administration of formalin in rats [21].

Statistical Analysis

Standard error mean (SEM) was used for the analysis of results and ANOVA (on-way) test was followed by Dun-can test for multiple ranges. SPSS (version 16.0) was used in all parameters to determine significant differences. Results were considered as significant at $p < 0.05$ [22].

Results

Phytochemical Tests

Results reveals that the ethanolic extract of *T. undulata* contains different phytochemicals i.e. alkaloids, glycosides, saponins, tannins, flavonoids, terpenoids and anthraquinones (Table 1).

Fourier-transform infrared spectroscopy (FT-IR)

The band at 3310.17cm^{-1} specifies the O-H vibration frequency and confirms the presence of hydroxyl functional group. The band peak at 2929.08cm^{-1} indicates the C-H alkane group. the band at 1700.73cm^{-1} specifies the C=O vibration frequency and confirms the presence of carboxylic acid functional group. Curve peaks at 1603.07cm^{-1} indicated the aromatic functional group specifies the C=C vibration frequency. The band at 1515.08cm^{-1} specifies the N=O vibration frequency and shows the presence of nitro group. The band peak at 1270.01cm^{-1} indicates the presence of C-O acidic group. The band at 1030.54cm^{-1} specifies the C–N vibration frequency and confirms the

presence of amine functional group. Functional group of alkene was confirmed having peak at 832.53cm^{-1} & 875.44cm^{-1} (Table 2).

Heavy metal detection

Concentrations (ppm) of different heavy metals i.e Co (9.6502), Cr (0.6858), Mn (0.6551), Ni (19.2847), and Se (68.2275) were within the permitted limit and Sb (15.3650) concentration was higher than the permitted limit (Table 3).

Anti-ulcer activity

In anti-ulcer activity, the control (distilled water treated) group the ulcer index was 7(5-8) and the ulcerated area was 1.10-0.3(cm^2), in 250mg/kg *T. undulata* ethanolic extract treated group, the ulcer index was 4(3-6) and the ulcerated area was 0.5-0.2(cm^2). In 500mg/kg *T. undulate* ethanol extract treated group the ulcer index was 2(2-4) and the ulcerated area was 0.3-0.1(cm^2), while in standard drug (omeprazole 20mg/kg) treated group the ulcer index was 1.2(1-4) and the ulcerated area was 0.3-0.1(cm^2) (Table 4).

Laxative activity

Feed intake

In this test, for non-treated (normal saline) group, the feed intake was 37.38±0.77. In group 2 (Constipated Control) the feed intake was 22.16±1.09, While with 250mg/kg *T. undulata* ethanolic extract treated group, the feed intake was 30.56±0.86 and with 500mg/kg *T. undulata* ethanolic extract treated group, feed intake was 21.4±1.56 and feed intake after administration of standard drug (Lactulose) was 31.5±0.99 (Table 5).

Water intake

In non-treated (normal saline) the water intake was 16.3±0.60ml. In group 2 (constipated Control) the water intake was 12.9±0.11 ml, while with 250mg/kg *T. undulata* ethanolic extract treated group, the water intake was 4.48±0.31 ml and with 500mg/kg *T. undulata* ethanolic extract treated group, water intake was 6.36±0.19 ml. The water intake after administration of standard drug (Lactulose) was 10.74±0.76 (Table 6).

Number of fecal pellets

In non-treated (normal saline treated group) no. of fecal pellets were 05.2±0.37. In loperamide treated (Constipated Control) group number of fecal pallets were 02±0.31, while with 250mg/kg *T. undulata* ethanolic extract treated group, number of fecal pallets were 10±0.44 and with 500mg/kg *T. undulata* ethanolic extract treated group, number of fecal pellets were 12±0.70, the number of fecal pellets after administration of standard drug (Lactulose) were 13.2±0.49 (Table 7).

Weight of fresh pellets

In non treated (normal saline) treated group the weight of fresh pellets were 255.98±3.70 mg. In group II loperamide treated (constipated control) group the weight of fresh pellets were 159.76±6.62mg, while with 250mg/kg *T. undulata* ethanolic extract treated group, the weight of fresh pellets was 401.32±3.75mg and with 500mg/kg *T. undulata* ethanolic extract treated group, the weight of fresh pellets was 578.88±7.43 mg, the weight of pallets (fresh) after administration of standard drug (Lactulose) were 595±8.81 mg (Table 8).

Weight of dry pellets

In non-treated (normal saline) the weight of dry pellets was 184.74±4.16mg. In group 2 loperamide treated (Constipated Control) group the weight of dry pellets was 97.36±2.85mg, while with 250mg/kg *T. undulata* ethanolic extract treated group, the weight of dry pellets was 284.24±10.91mg and with 500mg/kg *T. undulata* ethanolic extract treated group, the weight of dry

pellets was 466.38±11.38mg, weight of dry pellets after administration of standard drug ((Lactulose) were 490.76± 3.78mg (Table 9).
In *T. undulata* ethanolic extract treated groups, a significant ($p<0.05$) increase was recorded in the numbers of pellets, weight and the presence of total water content in the fecal pellets of the constipated rats. Results reveals that, the *T. undulata* ethanolic extract at both doses (250mg/kg and 500mg/kg) significantly increased the GIT movement in and the overall results were comparable with lactulose (standard laxative drug).

Carrageenan-induced acute paw edema

After the administration of ethanolic extract of *T. undulata* at dose 250mg and 500mg orally, a significant ($p<0.05$) decline in edema was noticed as compared to Indomethacin (10mg/kg) treated group. Carrageenan was injected intradermally into the rat's hind paw, which results in quick and topical inflammation. The administration of *T. undulata* ethanolic extract at dose 250mg, 500mg and the Indomethacin (10mg/kg) shows a significant decrease in inflammation caused by carrageenan in rats. After one (01) hour of administration of *T. undulata* ethanolic extract significant ($p< 0.05$) decline in the paw edema was noticed. The same dose also repressed the next phase of acute paw edema and the maximum effects were observed at the 5th hour (Table 10).

Formalin-induced paw edema

Formalin was administered intraperitoneally into the hind paw of rats to observe the effects of edema. In control group, the maximum increase in edema was observed at 5th hour after the administration of formalin. The ethanolic extract of *T. undulata* at doses 250mg and 50mg/kg showed significant ($p < 0.05$) reduction in paw edema of rats after 3rd and 5th hour of the formalin administration. The standard drug indomethacin (10mg/kg) also showed highly significant ($p < 0.01$) reduction in the paw edema after 3rd and 5th hour of the formalin administration (Table 11).

Discussion

Plants have been used since ancient times to treat various ailments, including constipation. Nowadays, many herbal drugs are successfully employed for managing various diseases, including constipation [23]. In the current era, herbal products have gained significant attention for the management of different diseases, regardless of the significant developments in synthetic drugs. The use of synthetic medicines for long-term treatment is associated with adverse effects, particularly gastric ulcers [19].
The current study confirms that the *T. undulata* ethanolic extract contains various phytochemicals, including alkaloids, glycosides, terpenoids, tannins, saponins, flavonoids, and anthraquinones. These secondary metabolites are solely responsible for producing pharmacological effects. The phytochemical identification was accompanied by FTIR analysis of the plant extract, and the results revealed the presence of O-H, C=O, C=C, N=O, C-O, C-N, and C-H functional groups in the *T. undulata* ethanol extract. The presence of heavy metals in medicinal plants may be harmful and may damage human health [24]. Therefore, a determination of heavy metals was carried out to ensure the safety of the plant for human use. In *T. undulata* ethanolic extract, concentrations of Cu, Cr, Mn, Sb, and Ni were within the permitted limits, while the concentration of Se exceeded the permitted limit. Se plays a vital role in various physiological and biochemical pathways. An appropriate quantity of Se facilitates plant growth and regulation. However, an elevated concentration of Se can inhibit the growth and development of plants [25].
Ethanol-induced gastric ulcers cause a decrease in the secretion of bicarbonates and depletion of gastric wall mucus [26]. Ingesting ethanol increases the severity of ulcerative spots, hemorrhage, inflammation, erythema, and edema due to widespread damage to the mucosal capillaries of the rats [27]. *T. undulata* ethanolic extract exhibited significant ($p < 0.05$) gastro-protective activity at both doses (250 mg/kg and 500 mg/kg body weight), and the results were comparable to omeprazole, a standard gastroprotective drug. Findings of the current study indicate that the *T. undulata* ethanol extract has strong potential to decrease vascular permeability, inhibiting the injury of capillary

endothelium, and showing anti-inflammatory activity by inhibiting the release of different inflammatory mediators [28].

Plants have been used since ancient times to treat constipation [29]. Loperamide-induced constipation in rats is the most commonly used method for assessing laxative activity; it causes the inhibition of intestinal water secretion and colonic peristalsis. This inhibition is believed to delay intestinal luminal transit and extend the time of fecal evacuation [30].

The decrease in the weight, number, and total water content of the rats' pellets indicates the induction of constipation in rats. *T. undulata* ethanolic extract significantly increased colon motility, fecal volume, and defecation frequency in constipated rats, suggesting that *T. undulata* ethanolic extract possesses significant ($p < 0.05$) laxative activity. Studies suggest that the laxative activity of plants is due to the presence of glycosides [31]. Phytochemical studies of the *T. undulata* ethanolic extract also confirmed the presence of glycosides, indicating that the laxative activity is likely due to the presence of glycosides.

The administration of *T. undulata* ethanolic extract at doses of 250 mg and 500 mg orally showed a significant decrease in the inflammation caused by carrageenan. The initial stage (0–1 h) is attributed to histamine, bradykinin, and serotonin secretion, as well as the overproduction of prostaglandins in neighboring damaged tissues. In the later stage (1–6 h), clinically effective anti-inflammatory drugs are targeted due to an overproduction of pro-inflammatory mediators [32]. The current study shows that the ethanolic extracts of *T. undulata* significantly decreased paw edema in both phases ($p < 0.05$), and the results were comparable to the standard drug indomethacin. During both phases of inflammation, the reduction in paw edema clearly indicates that *T. undulata* ethanolic extract can inhibit different chemical mediators causing inflammation. The phytochemical studies of *T. undulata* ethanolic extract confirm the presence of phenols and flavonoids. Previous studies show that phenols and flavonoids possess anti-inflammatory effects [33]; therefore, it is proposed that the anti-inflammatory activity may be due to these chemical constituents.

The formalin-induced acute paw edema model is extensively used to determine acute inflammation in rats. Localized inflammation is caused by the subcutaneous injection into the hind paw of rats [34]. The *T. undulata* ethanolic extract showed significant ($p < 0.05$) anti-inflammatory effects at both doses (250 mg and 500 mg/kg). Subsequently, secondary metabolites (phenols and flavonoids) are primarily responsible for the anti-inflammatory effect.

Conclusion

Results of the present research conclude that the *T. undulata* ethanolic extract showed anti-ulcer, laxative and anti-inflammatory activities. However further investigations are required to identify major active compounds responsible for these activities, which may further lead to the discovery of a new drug.

Table 01: Tests for the identification of Phytochemicals in crude ethanolic extract of *T. undulata.*

S.No.	Phytochemicals	Remarks	Results
01	Alkaloids	Formation of yellow precipitates	**+ ve**
02	Flavonoids	Yellowish-green color precipitates	**+ ve**
03	Saponins	Formation of froths/bubbles	**+ ve**
04	Tannins	Formation of Brownish-green color precipitates	**+ ve**
05	Glycosides	red color precipitates occur	**+ ve**
06	Anthraquinones	An aqueous layer of pink or violet color appears	**+ ve**
07	Terpenoids	Formation of reddish-brown color precipitates	**+ ve**

(+ve) sign indicates the presence of phytochemicals while the (-ve) signs indicates the absence.

Table 02: FT-IR studies of ethanolic extract of *T. undulata.*

S.no	Wavelength	Reference ranges	Functional Group interpretation
1	832.53, 875.44	650-1000	C-H(Alkene)
2	1030.54	1250–1000	C-N (Amine)
3	1270.01	1300–1000	C-O (Acid)
4	1515.08	1550 and 1350	N=O (nitro)
5	1603.07	1600-1630	C=C(Aromatic)
6	1700.73	1730–1700	C=O (Carboxylic Acid)
7	2929.08	3000–2850	C-H(Alkane)
8	3310.17	3500–3200	O-H(hydroxyl group)

Table 03: Detection of heavy metals in ethanolic extract of *T.undulata*

S.no	Metal	Concentration (ppm)	Permitted limit (ppm)
1	Co	9.6502	25
2	Cr	0.6858	2
3	Mn	0.6551	5
4	Ni	19.2847	1.5
5	Se	28.2275	29
6	Sb	15.3650	2

Table 04: Effects of *T. undulata* ethanolic extract on gastric mucosal ulcer caused by ethanol in rats.

S.no	Drug/dose	Route of administration	Ulcer index(1-8)	Ulcerated area (cm^2)
1	Control	Oral	7(5-8)	1.10 ± 0.3
2	*T. undulata* 250mg/kg	Oral	4(3-6)	0.5 ± 0.2
3	*T. undulata* 500mg/kg	Oral	2(2-4)	0.3 ± 0.1
4	Standard drug (Lactulose)	Oral	1.2(1-4)	0.3 ± 0.1

Median (range) for ulcerative scores & mean± SD for ulcerative area (n=5).

Table 05: Effect of *T. undulata* ethanolic extract on feed intake of rats

S.no	Treatment	Feed intake
1	Control	37.38±0.77
2	Constipated Control	22.16±1.09
3	*T. undulata* 250mg/kg	30.56±0.86*
4	*T. undulata* 500mg/kg	21.4±1.56*
5	Standard drug (Lactulose)	31.5±0.99**

All values are mean ± SEM; n=5; *= p<0.05, **= p<0.01

Table 06: Effect of *T. undulata* ethanolic extract on water intake of rats

S.no	Treatment	Water intake
1	Control	16.3±0.60
2	Constipated Control	12.9±0.11
3	*T. undulata* 250mg/kg	4.48±.31*
4	*T. undulata* 500mg/kg	6.36±0.19*
5	Standard drug(Duphalac)	10.74±0.76**

All values are mean ± SEM; n=5; *= p<0.05, **= p<0.01

Table 07: Effect of *T. undulata* ethanolic extract on number of fecal pellets of rats

S.no	Treatment	No. of fecal pellets
1	Control	5.2±0.37
2	Constipated Control	2±0.31
3	*T. undulata* 250mg/kg	10±0.44*
4	*T. undulata* 500mg/kg	12±0.70*
5	Standard drug (Lactulose)	13.2±0.49**

All values are mean ± SEM; n=5; *= p<0.05, **= p<0.01

Table 08: Effect of *T. undulata* ethanolic extract on weight of pallets (fresh)

S.no	Treatment	Weight of pallets (fresh) mg
1	Control	255.98±3.70
2	Constipated Control	159.76±6.62
3	*T. undulata* 250mg/kg	401.32±3.75*
4	*T. undulata* 500mg/kg	578.88±7.43*
5	Standard drug(Duphalac)	595±8.81**

All values are mean ± SEM; n=5; *= p<0.05, **= p<0.01

Table 09: Effect of *T. undulata* ethanolic extract on weight of pallets (Dry)

S.no	Treatment	Weight of pallets (dry)
1	Control	184.74±4.16
2	Constipated Control	97.36±2.85
3	*T. undulata* 250mg/kg	284.24±10.91*
4	*T. undulata* 500mg/kg	466.38±11.38*
5	Standard drug (Lactulose)	490.76± 3.78**

All values are mean ± SEM; n=5; *= p<0.05, **= p<0.01

Table 10: Effect of *T. undulata* ethanolic extract on Carrageenan-induced paw edema in rats

Treatment	0 hours	1hour	2 hours	3hours	4 hours	5 hours	24 hours	48hours
Control	11.48±0.59	15.07±0.38	16.19±0.32	16.31±0.44	17.30±0.27	17.65±0.45	15.58±0.22	14.57±0.36
T. undulata 250mg/kg	11.54±0.52	14.50±0.29*	15.96±0.47*	15.78±0.30*	16.82±0.29*	16.63±0.22*	15.37±0.45*	15.59±0.45*
T. undulata 500mg/kg	12.33±0.68	15.59±0.38*	15.46±0.73*	17.03±0.30*	16.45±0.68*	17.83±0.47*	16.06±0.31*	16.16±0.50*
Standard Drug	14.62±0.53	16.78±0.44**	16.71±0.49**	16.81±0.23**	16.97±0.61**	16.03±0.42**	15.57±0.53**	15.73±0.51**

N=06, values are expressed as Mean±SEM, *= p<0.05, **= p<0.01

Table 11: Effect of *T.undulata* ethanolic extract on formalin induced paw edema in rats

Treatment	1 hours	2hour	3 hours	4hours	5hours
Control	6.72±0.36	6.96±0.42	8.51±0.22	8.56±0.41	7.44±0.91
T. undulata 250mg/kg	6.14±0.63*	6.50±0.59*	6.21±0.5*	5.38±0.58*	5.43±0.45*
T. undulata 250mg/kg	5.94±0.33*	5.64±0.37*	5.74±0.44*	5.10±0.37*	5.44±0.27*
Standard Drug	7.88±0.28**	7.56±0.51**	6.52±0.35**	6.33±0.33**	6.58±0.41**

N=06, values are expressed as Mean±SEM, *= p<0.05, **= p<0.01

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