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"A STUDY ON ANTI-INFLAMMATORY AND ANTI-ULCER ACTIVITIES OF TUBER EXTRACTS OF *SOLANUM TUBEROSUM (SOLANACEAE)* BY RATS"

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ABSTRACT
In Ayurvedic texts it was reported that tubers of *S. tuberosum* are used for anti- ulcer, anti-gout, anti-inflammatory, anti-arthritic, diuretic, anti-scurvy and to increase milk in lactating mothers. For external use, the grated raw *S. tuberosum* is applied locally in cases of arthritis, itching, neuralgia and in mild burns. Since no scientific data is available on anti-inflammatory and anti-ulcer activities of tubers extracts (alcoholic and aqueous) of this plant, hence the present work is planned to evaluate the above mentioned activities in experimental animal, rats.

KEY WORDS:
S. Tuberosum Tubers,Alcoholic & Aqueous Extracts, Anti-Ulcer Activity, Anti-Inflammatory Activity.

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INTRODUCTION:-

- Plants have been one of the important sources of medici ne since dawn of human civilization. These are the gifts of nature to mankind for treating different types of diseases. Almost from prehistoric period herbal medicine are used for alleviation of suffering caused by different diseases in human.
- Benefits:-

1. Herbal medicines exhibit fewer side effects and are safe.
2. Herbs and herbal formulations are cheaper and easily available.
3. For certain disease like hepatitis, herbs and herbal drugs are the only remedies.
4. Certain chemical constituents from the herbs are serving as prototype molecules for the discovery of more effective drugs than existing ones.

- **The traditional medicine is largely gaining popularity over allopathic medicine because of the following reasons:-**

1. Rising cost of medical care.
2. Natural products are free from side effects.
3. No reoccurrence after the treatment.
4. Easy availability of the drugs from natural sources especially in Developing countries.
5. Cure of disease by the changes in life style and social pathology.
6. Renewable sources.

OBJECTIVES OF THE STUDY:-

- Since the plant *S. tuberosum* has not explored to significant extent and on the background of available information of the plant, the present work was planned with the following objectives:-

1. To prepare various extracts (alcoholic and aqueous) with tubers of *S. tuberosum.*
2. To establish the pharmacological profile of the extracts of tubers of *S. tuberosum.*

*To evaluate anti-ulcer activity of the tubers extracts in various experimental animal models like-

1. Pylorus ligation induced ulcers in rats (SHAY) with the estimation of parameters like volume of gastric juice, pH, free and total acidity and ulcer index.
2. Stress induced ulcers (cold-water immersion induced ulcers).

*To evaluate anti-inflammatory activity of the tubers extracts in various experimental animal models like-

1. Carrageenan induced paw oedema model in rats.
2. Histamine induced paw oedema model in rats.
3. Formalin induced paw oedema model in rats.

DESCRIPTION OF THE PLANT:-

Family : Solanaceae
Genus : Solanum
Species: *S.tuberosum*
Synonym:
Hindi-Alu, Sanskrit -Golakandah, Kannada-Batate, Marathi –Batata.

Distribution: It grows throughout India and World.

Major Chemical Constituents:

S. tuberosum contains:- Starch, Sugar (Glucose, Sucrose and Fructose), Cellulose (10- 20%), Crude Fiber, Pectin Substances (0.7-1.5% of Dry Wt), Hemicelluloses (1%), Fat (1.1%) And Vitamin C.

Medicinal Uses:

S. Tuberosum Tubers Are Used As;Anti-ulcer, Anti-gout, Anti-inflammatory, Anti-arthritic, Diuretic,Anti-scurvy And To Increase Milk in Lactating Mothers, For External Use Is Applied Locally in Cases of Arthritis, Itching, Neuralgia and in Mild Burns.

INFLAMMATION

- Inflammation (Latin, *inflammare*, to set on fire) is part of the complex biological response

of vascular tissues to harmful stimuli, such as pathogens, damaged cells or irritants.

- Inflammation is a protective attempt by the organism to remove the injurious stimuli

and to initiate the healing process.

- Inflammation is not a synonym for infection, even in cases where inflammation is caused by infection.

- Infection is caused by an exogenous pathogen, while inflammation is one of the responses of the organism to the pathogen[1].

Causes of inflammation:

The numerous causes of inflammation may be classified as follows:

1. Microbes, e.g. bacteria, viruses, protozoa and fungi.
2. Physical agents, e.g. heat, cold, mechanical injury, ultraviolet and radiation.
3. Chemical agents: organic, e.g. microbial toxins and organic poisons.
4. Inorganic, e.g. acids, alkalis.
5. Antigens that stimulate immunological responses.

Inflammation can be classified as;

a. Acute Inflammation.
b. Chronic Inflammation.

ULCER

- Ulcer is defined as the erosion in the lining of the stomach or duodenum and is caused by the disruptions of the gastric mucosal defense and repair systems.
- Ulcer in the stomach is called gastric ulcer and in the duodenum is called duodenal ulcer and together peptic ulcer.
- In clinical practice, peptic ulcer is one of the most prevalent gastrointestinal disorders, commonly occurs in developed countries (Gregory M et al, 2009)[2].
- Peptic ulcer, also known as PUD or peptic ulcer disease is a break in the lining (mucosa) of the digestive tract produced by digestion of the mucosa by pepsin and acid, occurs when pepsin and acid are present in high concentration or when some other mechanism reduces the normal protective mechanism of the mucosa; bile salts may play a part, especially in stomach ulcer[3].

*Symptoms of a peptic ulcer are:-

1. Abdominal pain
2. Water brash (rush of saliva after an episode of regurgitation to dilute the acid in esophagus)
3. Nausea and copious vomiting.
4. Loss of appetite and weight.
5. Hematemesis (vomiting of blood); this can occur due to bleeding directly from a gastric ulcers or from damage to the esophagus from severe/continuing vomiting.

METHODOLOGY

1.1 Preparation of Different Extracts[7]:

A. Preparation of alcoholic extract:

Tubers of *S. tuberosum* were collected in the month of August from the Hind Pharmacy, Sultanpur (U.P) and dried in shade at room temperature then subjected to size reduction to a fine powder with the help of mixer grinder.

The tubers powder was packed in a soxhlet apparatus and extracted with 95% alcohol for 18 h. Appearance of colourless solvent in the siphon tube was taken as the termination of extraction. The extract was then transferred into the previously weighed empty beaker and evaporated to a thick paste on the water bath, maintained at 50^{o}C to get alcoholic (AETST) extract. The extract was finally air dried thoroughly to remove all traces of the solvent and the percentage yield was calculated.

B. Preparation of aqueous extract:

About 100 g of tubers powder was taken in a round bottom flask (2000 ml) and macerated with 500 ml of distilled water with 10 ml of chloroform (preservative) for 24 h with shaking for every hour in a closed vessel. Then the marc was removed by filtering the extract (AQETST) and then it was concentrated on a water bath maintained at 50^{o}C.

These two extracts were stored in airtight containers in a refrigerator below 10^{o}C. The two extracts were examined for their colour and consistency. Their percentage yield was calculated with reference to air-dried powder sample used for the extraction.

Table No: 1.1 Nature and Percentage Yield of the Extracts

Sl. No.	Name of the Extract	Nature	Color	%Yield (w/w) g
1.	Alcohol (AETST)	Sticky	Reddish Brown	12.50
2.	Aqueous (AQETST)	Solid	Dark brown	12.00

Both the AETST and AQETST were subjected to the following investigations:

1. Preliminary phytochemical screening.
2. Pharmacological activities
   a. Toxicity studies (LD_{50}).
   b. Anti-ulcer activity.
   c. Anti-inflammatory activity.

1.2 Preliminary Phytochemical Investigations:

The preliminary phytochemical investigations were carried out with AETST and AQETST for qualitative identification of phytochemical constituents present with each extract and test were carried out by following standard methods[7,8,9]. All the chemicals and reagents used were of analytical grade.

1.3 Pharmacological activities:

Experimental animals:

Albino rats (Wistar strain) of either sex weighing between 120-200 g and Albino mice 18-22 g were procured from National Centre for Laboratory Animal sciences, C/0 Shri. Venkateswara Enterprises, Bengaluru for experimental purpose and the animals were acclimatized for 7 days under standard husbandry condition as:

Room temperature- 26 ± 2^0C

Relative humidity- 45-55%

Light/ dark cycle - 12:12 h

The animals were fed with synthetic standard pellet diet purchased from Amrut Laboratories & Pranav Agro industries Ltd. Sangli (MS) and water was allowed *ad libitum* under strict hygienic conditions. All animal studies were performed in accordance to CPCSEA Guidelines No. 425 and Institutional Animal Ethical Committee (IAEC) of Luqman college of Pharmacy, Kalburgi, (RGHUS University, Karnataka) with CPCSEA Registration Number 557/02/e/CPCSEA. The procedures were followed as per rules and regulations.

1.3.1 Determination of acute toxicity (LD_{50})[77]

Method:

The acute toxicity of AETST and AQETST was determined in albino mice of either sex weighing between 18-22 g those maintained under standard husbandry conditions. The animals were fasted 3 h prior to the experiment and "up and down" (OECD Guideline No.
425) method of CPCSEA was adopted for toxicity studies. Animals were administered With single dose of extracts and observed for its mortality during 48 h study period (short term) toxicity. Based on the short-term toxicity profile of the extracts the doses of the next animals were determined as per as OECD Guidelines No: 425. All the animals were observed for long term toxicity (7 days) and then $1/5^{th}$, $1/10^{th}$ and $1/20^{th}$ of the maximum dose tested for LD_{50} of the individual extract was taken as effective dose ED_{50} and were used throughout the experimental studies.

Table No: 1.2 Details of Qualitative Phytochemical Tests.

Test	AETST	AQETST
I. Tests for sterols		
1. Test solution + Conc H_2SO_4	+	+
2. Salkowski's test	+	+
3. Test solution + sulphur	+	+
4. Libermann Burchard's test	+	+
II. Tests for Glycosides		
1. Baljet's test	+	+
2. Keller – killiani test	+	+
3. Bromine water test.	+	+
4. Legal's test	+	+
III. Test for Saponins		
1. Foam test	–	–
IV. Tests for Carbohydrates		
1. Molisch's test	+	+
2. Barfoed's test	+	+
3. Benedict's test	+	+
4. Fehling test	+	+
V. Tests for Alkaloids		
1. Mayer's test.	+	+
2. Wagner's test.	+	+
3. Hager's test	+	+
4. Dragendorff's test	+	+
VI. Test for Ascorbic acid		
1. Dichlorophenolindophenol test	–	–
VII. Tests for Flavonoids		
1. Ferric chloride test	+	+
2. Shinoda test	–	–
3. Zn-Hcl reduction test	+	+
4. Sodium hydroxide test	+	+
5. Lead acetate test.	+	+
VIII. Tests for Tannins		
1. Ferric chloride test.	+	+
2. Gelatin test	–	–
IX. Tests for Proteins		
1. Million's test	–	–
2. Biuret's test	–	–
3. Ninhydrin test	–	–
X. Test for fixed oils and fats		
1. Spot test	–	–
XI. Tests for triterpines		
1. Salkowski's test	+	+
2. Libermann- Burchard test	+	+

(+) Indicates positive result and (–) Indicates negative result.

1.3.1 Determination of acute toxicity (LD_{50})[77]

Method:

The acute toxicity of AETST and AQETST was determined in albino mice of either sex weighing between 18-22 g those maintained under standard husbandry conditions. The animals were fasted 3 h prior to the experiment and "up and down" (OECD Guideline No.
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With single dose of extracts and observed for its mortality during 48 h study period (short term) toxicity. Based on the short-term toxicity profile of the extracts the doses of the next animals were determined as per as OECD Guidelines No: 425. All the animals were observed for long term toxicity (7 days) and then $1/5^{th}$, $1/10^{th}$ and $1/20^{th}$ of the maximum dose tested for LD_{50} of the individual extract was taken as effective dose ED_{50} and were used throughout the experimental studies.

1.3.2 Determination of Anti-ulcer Activity:

1. Pylorus Ligation Model[38-41]:

Albino rats weighing between 150-200 g and each group containing 6 animals were divided into 8 groups.

Group A: Normal animals treated with vehicle only
Group B: Standard Ranitidine (30 mg/kg i.p)
Group C: AETST (100 mg/kg p.o)
Group D: AETST (200 mg/kg p.o)
Group E: AETST (400 mg/kg p.o)
Group F: AQETST (100 mg/kg p.o)
Group G: AQETST (200 mg/kg p.o)
Group H: AQETST (400 mg/kg p.o)

Experimental Procedure:

Albino rats weighing between 150-200 g were divided into 8 groups of 6 rats in each. They were fasted in individual cages for 24 h prior to the experiment with free access to water with measures to avoid coprophagy. Group A served as normal control, which was given with vehicle only. Group B with standard drug, groups C, D, E and F, G, H treated with low, medium and high doses of AETST and AQETST respectively. The various groups were treated with vehicle/extracts 30 min prior to pylorus ligation.

Under light ether anesthesia, the abdomen was opened and the pylorus was ligated and sutured. 4 h after ligation all the animals were sacrificed with excess of anaesthetic ether and the stomach were dissected out. Gastric juice was collected into tubes and centrifuged at 1000 rpm for 10 min and volume was noted. The pH of the gastric juice will be recorded by pH meter. The gastric content was subjected for analysis of free and total acidity. The glandular portion of the stomach was opened along the greater curvature and the severity of hemorrhagic erosions in the acid secreting mucosa was assessed on a scale of 0 to 3, i.e. ulcer index was determined by the following formula,

$$U_i = U_N + U_S + U_P \times 10^{-1}$$

Where U_i is Ulcer index,
U_N = average of number of ulcers per animal
U_S = average of severity score,
U_P = percentage of animals with ulcers.

Mean ulcer score for each animal is expressed as Ulcer Index. The percentage ulcer protection was calculated using the formula

*Percentage ulcer protection = Uc - Ut / Uc X 100

Where, Ut = Ulcer index of treated group,
Uc = Ulcer index of the control group.

Table No: 1.3.Ulcer scores

S. No.	Stomach colour	Ulcer score
1	Normal colour	0
2	Red colour	0.5
3	Red spots	1
4	Hemorrhagic streaks	1.5
5	3 > 5 ulcers	2
6	< 5 ulcers	3

Reagents for biochemical estimations of free and total acidity of gastric juice

1) Reagents for estimation of free and total acidity

- Freshly prepared 0.01N oxalic acid solution was used to standardize Sodium hydroxide.
- Freshly prepared 0.01N Sodium hydroxide
- Topfer's reagent. It is Dimethylamino azobenzene 0.5% in absolute Ethanol available in 100 ml package.
- Freshly prepared 1% Phenolphthalein solution prepared in 50% absolute Ethanol.

Methods for biochemical estimation of free and total acidity:

Collection of gastric juice[13,14].

Gastric content collected from pylorus ligated rats was centrifuged and the volumes of gastric juice as well as pH of gastric juice were noted. Further the gastric juice was subjected to biochemical estimations as follows:

Determination of free and total acidity:-

1 ml of gastric juice was pipetted into a 100 ml conical flask, 2 or 3 drops of Topfer's reagent was added and titrated with 0.01N Sodium hydroxide until all traces of red colour disappears and the colour of the solution was 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.

Acidity was calculated by using the formula;

$$\text{Acidity} = \frac{\text{Volume of NaOH} \times \text{Normality of NaOH} \times 100}{0.1} \text{ m eq/lt/100 g}$$

2. Stress induced ulcers by cold water immersion[15]:

Albino rats weighing between 150-200 g and each group containing 6 animals were divided into 8 groups:

Group A: Normal control treated with vehicle only.
Group B: Standard Ranitidine (30 mg/kg i.p).
Group C: AETST (100 mg/kg p.o).
Group D: AETST (200 mg/kg p.o).
Group E: AETST (400 mg/kg p.o).
Group F: AQETST (100 mg/kg p.o).
Group G: AQETST (200 mg/kg p.o).
Group H: AQETST (400 mg/kg p.o).

Experimental Procedure:

Albino rats of either sex weighing between 150-200 g were divided into 8 groups of 6 rats in each. Group A served as normal control, which was given with vehicle only. Group B with standard drug. Groups C, D, E and F, G, H treated with low, medium and high doses of AETST and AQETST respectively. After 30 min of oral administration of the vehicle/Std/extracts, rats were placed vertically in individual restraint cages in cold water maintained at 22^0C for 1 h. Then, they were taken out, dried and injected with 30 mg/kg Evans blue i.v. via the tail vein. 10 min later, sacrificed with ether and their stomachs were removed. Formol-saline (2%v/v) is then injected into the totally ligated stomachs for overnight storage. The next day, the stomachs were opened along the greater curvature, washed in warm water and examined for ulcers microscopically with the help of hand lens (10x). Mean ulcer score for each animal is expressed as ulcer index.

1.3.3 Determination of anti-inflammatory activity:

1. Carrageenan induced paw edema[17-18]:

Group A: Toxicant control (0.1 ml of 1% w/v Carrageenan, hind paw)
Group B: Standard (Ibuprofen 40 mg/ kg, p.o)
Group C: AETST (100 mg/kg p.o)
Group D: AETST (200 mg/kg p.o)
Group E: AETST (400 mg/kg p.o)
Group F: AQETST (100 mg/kg p.o)
Group G: AQETST (200 mg/kg p.o)
Group H: AQETST (400 mg/kg p.o)

Experimental Procedure:

Male albino rats (125-150 g) of 8 groups were housed as groups of six, fasted overnight prior to and during the experiment but have free access to water. Group A was served as normal toxicant control treated with toxicant carrageenan, group B

with Ibuprofen (40 mg/kg p.o.) served as standard, groups C, D and E administered with AETST and groups F, G and H with AQETST (low, medium and high doses p.o) respectively. The rats in Groups B, C, D, E, F, G and H were administered with 0.1 ml of 1% w/v of carrageenan into sub plantar region of right hind paw of rats 1 h after the administration of Ibuprofen/extracts. Immediately thereafter the oedema volumes of the injected paws were measured plethysmographically at prefixed time intervals.

2. Histamine induced paw edema[45-47]:

Group A: Toxicant control (0.1 ml of 1% w/v histamine, hind paw)
Group B: Standard (Ibuprofen 40 mg/ kg)
Group C: AETST (100 mg/kg p.o)
Group D: AETST (200 mg/kg p.o)
Group E: AETST (400 mg/kg p.o)
Group F: AQETST (100 mg/kg p.o)
Group G: AQETST (200 mg/kg p.o)
Group H: AQETST (400 mg/kg p.o)

Experimental Procedure:

Male albino rats (125-150 g) of 8 groups were housed as groups of 6, fasted overnight prior to and during the experiment but have free access to water. Group A was served as toxicant control treated with inflammogen histamine, group B with Ibuprofen (40 mg/kg p.o.) that served as standard. Groups C, D, E and F, G, H will administered with AETST and AQETST (low, medium and high dose p.o) respectively. The rats of groups B, C, D, E, F, G and H were administered with 1% w/v of histamine into sub plantar region of right hind paw of rats 1 h after administration of Ibuprofen/extracts. Immediately thereafter the oedema volumes of the injected paws were measured plethysmographically at prefixed time intervals.

3. Formalin Induced Paw Oedema[44-47]:

Group A:Toxicant control (Formalin 1%, hind paw)
Group B:Standard (Ibuprofen 40 mg/ kg)
Group C:AETST (100 mg/kg p.o)
Group D:AETST (200 mg/kg p.o)
Group E:AETST (400 mg/kg p.o)
Group F:AQETST (100 mg/kg p.o)
Group G:AQETST (200 mg/kg p.o)
Group H:AQETST (400 mg/kg p.o)

Experimental Procedure:

Male albino rats (125-150 g) of 8 groups were housed as groups of 6, fasted overnight prior to and during the experiment but have free access to water. Group A was served as toxicant control treated with toxicant Formalin, group B with Ibuprofen (40 mg/kg p.o.) that served as standard. Groups C, D, E and F, G, H were administered with AETST and AQETST (low, medium and high dose p.o) respectively. The rats of groups B, C, D, E, F, G and H were administered with 1% of Formalin into sub plantar region of right hind paw of rats 1 h after administration of Ibuprofen/extracts. Immediately thereafter the oedema volumes of the injected paws were measured plethysmographically at prefixed time intervals.

For comparison purpose, the volume of oedema was measured at prefixed time intervals. The difference between paw volumes of the treated animals was measured and the mean oedema volume was calculated. Percentage reduction in oedema volume was calculated by using the formula,

$$\text{Percentage reduction} = \frac{Vo - Vt}{Vo} \times 100$$

Where, Vo = Volume of the paw of control at time't'.
Vt = Volume of the paw of drug treated at time't'.

Statistical analysis:

All results will be expressed as mean ± SEM from 6 animals. Statistical difference in mean will be analyzed using one-way ANOVA (analysis of variance) followed by Post hoc test (Dunnett's't' test). $P< 0.05^{*}$, 0.01^{**} and 0.001^{***} will be considered as statistically significant.

3. RESULTS

PRELIMINARY PHYTOCHEMICAL STUDIES:-

Table No: 3.1 Antiulcer effects of AETST and AQETST in pylorus ligation induced ulcer model in rats

ULCER NUMBERS:-								
Animals	Control	Ranitidine 30 mg/kg	AETST 100 mg/kg	AETST 200 mg/kg	AETST 400 mg/kg	AQETST 100 mg/kg	AQETST 200 mg/kg	AQETST 400 mg/kg
H	5	0	3	1	0	4	1	0
B	4	0	3	1	1	4	1	1
T	6	0	3	3	1	3	1	1
HB	7	1	5	1	1	3	2	0
HT	4	0	3	1	1	3	1	1
BT	4	1	5	1	1	3	1	1
mean±SEM	**5.00±0.51**	**0.33±0.21*****	**3.66±0.42***	**1.33±0.33****	**0.83±0.16***	**3.33±0.21***	**1.16±0.16****	**0.66±0.21****
ULCER SCORE:-								
H	3.0	0.0	2	1.5	0.5	3.0	1.5	0.5
B	2.0	0.5	2	1.5	0.5	2.0	1.5	0.5
T	3.0	0.5	2	2.0	1.0	2.0	1.5	1.0
HB	3.0	1.0	3	1.5	1.0	2.0	1.5	0.5
HT	2.0	0.5	2	1.5	1.0	1.5	1.0	1.0
BT	1.5	0.5	3	1.5	1.0	2.0	1.0	1.0
mean±SEM	**2.41±0.27**	**0.50±0.12*****	**2.33±0.21^{ns}**	**1.58±0.08****	**0.83±0.10***	**2.08±0.20^{ns}**	**1.33±0.10****	**0.75±0.11****

n = 6, Significant at P < 0.05*, 0.01** and 0.001***, ns = not significant.
AETST- Alcoholic Extract of Tuber of *S. tuberosum,*
AQETST- Aqueous Extract of Tuber of *S. tuberosum.*

Table No: 3.2 Antiulcer effects of AETST and AQETST in pylorus ligation induced ulcer model in rats

VOLUME OF GASTRIC JUICE(ml)								
Animals	Control	Ranitidine 30 mg/kg	AETST 100 mg/kg	AETST 200 mg/kg	AETST 400 mg/kg	AQETST 100 mg/kg	AQETST 200 mg/kg	AQETST 400 mg/kg
H	6.5	4.5	5.9	5.0	5.0	6.2	5.1	4.3
B	6.5	4.8	6.0	4.8	4.5	5.5	4.8	4.2
T	7.0	4.0	5.8	5.2	4.7	5.4	4.8	5.0
HB	6.4	3.9	6.2	4.9	4.9	5.9	4.9	4.5
HT	6.8	4.3	6.0	5.3	4.8	5.7	4.7	4.8
BT	7.0	4.2	6.3	4.9	4.6	5.6	4.8	4.6
mean± SEM	**6.70±0.10**	**4.28±0.13*****	**6.03±0.07*****	**5.01±0.07*****	**4.75±0.07*****	**5.71±0.11*****	**4.85±0.05*****	**4.56±0.12*****

FREE ACIDITY (m eq/L)								
H	35	16	27	20	22	27	20	19
B	30	15	25	22	21	25	22	21
T	28	19	23	24	18	20	24	18
HB	32	18	28	23	20	28	23	20
HT	34	17	23	24	19	21	22	19
BT	29	19	24	21	25	22	20	23
mean± SEM	**31.33±1.15**	**17.33±0.66*****	**25.00±0.85*****	**22.33±0.66*****	**20.83±1.01*****	**23.83±1.35*****	**21.83±0.65*****	**20.00±0.73*****
TOTAL ACIDITY (m eq/L)								
H	76	41	56	53	46	55	52	43
B	82	44	58	50	48	54	50	47
T	88	48	59	42	44	56	42	44
HB	86	40	60	41	49	60	41	49
HT	78	45	62	47	45	62	44	45
BT	84	43	63	51	48	61	51	48
mean± SEM	**82.33±1.89**	**43.50±1.17*****	**59.67±1.05*****	**47.33±2.01*****	**46.67±0.80*****	**58.00±1.39*****	**46.67±1.99*****	**46.00±0.96*****

n = 6, Significant at P < 0.05*, 0.01** and 0.001***, ns = not significant.
AETST- Alcoholic Extract of Tuber of *S. tuberosum,*
AQETST- Aqueous Extract of Tuber of *S. tuberosum.*

Table No: 3.3 Antiulcer effects of AETST and AQETST in stress induced ulcer model in rats

ULCER NUMBER								
Animals	Control	Ranitidine 30 mg/kg	AETST 100 mg/kg	AETST 200 mg/kg	AETST 400 mg/kg	AQETST 100 mg/kg	AQETST 200 mg/kg	AQETST 400 mg/kg
H	4	1	4	2	1	4	2	1
B	4	0	3	2	1	3	1	1
T	6	0	3	1	0	3	2	1
HB	5	1	3	1	1	3	1	1
HT	5	0	4	2	1	3	2	0
BT	4	1	4	2	1	3	1	1
mean±SEM	**4.67±0.33**	**0.50±0.22*****	**3.50±0.22*****	**1.67±0.21*****	**0.83±0.16*****	**3.17±0.16*****	**1.50±0.22*****	**0.83±0.16*****

ULCER SCORE								
H	2.0	1.0	3.0	2.0	1.0	3.0	2.0	1.0
B	3.0	0.5	2.0	2.0	1.5	2.0	1.5	1.0
T	3.0	0.5	2.0	1.5	1.0	3.0	1.5	1.0
HB	3.0	1.0	2.0	1.5	1.0	2.0	1.5	0.5
HT	3.0	0.5	3.0	2.0	1.0	2.0	2.0	1.0
BT	2.0	1.0	3.0	2.0	1.0	3.0	1.5	1.0
mean±SEM	**2.67±0.21**	**0.75±0.11* ****	**2.50±0.22 ns**	**1.83±0.10* ***	**1.08±0.08* ****	**2.50±0.22 ns**	**1.67±0.10* ****	**0.91±0.08* ****

n = 6, Significant at P < 0.05*, 0.01** and 0.001***, ns = not significant.
AETST- Alcoholic Extract of Tuber of *S. tuberosum,*
AQETST- Aqueous Extract of Tuber of *S. tuberosum.*

Table No: 3.4 Antiulcer effects of AETST and AQETST in stress induced ulcer model in rats

VOLUME OF GASTRIC JUICE (ml)								
Animals	Control	Ranitidine 30mg/kg	AETST 100 mg/kg	AETST 200 mg/kg	AETST 400 mg/kg	AQETST 100 mg/kg	AQETST 200 mg/kg	AQETST 400 mg/kg
H	6.8	4.6	6.2	5.2	5.1	6.2	5.1	4.6
B	6.6	4.8	6.0	5.0	4.7	5.9	4.9	4.8
T	7.0	4.1	6.1	5.1	4.8	5.8	4.8	5.0
HB	6.4	4.2	6.2	5.2	5.0	6.2	5.1	4.5
HT	6.8	4.3	6.4	5.3	4.9	5.9	4.7	4.8
BT	7.0	4.3	6.3	5.1	4.8	6.1	5.1	4.9
mean±SEM	**6.77±0.09**	**4.38±0.10*****	**6.20±0.05*****	**5.15±0.04*****	**4.88±0.06*****	**6.02±0.07*****	**4.95±0.07*****	**4.77±0.07*****
FREE ACIDITY (m eq/L)								
H	31	20	25	24	23	26	20	21
B	33	17	26	22	24	28	24	24
T	32	21	27	28	20	24	23	22
HB	34	20	29	23	22	28	25	19
HT	35	19	26	26	22	23	23	20
BT	35	17	28	24	25	25	25	23
mean±SEM	**33.33±0.66**	**19.00±0.68** ***	**26.83±0.60*****	**24.50±0.88*****	**22.67±0.71*****	**25.67±0.84*****	**23.33±0.76*****	**21.50±0.76*****

TOTAL ACIDITY (m eq/L)								
H	80	44	58	50	48	60	52	45
B	83	43	62	52	50	60	51	50
T	86	48	60	48	48	58	44	44
HB	88	48	64	45	51	61	45	49
HT	87	47	62	47	47	62	44	48
BT	85	44	64	52	48	61	51	47
mean±SEM	**84.83±1.19**	**45.67±0.91****	**61.67±0.95*****	**49.00±1.15*****	**48.67±0.61*****	**60.33±0.55*****	**47.83±1.57*****	**47.17±0.94*****

n = 6, Significant at P < 0.05*, 0.01** and 0.001***, ns = not significant.
AETST- Alcoholic Extract of Tuber of *S. tuberosum,*
AQETST- Aqueous Extract of Tuber of *S. tuberosum*.

Table No: 3.5 Antiulcer effects of AETST and AQETST in different ulcers models in rats

		Pylorus ligation model					Stress induced ulcer model				
Groups	Treatment	Ulcer Number	Ulcer Score	Incidence of Ulcers (%)	Ulcer Index	Inhibition of Ulcers (%)	Ulcer Number	Ulcer score	Incidence of Ulcers (%)	Ulcer Index	Inhibit-ion of Ulcers (%)
Control	vehicle 10 ml/kg p.o	**5.00 ±0.51**	**2.41 ±0.27**	100	10.74	-	**4.67 ±0.33**	**2.67 ±0.21**	100	10.73	--
Stan Dard	Ranitidine 30 mg/kg	**0.33 ±0.21*****	**0.50 ±0.12*****	33.33	3.41	68.24	**0.50 ±0.22*****	**0.75 ±0.11*****	50	5.12	52.28
AETST	100 mg/kg p.o	**3.66 ±0.42***	**2.33 ±0.21**^{ns}	100	10.59	1.39	**3.50 ±0.22****	**2.50 ±0.22**^{ns}	100	10.60	1.21
AETST	200 mg/kg p.o	**1.33 ±0.33*****	**1.58 ±0.08****	100	10.29	4.18	**1.67 ±0.21*****	**1.83 ±0.10****	100	10.35	3.54
AETST	400 mg/kg p.o	**0.83 ±0.16*****	**0.83 ±0.10*****	83.33	8.49	20.94	**0.83 ±0.16*****	**1.08 ±0.08*****	83.33	8.52	20.59
AQETST	100 mg/kg p.o	**3.33 ±0.21****	**2.08 ±0.20**^{ns}	100	10.54	1.86	**3.17 ±0.16*****	**2.50 ±0.22**^{ns}	100	10.56	1.58
AQETST	200 mg/kg p.o	**1.16 ±0.16*****	**1.33 ±0.10*****	100	10.24	4.65	**1.50 ±0.22*****	**1.67 ±0.10*****	100	10.31	3.91
AQETST	400 mg/kg p.o	**0.66 ±0.21*****	**0.75 ±0.11*****	66.66	6.80	36.68	**0.83 ±0.16*****	**0.91 ±0.08*****	83.33	8.50	20.78

n = 6, Significant at P < 0.05*, 0.01** and 0.001***, ns = not significant.

3.2.3 Anti-inflammatory activity:

Table No: 3.6 Anti-inflammatory effects of AETST and AQETST in Carrageenan induced paw oedema model in rats

Time after		Paw oedema volume (ml)							
Treatment	Animal	Toxicant	Standard	AETST 100 mg/kg	AETST 200 mg/kg	AETST 400 mg/kg	AQETST 100 mg/kg	AQETST 200 mg/kg	AQETST 400 mg/kg
1 h	H	0.35	0.20	0.35	0.25	0.25	0.30	0.25	0.30
	B	0.40	0.25	0.40	0.30	0.30	0.30	0.30	0.25
	T	0.30	0.10	0.25	0.30	0.25	0.35	0.20	0.20
	HB	0.35	0.30	0.35	0.35	0.30	0.30	0.30	0.30
	BT	0.35	0.20	0.30	0.30	0.30	0.35	0.35	0.25
	HT	0.35	0.15	0.35	0.30	0.20	0.30	0.30	0.20
mean±SEM		**0.350±0.012**	**0.200±0.028*****	**0.333±0.021^{ns}**	**0.300±0.012^{ns}**	**0.266±0.016***	**0.316±0.010^{ns}**	**0.283±0.021^{ns}**	**0.250±0.018****
2 h	H	0.50	0.15	0.35	0.25	0.25	0.35	0.30	0.20
	B	0.40	0.25	0.40	0.40	0.30	0.40	0.30	0.25
	T	0.45	0.10	0.35	0.35	0.35	0.40	0.25	0.30
	HB	0.40	0.25	0.45	0.40	0.30	0.35	0.40	0.30
	BT	0.45	0.15	0.45	0.30	0.25	0.45	0.30	0.25
	HT	0.40	0.10	0.40	0.30	0.35	0.35	0.35	0.30
mean±SEM		**0.433±0.016**	**0.167±0.027*****	**0.400±0.018^{ns}**	**0.333±0.024****	**0.300±0.018*****	**0.383±0.016^{ns}**	**0.317±0.021****	**0.267±0.016*****
3 h	H	0.50	0.10	0.40	0.30	0.30	0.40	0.40	0.20
	B	0.45	0.15	0.45	0.40	0.30	0.40	0.35	0.25
	T	0.50	0.00	0.40	0.35	0.35	0.40	0.30	0.30
	HB	0.50	0.15	0.45	0.40	0.25	0.35	0.30	0.30
	BT	0.45	0.10	0.40	0.35	0.30	0.45	0.35	0.35
	HT	0.50	0.10	0.40	0.30	0.30	0.40	0.30	0.20
mean±SEM		**0.483±0.010**	**0.100±0.022*****	**0.417±0.010***	**0.350±0.018*****	**0.300±0.012*****	**0.400±0.012****	**0.333±0.016*****	**0.267±0.024*****
4 h	H	0.50	0.10	0.30	0.30	0.20	0.30	0.30	0.15
	B	0.45	0.00	0.40	0.35	0.15	0.35	0.30	0.10
	T	0.40	0.15	0.35	0.30	0.30	0.30	0.25	0.20
	HB	0.50	0.10	0.40	0.25	0.10	0.25	0.30	0.15
	BT	0.40	0.05	0.35	0.35	0.15	0.40	0.25	0.20
	HT	0.45	0.00	0.30	0.25	0.20	0.30	0.20	0.10
mean±SEM		**0.450±0.018**	**0.066±0.024*****	**0.350±0.018****	**0.300±0.018*****	**0.183±0.027*****	**0.317±0.021*****	**0.267±0.016*****	**0.150±0.018*****

n = 6, Significant at P < 0.05*, 0.01** and 0.001***, ns = not significant.
AETST- Alcoholic Extract of Tuber of *S. tuberosum,*
AQETST- Aqueous Extract of Tuber of *S. tuberosum.*

Table No: 3.7 Anti-inflammatory effects of AETST and AQETST in Carrageenan induced paw oedema model in rats at different time intervals

Sl. No.	Groups	Treatment	1 h	% ROV	2 h	% ROV	3 h	% ROV	4 h	% ROV
A	Toxicant	Carrageenan (1% w/v)	**0.350 ±0.012**	--	**0.433 ±0.016**	--	**0.483 ±0.010**	--	**0.450 ±0.018**	--
B	Standard	Ibuprofen 40 mg/kg	**0.200 ±0.028*****	42.85	**0.167 ±0.027****	61.43	**0.100 ±0.022*****	79.29	**0.066 ±0.024***	85.33
C	AETST	100 mg/kg	**0.333 ±0.021**^{ns}	4.85	**0.400 ±0.018**^{ns}	7.62	**0.417 ±0.010***	13.66	**0.350 ±0.018***	22.22
D	AETST	200 mg/kg	**0.300 ±0.012**^{ns}	14.28	**0.333 ±0.024****	23.09	**0.350 ±0.018*****	27.53	**0.300 ±0.018***	33.33
E	AETST	400 mg/kg	**0.266 ±0.016***	24.00	**0.300 ±0.018****	30.71	**0.300 ±0.012*****	37.88	**0.183 ±0.027***	59.25
F	AQETST	100 mg/kg	**0.316 ±0.010**^{ns}	9.71	**0.383 ±0.016**^{ns}	11.44	**0.400 ±0.012****	17.14	**0.317 ±0.021***	29.55
G	AQETST	200 mg/kg	**0.283 ±0.021**^{ns}	19.14	**0.317 ±0.021****	26.78	**0.333 ±0.016*****	31.05	**0.267 ±0.016***	40.66
H	AQETST	400 mg/kg	**0.250 ±0.018****	28.57	**0.267 ±0.016****	38.33	**0.267 ±0.024*****	44.72	**0.150 ±0.018***	66.66

n = 6, Significant at P < 0.05*, 0.01** and 0.001***, ns = not significant. ROV- Reduction of Oedema Volume. AETST- Alcoholic Extract of Tuber of *S. tuberosum,*

AQETST- Aqueous Extract of Tuber of *S. tuberosum* .

Table No: 3.8 Anti-inflammatory effects of AETST and AQETST in Histamine induced paw oedema model in rats

Time after		PAW OEDEMA VOLUME (ML)							
Treat Ment	Animals	Toxicant	Standard	AETST 100 mg/kg	AETST 200 mg/kg	AETST 400 mg/kg	AQETST 100 mg/kg	AQETST 200 mg/kg	AQETST 400 mg/kg
1 h	H	0.35	0.15	0.40	0.25	0.20	0.30	0.25	0.20
	B	0.40	0.10	0.35	0.25	0.25	0.40	0.30	0.15
	T	0.40	0.20	0.30	0.35	0.30	0.40	0.35	0.20
	HB	0.40	0.20	0.40	0.40	0.20	0.35	0.30	0.20
	BT	0.40	0.20	0.35	0.30	0.25	0.30	0.25	0.25
	HT	0.35	0.15	0.40	0.35	0.20	0.35	0.25	0.20
mean±SEM		**0.383±0.010**	**0.167±0.016*****	**0.367±0.016^{ns}**	**0.317±0.024***	**0.233±0.016*****	**0.350±0.018^{ns}**	**0.283±0.016****	**0.200±0.012*****
2 h	H	0.45	0.20	0.45	0.30	0.20	0.35	0.35	0.25
	B	0.50	0.15	0.30	0.30	0.25	0.40	0.30	0.20
	T	0.40	0.10	0.30	0.35	0.30	0.40	0.35	0.25
	HB	0.50	0.15	0.50	0.35	0.20	0.30	0.30	0.20
	BT	0.45	0.10	0.45	0.35	0.25	0.35	0.30	0.15
	HT	0.40	0.10	0.40	0.35	0.30	0.40	0.30	0.25
mean±SEM		**0.450±0.018**	**0.133±0.016*****	**0.400±0.034^{ns}**	**0.333±0.010*****	**0.250±0.018*****	**0.367±0.016***	**0.317±0.010*****	**0.217±0.016*****
3 h	H	0.45	0.10	0.45	0.30	0.20	0.30	0.30	0.15
	B	0.50	0.15	0.40	0.30	0.20	0.35	0.30	0.15
	T	0.50	0.00	0.40	0.35	0.25	0.40	0.25	0.20
	HB	0.55	0.00	0.40	0.30	0.20	0.35	0.30	0.20
	BT	0.50	0.05	0.45	0.35	0.25	0.40	0.25	0.15
	HT	0.50	0.10	0.40	0.30	0.20	0.40	0.30	0.25
mean±SEM		**0.500±0.012**	**0.066±0.024*****	**0.417±0.010****	**0.317±0.010*****	**0.217±0.010*****	**0.367±0.016*****	**0.283±0.010*****	**0.183±0.016*****
4 h	H	0.45	0.00	0.40	0.20	0.15	0.25	0.20	0.10
	B	0.40	0.10	0.35	0.25	0.15	0.30	0.20	0.10
	T	0.50	0.00	0.30	0.30	0.20	0.30	0.15	0.15
	HB	0.50	0.00	0.30	0.25	0.10	0.30	0.25	0.10
	BT	0.50	0.00	0.40	0.30	0.15	0.30	0.20	0.10
	HT	0.45	0.10	0.35	0.20	0.15	0.35	0.30	0.15
mean±SEM		**0.467±0.016**	**0.033±0.021*****	**0.350±0.018*****	**0.250±0.018*****	**0.150±0.012*****	**0.300±0.012*****	**0.217±0.021*****	**0.117±0.010*****

n = 6, Significant at P < 0.05*, 0.01** and 0.001***, ns = not significant.
AETST- Alcoholic Extract of Tuber of *S. tuberosum,*
AQETST- Aqueous Extract of Tuber of *S. tuberosum*.

Table No: 3.9 Anti-inflammatory effects of AETST and AQETST in Histamine induced paw oedema model in rats at different time intervals

Sr. No	Groups	Treatment	1 h	% ROV	2 h	% ROV	3 h	% ROV	4 h	% ROV
A	Toxicant	Histamine (1%w/v)	**0.383 ±0.010**	--	**0.450 ±0.018**	--	**0.500 ±0.012**	--	**0.467 ±0.016**	--
B	Standard	Ibuprofen 40 mg/kg	**0.167 ±0.016*****	56.39	**0.133 ±0.016**$^{**}_{*}$	70.44	**0.066 ±0.024**$^{*}_{**}$	86.80	**0.033 ±0.021**$^{**}_{*}$	92.93
C	AETST	100 mg/kg	**0.367 ±0.016**^{ns}	4.17	**0.400 ±0.034**^{ns}	11.11	**0.417 ±0.010**$^{*}_{*}$	16.60	**0.350 ±0.018**$^{**}_{*}$	25.05
D	AETST	200 mg/kg	**0.317 ±0.024***	17.23	**0.333 ±0.010**$^{**}_{*}$	26.00	**0.317 ±0.010**$^{*}_{**}$	36.66	**0.250 ±0.018**$^{**}_{*}$	46.46
E	AETST	400 mg/kg	**0.233 ±0.016*****	39.16	**0.250 ±0.018****	44.44	**0.217 ±0.010**$^{*}_{**}$	56.66	**0.150 ±0.012**$^{**}_{*}$	67.88
F	AQETST	100 mg/kg	**0.350 ±0.018**^{ns}	8.61	**0.367 ±0.016***	18.44	**0.367 ±0.016**$^{*}_{**}$	26.60	**0.300 ±0.012**$^{**}_{*}$	35.76
G	AQETST	200 mg/kg	**0.283 ±0.016****	26.10	**0.317 ±0.010**$^{**}_{*}$	29.55	**0.283 ±0.010**$^{*}_{**}$	43.40	**0.217 ±0.021**$^{**}_{*}$	53.53
H	AQETST	400 mg/kg	**0.200 ±0.012*****	47.78	**0.217 ±0.016**$^{**}_{*}$	51.77	**0.183 ±0.016**$^{*}_{**}$	63.40	**0.117 ±0.010**$^{**}_{*}$	74.94

n = 6, Significant at P < 0.05*, 0.01** and 0.001***, ns = not significant. ROV-Reduction of OedemaVolume.

AETST- Alcoholic Extract of Tuber of *S. tuberosum,*

AQETST- Aqueous Extract of Tuber of *S. tuberosum*.

Table No: 3.10 Anti-inflammatory effects of AETST and AQETST in Formalin induced paw edema model in rats

TIME AFTER		PAW OEDEMA VOLUME (ML)							
Treatment	Animals	Toxicant	Standard	AETST 100 mg/kg	AETST 200 mg/kg	AETST 400 mg/kg	AQETST 100 mg/kg	AQETST 200 mg/kg	AQETST 400 mg/kg
1 h	H	0.40	0.20	0.40	0.30	0.25	0.40	0.35	0.25
	B	0.40	0.20	0.40	0.35	0.30	0.35	0.35	0.20
	T	0.45	0.15	0.25	0.30	0.20	0.40	0.25	0.20
	HB	0.40	0.25	0.40	0.40	0.25	0.35	0.30	0.25
	BT	0.35	0.20	0.45	0.30	0.30	0.30	0.30	0.30
	HT	0.40	0.10	0.40	0.35	0.20	0.40	0.35	0.20
mean±SEM		**0.400± 0.012**	**0.183±0.021*****	**0.383±0.027^{ns}**	**0.333±0.016^{ns}**	**0.250±0.018*****	**0.367±0.016^{ns}**	**0.317±0.016***	**0.233±0.016*****
2 h	H	0.50	0.20	0.50	0.30	0.30	0.50	0.30	0.20
	B	0.45	0.15	0.40	0.40	0.25	0.35	0.35	0.25
	T	0.50	0.20	0.45	0.35	0.30	0.40	0.30	0.20
	HB	0.45	0.20	0.40	0.40	0.20	0.35	0.35	0.30
	BT	0.40	0.15	0.45	0.40	0.25	0.40	0.30	0.20
	HT	0.50	0.10	0.40	0.35	0.30	0.50	0.40	0.25
mean±SEM		**0.467± 0.016**	**0.167±0.016*****	**0.433±0.016^{ns}**	**0.367±0.016****	**0.267±0.016*****	**0.417±0.027^{ns}**	**0.333±0.016*****	**±0.233±0.016*****
3 h	H	0.55	0.10	0.45	0.40	0.30	0.5	0.25	0.15
	B	0.50	0.05	0.50	0.35	0.25	0.45	0.30	0.20
	T	0.50	0.10	0.40	0.30	0.20	0.40	0.35	0.20
	HB	0.50	0.10	0.45	0.30	0.25	0.30	0.35	0.25
	BT	0.50	0.10	0.40	0.35	0.20	0.45	0.35	0.20
	HT	0.55	0.05	0.50	0.40	0.20	0.40	0.30	0.20
mean±SEM		**0.517± 0.010**	**0.083±0.010*****	**0.450±0.018^{ns}**	**0.350±0.018*****	**0.233±0.016*****	**0.417±0.027****	**0.317±0.016*****	**0.200±0.012*****
4 h	H	0.50	0.10	0.35	0.30	0.20	0.40	0.20	0.10
	B	0.45	0.00	0.40	0.25	0.20	0.30	0.20	0.15
	T	0.50	0.00	0.30	0.20	0.15	0.30	0.30	0.10
	HB	0.45	0.10	0.40	0.25	0.20	0.25	0.20	0.20
	BT	0.50	0.10	0.35	0.30	0.10	0.35	0.25	0.10
	HT	0.50	0.00	0.40	0.30	0.15	0.30	0.25	0.15
mean±SEM		**0.483± 0.010**	**0.050±0.022*****	**0.367±0.016****	**0.267±0.016*****	**0.167±0.016*****	**0.317±0.021*****	**0.233±0.016*****	**0.133±0.016*****

n = 6, Significant at P < 0.05*, 0.01** and 0.001***, ns = not significant.
AETST- Alcoholic Extract of Tuber of *S. tuberosum,*
AQETST- Aqueous Extract of Tuber of *S. tuberosum* .

Table No: 3.11 Anti-inflammatory effects of AETST and AQETST in Formalin induced paw oedema model in rats at different time intervals

Sl.No.	Groups	Treatment	1 h	% ROV	2 h	% ROV	3 h	% ROV	4 h	% ROV
A	Toxicant	Formalin (1% w/v)	**0.400 ±0.012**	--	**0.467 ±0.016**	--	**0.517 ±0.010**	--	**0.483 ±0.010**	--
B	Standard	Ibuprofen 40mg/kg	**0.183 ±0.021**$^{*}_{**}$	54.25	**0.167 ±0.016**$^{*}_{**}$	64.23	**0.083 ±0.010**$^{*}_{**}$	83.90	**0.050 ±0.022**$^{*}_{**}$	89.64
C	AETST	100 mg/kg	**0.383 ±0.027**$^{n}_{s}$	4.25	**0.433 ±0.016**^{ns}	7.28	**0.450 ±0.018**$^{n}_{s}$	12.95	**0.367 ±0.016**$^{*}_{*}$	24.01
D	AETST	200 mg/kg	**0.333 ±0.016**$^{n}_{s}$	16.75	**0.367 ±0.016**$^{*}_{*}$	21.41	**0.350 ±0.018**$^{*}_{**}$	32.30	**0.267 ±0.016**$^{*}_{**}$	44.72
E	AETST	400 mg/kg	**0.250 ±0.018**$^{*}_{**}$	37.50	**0.267 ±0.016**$^{*}_{**}$	42.82	**0.233 ±0.016**$^{*}_{**}$	54.92	**0.167 ±0.016**$^{*}_{**}$	65.42
F	AQETST	100 mg/kg	**0.367 ±0.016**$^{n}_{s}$	8.25	**0.417 ±0.027**^{ns}	10.70	**0.417 ±0.027**$^{*}_{*}$	19.34	**0.317 ±0.021**$^{*}_{**}$	34.36
G	AQETST	200 mg/kg	**0.317 ±0.016***	20.75	**0.333 ±0.016**$^{*}_{**}$	28.69	**0.317 ±0.016**$^{*}_{**}$	38.68	**0.233 ±0.016**$^{*}_{**}$	51.75
H	AQETST	400 mg/kg	**0.233 ±0.016**$^{*}_{**}$	41.75	**±0.233 ±0.016**$^{*}_{**}$	50.10	**0.200 ±0.012**$^{*}_{**}$	61.31	**0.133 ±0.016**$^{*}_{**}$	72.46

n = 6, Significant at P < 0.05*, 0.01** and 0.001***, ns = not significant.

ROV- Reduction of Oedema Volume.

AETST- Alcoholic Extract of Tuber of *S. tuberosum,*

AQETST- Aqueous Extract of Tuber of *S. tuberosum.*

4. DISCUSSION

Peptic ulcer is a conglomerate of most common heterogenous disorders, present as a crater in the lining of the GIT mucosa due to acid, pepsin, bile acid, pancreatic enzyme and bacteria. It is due to an imbalance between aggressive (acid and pepsin) and defensive (bicarbonates, mucin, PG etc) factors. Peptic ulcer disease also occurs due to administration of NSAIDs, stress, *H. pylori* or pathological condition like Zollinger – Ellison syndrome. NSAIDs causes erosions, petechiae, type C gastritis, ulceration/combination with interference of ulcer healing. Further they also induce damage of the mucosa with imbalance between aggressive and defensive factors. Though a very good numbers of anti-ulcers drugs like antisecretory drugs, H_2 receptor antagonists, proton pump inhibitors, antimuscaranic, cytoprotectants and Prostaglandins analogues are available, the side effects associated with these drugs limit their use. Many herbal drugs from Ayurveda of Indian traditional system of medicine are advocated for the management of peptic ulcer. Herbal medicines used as whole plant powders/extracts from different parts are now a days consider as safe medication for the treatment of a numbers of diseases as it is a general notion that plant based drugs are safer without any side effects[4,11,19].

Though the presently available anti-ulcer drugs have remarkable effects in ulcer therapy the efficacy is still incomplete as there are many a number of incidences of relapse with adverse effects and drug-drug interaction are reported with the therapy. Hence there is a need for ideal anti-ulcer drugs with extended action from herbal source with a caliber of better protection and low incidence of relapse of ulcers[20,21]. In Indian system of medicine a very good numbers of herbs are reported to produce antiulcer and anti-inflammatory activities. Hence in the present study a plant by name S.*tuberosum* has considered to evaluate its antiulcer and anti-inflammatory activities scientifically. For this alcohol and aqueous extracts prepared from the tubers of the plants were tested against different ulcer models in rats and inflammatory models also in rats[1].

In pylorus ligation induced ulcer model, ulcers are produced due to accumulation of acid at the pyloric end that causes ulcers. Both the extracts AETST and AQETST significantly reduced ulcers by decreasing gastric volume and increasing the pH, thereby reducing the severity of ulcers i.e. ulcers numbers and ulcers index[22].

Stress induced ulcer are due to release of histamine with an increase in acid secretion and reduction in mucus production. Stress stimulate adenohypophysial axis and causes release of endogenous opiates and also produces severe gastric erosion by the activation of central vagal discharge which release endogenous opiates that cause mucosal congestion by peripheral mechanism to develop gastric ulcers. Both the extracts have significantly reduced gastric secretion thus prevented gastric mucosa from the development of ulcers. Several studies reported that gastroduodenal protection by prostaglandins is due to increase in mucosal resistant and decrease in aggressive factors like acid and pepsin[23].

Tannins[20], carbohydrate[24], flavonoids[25], glycosides[26] and triterpines[27] are reported for their anti-ulcers activity. Both AETST and AQETST contained all the above mentioned phytoconstituents and hence these might have contributed for the anti-ulcer activity. The anti-ulcerogenic effect of AETST and AQETST may be related to their antisecretory action since acid is a major factor in the development of peptic ulcers.

Carrageenan induced paw oedema model is used for screening of NSAIDs and inflammation produced by its biphasic in nature with the release of serotonin, bradykinin and histamine at I Phase followed by release of prostaglandins in II Phase.

Histamine being an important mediator of inflammation and also a potent vasodilator that causes increase in vascular permeability. In both phases due to release of these mediators cause pain and fever and both the extracts significantly

reduced paw oedema in II Phase of the inflammation indicating there effect on prostaglandins[28].

Formalin induced paw oedema model consist of two phases too with nociception in neurogenic and inflammatory phases. Drugs that primarily act on central nervous system are capable to inhibit both phases equally and by inhibiting the late phase, peripherally acting drugs produce there anti-inflammatory activity. The neurogenic and inflammatory phases are due to release of substance P, serotonin, histamine, prostaglandins and leukotrienes respectively. Both the extracts significantly reduced both phases of inflammation in formalin induced paw oedema model in rats[18].

Tannins, sterols, flavonoids, alkaloids and triterpines are reported for their anti-inflammatory activity. Both AETST and AQETST contained all the above mentioned phytoconstituents and hence these might have contributed for the anti-inflammatory activity[25,29].

5. CONCLUSION

Preliminary phytochemical evaluation of both AETST and AQETST revealed the presence of tannins, carbohydrate, sterols, flavonoids, glycosides, alkaloids and triterpines in both the extracts. Acute oral toxicity studies no mortality recorded with either of the extracts even at the dose level of 2000 mg/kg body weight.

Anti-ulcer and anti-inflammatory activities confirmed with both the extracts in experimental animals, rats with different ulcer and inflammatory models. In both ulcer and inflammatory models both the extracts at low, medium and high doses produced a significant anti-ulcer and anti-inflammatory activities ($P < 0.05$*, 0.01** and 0.001***).

Phytochemical constituents like tannins, flavonoids and triterpines are already reported for their anti-ulcer and anti-inflammatory activities and both the extracts contained the above mentioned constituents. Hence these can be accounted for the observed anti-ulcer and anti-inflammatory activities in rats.

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