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Research Study

Medical research

Evaluation of Pharmacological activity of Tuber Extracts of *Solanum Tuberosum* on Wister strain Albino Rats

V.Palanivel¹, G.Indraja²

¹Principal, Pachamuthu College of Pharmacy, Dharmapuri, Tamilnadu, India.

²Mahathi College of Pharmacy, Tamilnadu, India.

*Corresponding Author: V.Palanivel

Email id: drvpalanivel@gmail.com

ABSTRACT

S. Tuberosum is mentioned for its anti-ulcer and anti-inflammatory activities in Ayurvedic texts without an available scientific data. Hence the present study is planned to explore anti-ulcer and anti-inflammatory activities of AETST and AQETST. Preliminary phytochemical investigations identified with tannins, carbohydrate, sterols, flavonoids, glycosides, alkaloid and triterpenes in both extracts. Acute oral toxicity studies revealed that there is no mortality with both the extracts even upto the dose level of 2000mg/kg. In pylorus ligation induced ulcer model, selected doses like low (100 mg/kg), medium (200 mg/kg) and high (400 mg/kg) doses (AETST and AQETST) of both the extracts significantly reduced the ulcers ($P < 0.05^*$, 0.01^{**} and 0.001^{***}). In stress induced ulcers by cold water immersion model also both the extracts with the doses mentioned above significantly reduced the ulcers ($P < 0.05^*$, 0.01^{**} and 0.001^{***}). In carrageenan, histamine and formalin induced inflammatory models both the extracts significantly reduced inflammation ($P < 0.05^*$, 0.01^{**} and 0.001^{***}).

Keywords: *S. tuberosum*, tubers, alcoholic and aqueous extracts, anti-ulcer activity, pylorus ligation, stress, anti-inflammatory activity, carrageenan, histamine and formalin.

INTRODUCTION

Plants have been one of the important sources of medicine 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. Further they are well documented in India and other countries: even today they are in great use in these countries.

Herbal therapy provides rational means for the treatment of many diseases which are considered to be obstinate and incurable in other system of

medicine. It lays a great deal of emphasis upon the maintenance of positive health of an individual and thus aims at both the prevention and cure of diseases.

In the present study, we have chosen a plant *S. tuberosum* (Solanaceae) for which different pharmacological activities are reported with different parts of the plant. From the literature Ayurvedic texts we found that tubers of *S. tuberosum* have been traditionally indicated for the treatments of anti-ulcer and anti-inflammatory condition. However anti-ulcer and anti-inflammatory activities of this plant are not reported. But for its medicinal properties reported in the Ayurvedic texts prompted us to select tubers extracts of this plant for the study of anti-ulcer and

anti-inflammatory activities in different experimental animal models¹⁻⁶.

Objectives

To evaluate the anti-ulcer and anti-inflammatory activities of tubers extracts of *S. tuberosum* in rats.

Background

In Ayurvedic texts it was reported that tubers of *S. tuberosum* are used for anti-ulcer, anti-gout, anti-inflammatory, anti-arthritis, 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-ulcer and anti-inflammatory 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, rats⁷⁻¹².

Materials and methods

For assessing anti-ulcer and anti-inflammatory activities, ulcer models like pylorus ligation induced ulcer and stress induced ulcers by cold water immersion models and carrageenan, histamine and formalin induced inflammatory models are used. Standard reference compounds like Ranitidine and Ibuprofen respectively are used in the above mentioned two models.

Results

When AETST and AQETST are subjected for LD₅₀ study none of them produced behavior abnormalities or mortality even at the dose level of 2000 mg/kg body weight. Preliminary phytochemical investigation reveals the presence of tannins, carbohydrate, sterols, flavonoids, glycosides, alkaloid and triterpenes in both the extracts.

In pylorus ligation induced ulcer model, selected doses like low (100 mg/kg), medium (200 mg/kg) and high (400 mg/kg) doses (AETST and AQETST) of both the extracts significantly reduced the ulcers ($P < 0.05^*$, 0.01^{**} and 0.001^{***}). In stress induced ulcers by cold water immersion model also both the extracts with the doses mentioned above significantly reduced the ulcers ($P < 0.05^*$, 0.01^{**} and 0.001^{***}).

Preliminary Phytochemical studies Preliminary phytochemical screening

AETST and AQETST were subjected for phytochemical screening and found to contain tannins, carbohydrate, sterols, flavonoids, glycosides, alkaloid and triterpenes both in alcoholic and aqueous extracts.

PHARMACOLOGICAL ACTIVITIES

Acute oral toxicity study

The mice treated with AETST and AQETST at a dose of 2000 mg/kg, p.o. exhibited normal behaviour, without any signs of passivity, stereotypy and vocalization. Their motor activity and secretory signs were also normal and no sign of depression. AETST and AQETST even up to the dose level of 2000 mg/kg body weight did not produce any behavioural symptoms or mortality. So $1/5^{th}$, $1/10^{th}$ and $1/20^{th}$ doses of LD₅₀ (maximum dose tested for each extract) was selected as low, medium and high doses and were used in the present study to explore anti-ulcer and anti-inflammatory activities.

Anti-ulcer activity

Pylorus ligation induced ulcer model in rats

In pylorus ligation induced ulcer model in rats (positive control) a significant increase in ulcer number (5.00 ± 0.51), ulcer score (2.41 ± 0.27) and ulcer index (10.74) are noted. In the same model a significant increase in volume of gastric juice (6.70 ± 0.10 ml), free acidity (31.33 ± 1.15 m eq/L) and total acidity (82.33 ± 1.89 m eq/L) are noted.

In the group of rats treated with standard drug ranitidine (30 mg/kg) has significantly reduced ulcer number (0.33 ± 0.21), ulcer score (0.50 ± 0.12), ulcer index (3.41), volume of gastric juice (4.28 ± 0.13 ml), free acidity (17.33 ± 0.66 m eq/L), total acidity (43.50 ± 1.17 m eq/L) and the ulcers are inhibited by 68.24 %. AETST with low, medium and high dose treatment showed a significant decrease in ulcer number (3.66 ± 0.42 , 1.33 ± 0.33 and 0.83 ± 0.16), ulcer score (2.33 ± 0.21 , 1.58 ± 0.08 and 0.83 ± 0.10), ulcer index (10.59, 10.29 and 8.49), volume of gastric juice (6.03 ± 0.07 ml, 5.01 ± 0.07 ml and 4.75 ± 0.07 ml), free acidity (25.00 ± 0.85 , 22.33 ± 0.66 and 20.83 ± 1.01 m eq/L), total acidity (59.67 ± 1.05 , 47.33 ± 2.01 and 46.67 ± 0.80 m eq/L) and the ulcers are inhibited by 1.39, 4.18 and 20.94 % respectively.

AQETST with low, medium and high dose treatment showed a significant decrease in ulcer number (3.33 ± 0.21 , 1.16 ± 0.16 and 0.66 ± 0.21), ulcer score (2.08 ± 0.20 , 1.33 ± 0.10 and 0.75 ± 0.11), ulcer index (10.54, 10.24 and 6.80), volume of gastric juice (5.71 ± 0.11 ml, 4.85 ± 0.05 ml and 4.56 ± 0.12 ml), free acidity (23.83 ± 1.35 , 21.83 ± 0.65 and 20.00 ± 0.73 m eq/L), total acidity (58.00 ± 1.39 , 46.67 ± 1.99 and 46.00 ± 0.96 m eq/L) and the ulcers are inhibited by 1.86, 4.65 and 36.68 % respectively. The order of potency in antiulcer activity

is Ranitidine >AQETST > AETST. The results are shown in Table Nos.5.1 and 5.2 and represented graphically in Fig Nos. 5.1, 5.2 and 5.3.

Stress induced ulcer model in rats

In stress induced ulcer model in rats (positive control) a significant increase in ulcer number (4.67 ± 0.33), ulcer score (2.67 ± 0.21), ulcer index (10.73), volume of gastric juice (6.77 ± 0.09 ml), free acidity (33.33 ± 0.66 m eq/L) and total acidity (84.83 ± 1.19 m eq/L) are noted.

In the group of rats treated with standard drug ranitidine (30 mg/kg) has significantly reduced ulcer number (0.50 ± 0.22), ulcer score (0.75 ± 0.11), ulcer index (5.12), volume of gastric juice (4.38 ± 0.10 ml), free acidity (19.00 ± 0.68 m eq/L), total acidity (45.67 ± 0.91 m eq/L) and the ulcers are inhibited by 52.28 %.

AETST with low, medium and high dose treatment showed a significant decrease in ulcer number (3.50 ± 0.22 , 1.67 ± 0.21 and 0.83 ± 0.16),

ulcer score (2.50 ± 0.22 , 1.83 ± 0.10 and 1.08 ± 0.08), ulcer index (10.60, 10.35 and 8.52), volume of gastric juice (6.20 ± 0.05 ml, 5.15 ± 0.04 ml and 4.88 ± 0.06 ml), free acidity (26.83 ± 0.60 , 24.50 ± 0.88 and 22.67 ± 0.71 m eq/L), total acidity (61.67 ± 0.95 , 49.00 ± 1.15 and 48.67 ± 0.61 m eq/L) and the ulcers are inhibited by 1.21, 3.54 and 20.59 % respectively.

AQETST with low, medium and high dose treatment showed a significant decrease in ulcer number (3.17 ± 0.16 , 1.50 ± 0.22 and 0.83 ± 0.16), ulcer score (2.50 ± 0.22 , 1.67 ± 0.10 and 0.91 ± 0.08), ulcer index (10.56, 10.31 and 8.50), volume of gastric juice (6.02 ± 0.07 ml, 4.95 ± 0.07 ml and 4.77 ± 0.07 ml), free acidity (25.67 ± 0.84 , 23.33 ± 0.76 and 21.50 ± 0.76 m eq/L), total acidity (60.33 ± 0.55 , 47.83 ± 1.57 and 47.17 ± 0.94 m eq/L) and the ulcers are inhibited by 1.58, 3.91 and 20.78 % respectively. The order of potency in antiulcer activity is Ranitidine >AQETST > AETST. The results are shown in Table Nos.5.3 and 5.4 and represented graphically in Fig Nos. 5.4, 5.5 and 5.6.

Antiulcer effects of AETST and AQETST in pylorus ligation 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 100mg/kg	AQETST 200mg/kg	AQETST 400mg/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*.

Antiulcer effects of AETST and AQETST in pylorus ligation 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	6.5	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*.

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 100mg/kg	AQETST 200mg/kg	AQETST 400mg/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*.

Antiulcer effects of AETST and AQETST in stress 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	6.8	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***

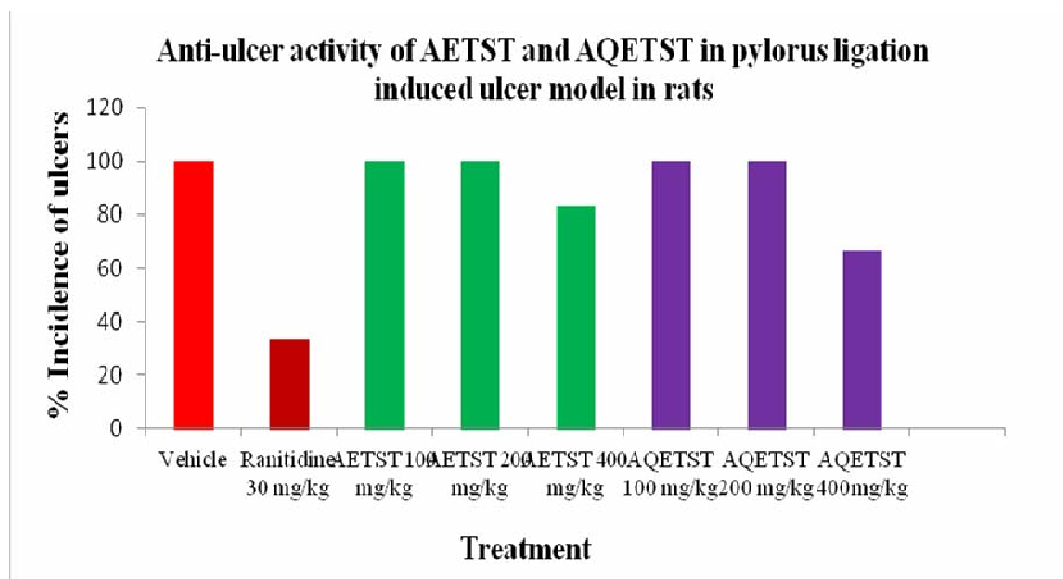
n = 6, Significant at P < 0.05*, 0.01** and 0.001***, ns = not significant. AETST- Alcoholic Extract of Tuber of *S. tuberosum*, AQETST- Aqueous Extract of Tuber of *S. tuberosum*.

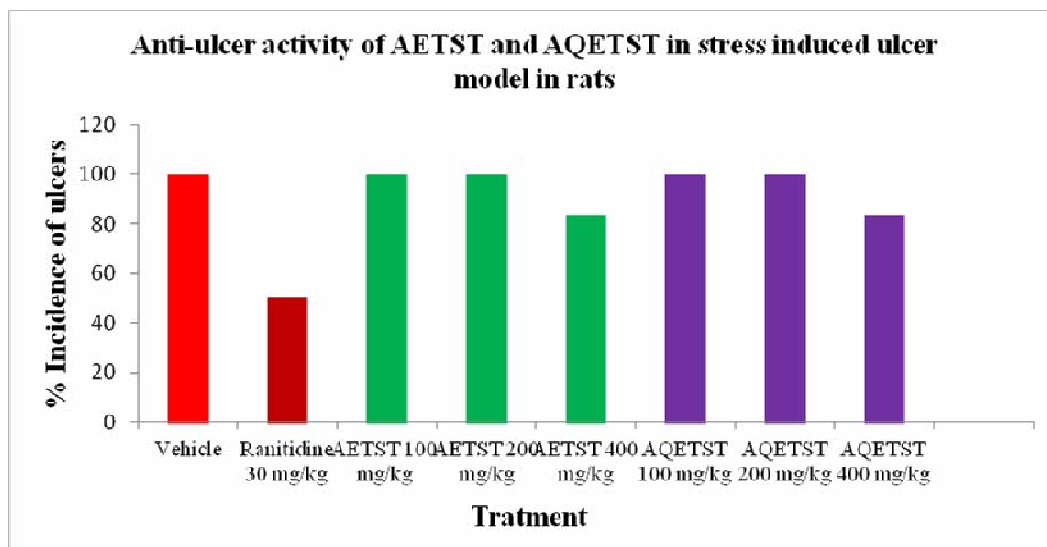
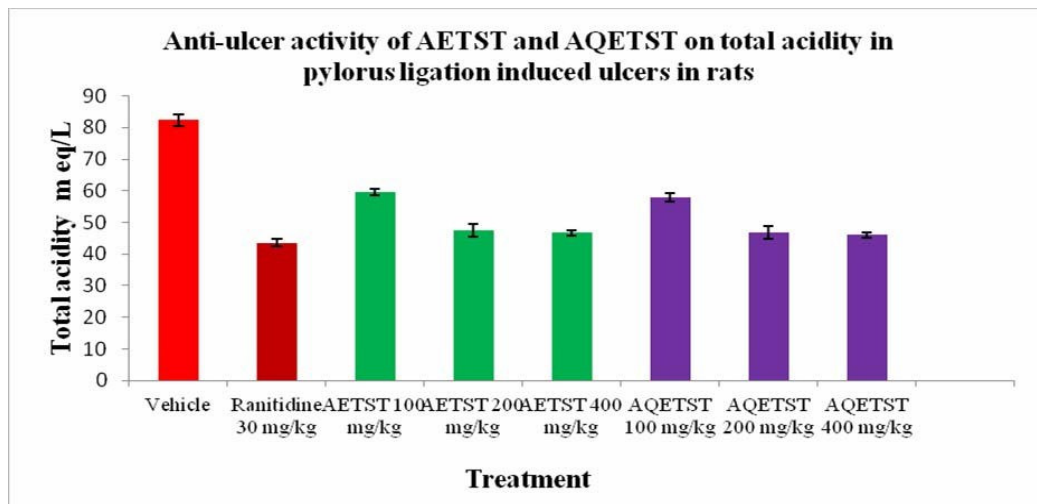
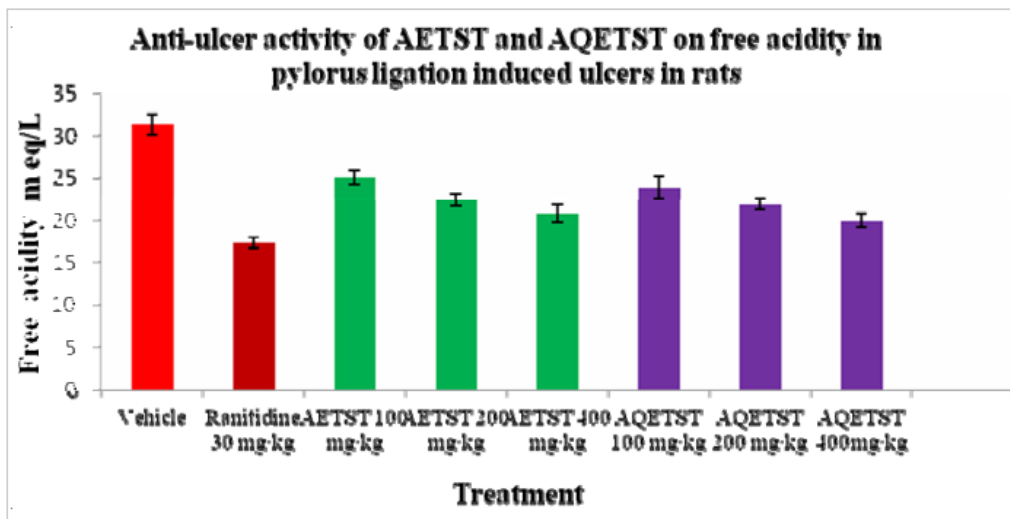
Antiulcer effects of AETST and AQETST in different ulcers models in rats

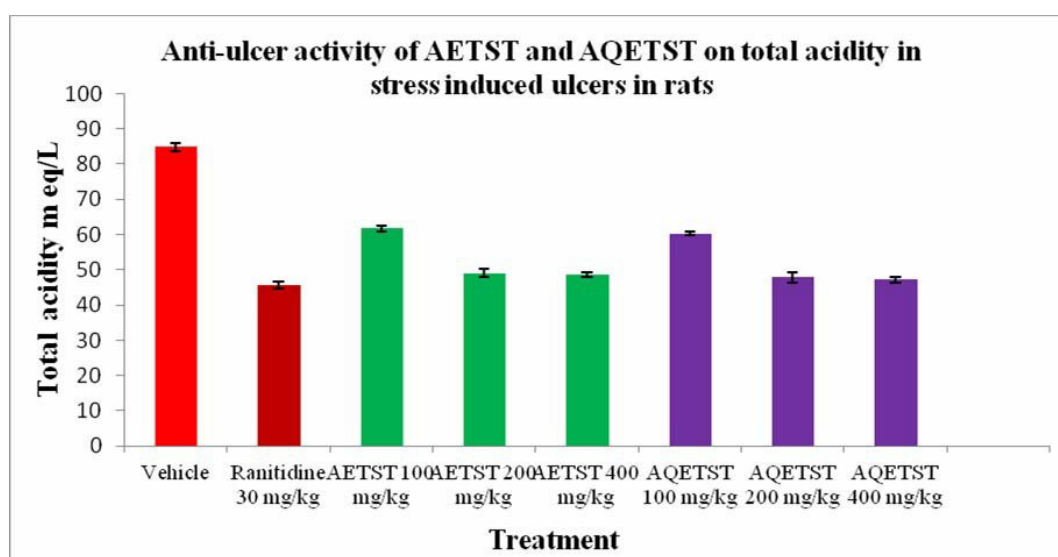
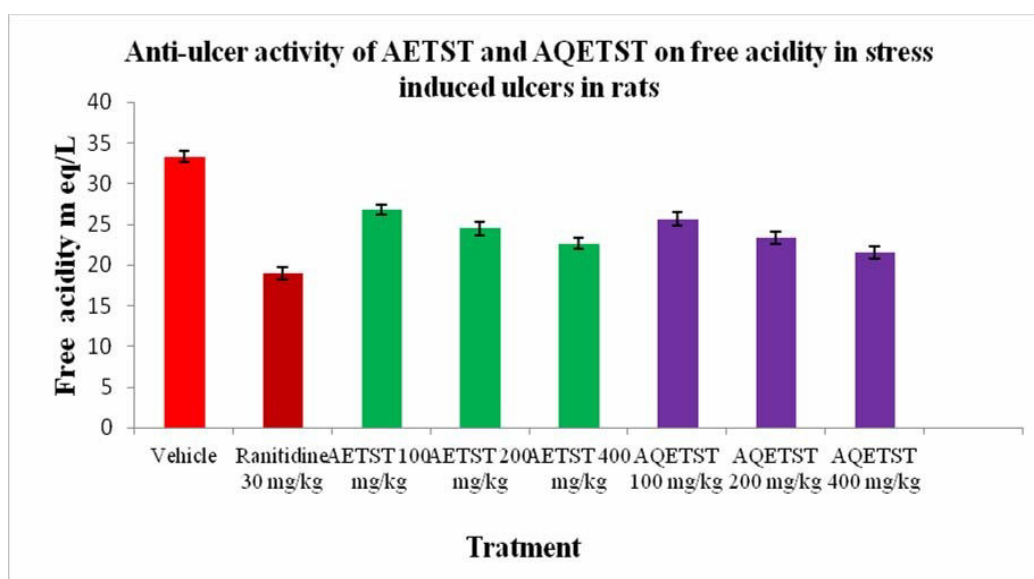
Groups	Treatment	Pylorus ligation model					Stress induced ulcer model				
		Ulcer Number	Ulcer Score	Incidence of Ulcers (%)	Ulcer Index	Inhibition of Ulcers (%)	Ulcer Number	Ulcer score	Incidence of Ulcers (%)	Ulcer Index	Inhibition of Ulcers (%)
Control	vehicle 10 ml/kg p.o	5.00±0.51	2.41±0.27	100	10.74	-	4.67±0.33	2.67±0.21	100	10.73	--
Standard	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.

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







ANTI-INFLAMMATORY ACTIVITY

Anti-inflammatory activity of AETST and AQETST in Carrageenan induced paw oedema model in rats

The AETST and AQETST with three selected doses i.e. 100, 200 and 400 mg/kg have exhibited a significant reduction in paw oedema volume in carrageenan induced paw oedema in rats at different time intervals. Results are tabulated in Table No. 5.7. Ibuprofen (40 mg/kg) was used as standard reference and it has significantly reduced paw oedema volume by 42.85% at 1st h, 61.43% at 2nd h, 79.29% at 3rd h and 85.33% at 4th h, thus standard drug has exhibited

time dependent reduction in oedema volume.

During 1st h of study AETST and AQETST with low, medium and high doses have significantly reduced oedema volume by 4.85%, 14.28%, 24.00% and 9.71%, 19.14%, 28.57% respectively, which was found to be a time dependent effect.

During 2nd h of study AETST and AQETST with low, medium and high doses have significantly reduced oedema volume by 7.62%, 23.09%, 30.71% and 11.44%, 26.78%, 38.33% respectively a time dependent effect.

During 3rd h of study AETST and AQETST with low, medium and high doses have significantly reduced oedema volume by 13.66%, 27.53%, 37.88%

and 17.14%, 31.05%, 44.72% respectively a time dependent effect was noted.

During 4th h of study AETST and AQETST with low, medium and high doses have significantly reduced oedema volume by 22.22%, 33.33%, 59.25% and 29.55%, 40.66%, 66.66% respectively a time dependent effect was noted and result are graphically

represented in Fig No.5.7.

ANOVA indicates a significant difference among the AETST and AQETST treated groups. Dunnett's 't' test confirms a significant anti-inflammatory activity with both the extracts, but more with AQETST than AETST.

Anti-inflammatory effects of AETST and AQETST in Carrageenan induced paw oedema 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	0.35	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*.

Anti-inflammatory effects of AETST and AQETST in Carrageenan induced paw oedema model in rats at different time intervals

Serial	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*.

Anti-inflammatory activity of AETST and AQETST in Histamine induced paw oedema model in rats

The AETST and AQETST with three selected doses i.e. 100, 200 and 400 mg/kg have exhibited a significant reduction in paw oedema volume in histamine induced paw oedema in rats at different time intervals. Results are tabulated in Table No. 5.9. Ibuprofen (40 mg/kg) was used as standard reference and it has significantly reduced paw oedema volume by 56.39% at 1st h, 70.44% at 2nd h, 86.80% at 3rd h and 92.93% at 4th h, thus exhibited a time dependent reduction in oedema volume.

During 1st h of study AETST and AQETST with low, medium and high doses have significantly reduced oedema volume by 4.17%, 17.23%, 39.16% and 8.61%, 26.10%, 47.78% respectively, which was found to be a time dependent effect.

During 2nd h of study AETST and AQETST with low, medium and high doses have

significantly reduced oedema volume by 11.11%, 26.00%, 44.44% and 18.44%, 29.55%, 51.77% respectively noted a time dependent effect.

During 3rd h of study AETST and AQETST with low, medium and high doses have significantly reduced oedema volume by 16.60%, 36.66%, 56.66% and 26.60%, 43.40%, 63.40% respectively a time dependent effect was noted.

During 4th h of study AETST and AQETST with low, medium and high doses have significantly reduced oedema volume by 25.05%, 46.46%, 67.88% and 35.76%, 53.53%, 74.94% respectively a time dependent effect was noted and result are graphically represented in Fig No.5.8.

ANOVA indicates a significant difference among the AETST and AQETST treated groups. Dunnett's 't' test confirms a significant anti-inflammatory activity with both the extracts, but more with AQETST than AETST.

Anti-inflammatory effects of AETST and AQETST in Histamine induced paw oedema 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	0.35	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*.

Anti-inflammatory effects of AETST and AQETST in Histamine induced paw oedema model in rats at different time intervals

Serial	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 Oedema Volume. AETST- Alcoholic Extract of Tuber of *S. tuberosum*, AQETST- Aqueous Extract of Tuber of *S. tuberosum*.

Anti-inflammatory activity of AETST and AQETST in Formalin induced paw oedema model in rats

The AETST and AQETST with three selected doses i.e. 100, 200 and 400 mg/kg have exhibited a significant reduction in paw oedema volume in Formalin induced paw oedema in rats at different time intervals. Results are tabulated in Table No. 5.11. Ibuprofen (40 mg/kg) was used as standard reference and it has significantly reduced paw oedema volume by 54.25% at 1st h, 64.23% at 2nd h, 83.90% at 3rd h and 89.64% at 4th h, which was found to be a time dependent effect.

During 1st h of study AETST and AQETST with low, medium and high doses have significantly reduced oedema volume by 4.25%, 16.75%, 37.50% and 8.25%, 20.75%, 41.75% respectively noted as time dependent effect.

During 2nd h of study AETST and AQETST with low, medium and high doses have significantly

reduced oedema volume by 7.28%, 21.41%, 42.82% and 10.70%, 28.69%, 50.10% respectively noted as time dependent effect.

During 3rd h of study AETST and AQETST with low, medium and high doses have significantly reduced oedema volume by 12.95%, 32.30%, 54.92% and 19.34%, 38.68%, 61.31% respectively recorded as time dependent effect.

During 4th h of study AETST and AQETST with low, medium and high doses have significantly reduced oedema volume by 24.01%, 44.72%, 65.42% and 34.36%, 51.75%, 72.46% respectively which was recorded as time dependent effect and result are graphically represented in FigNo.5.9.

ANOVA indicates a significant difference among the AETST and AQETST treated groups. Dunnett's 't' test confirms a significant anti-inflammatory activity with both the extracts, but more with AQETST than AETST.

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***
	H	0.50	0.10	0.35	0.30	0.20	0.40	0.20	0.10

4 h	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.

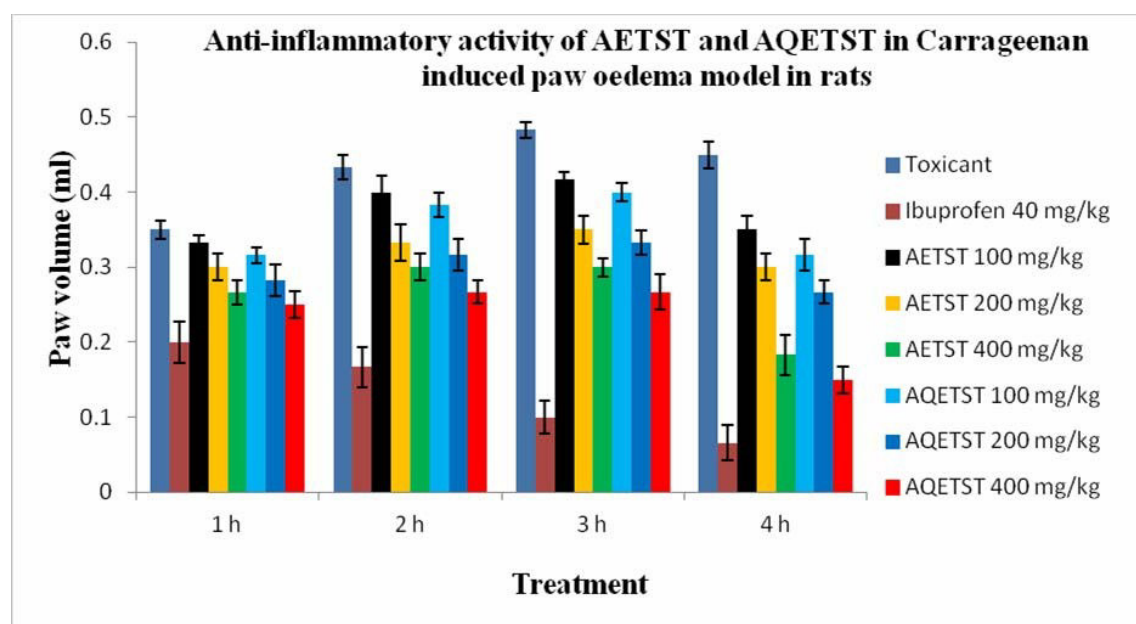
AETST- Alcoholic Extract of Tuber of *S. tuberosum*, AQETST- Aqueous Extract of Tuber of *S. tuberosum*.

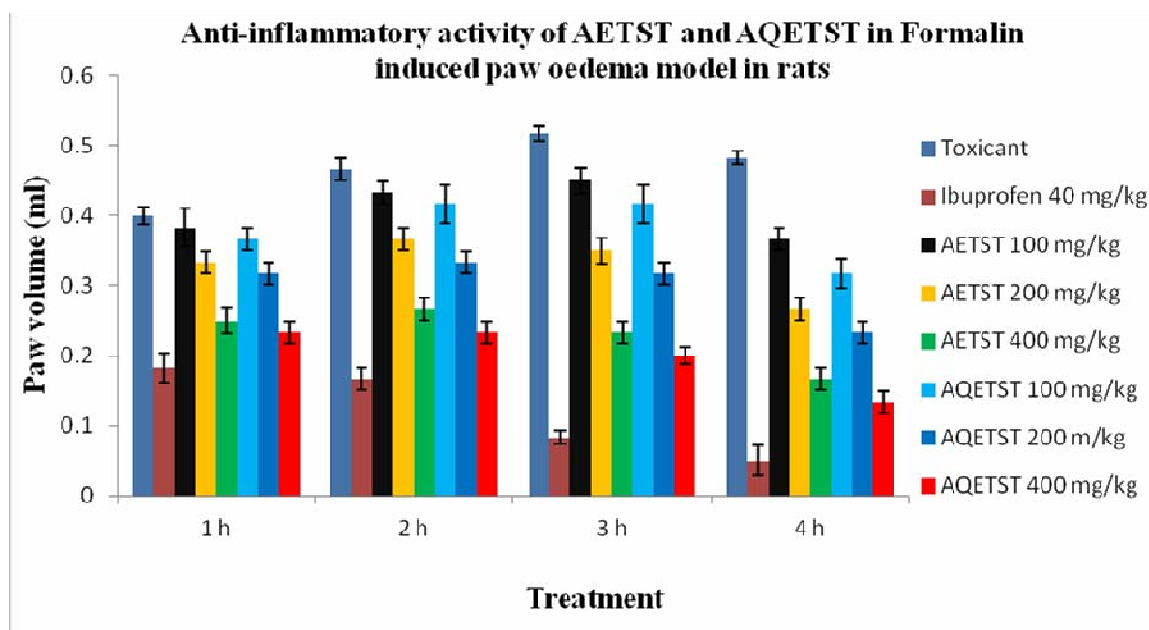
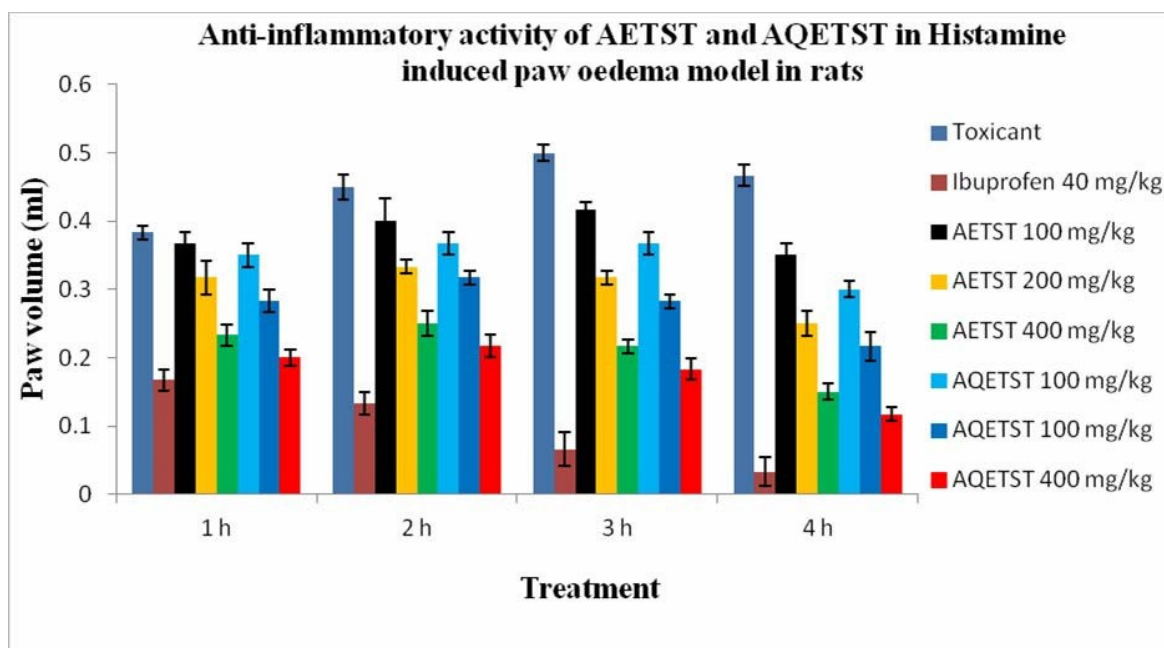
Anti-inflammatory effects of AETST and AQETST in Formalin induced paw oedema model in rats at different time intervals

Serial	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 ^{ns}	4.25	0.433 ±0.016 ^{ns}	7.28	0.450 ±0.018 ^{ns}	12.95	0.367 ±0.016**	24.01
D	AETST	200 mg/kg	0.333 ±0.016 ^{ns}	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 ^{ns}	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*.





CONCLUSION

The present study reveals that both the AETST and AQETST possessed both anti-ulcer and anti-inflammatory activities. Phytochemical constituent like tannins, flavonoids and triterpenes are already

reported for their anti-ulcer and anti-inflammatory activities. These phytochemical constituents are present in both the extracts, hence responsible for the observed activities.

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