

Diuretic Potential of Whole Plant Extract of *Solanum Surattense* burm in Experimental Rats

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ABSTRACT

The present study was undertaken to investigate diuretic effect of alcoholic (AlcE) and aqueous extracts (AqE) of whole plant of *Solanum surattense* Burm in Wistar rats. In the present study AlcE and AqE (200 mg/kg b.w., p.o.) of *Solanum surattense* Burm (family: Solanaceae) were tested for diuretic activity. The animals were grouped into four (n=6). All the animals received priming dose of normal saline (25 ml/kg b.w.). The first group served as control and the second group received the standard drug furosemide (20 mg/kg.i.p.) in normal saline. The other three groups received p alcohol and aqueous extracts of *Solanum surattense* Burm in a dose of 200 mg/kg b.w.p.o. suspended in normal saline. Urine volume was recorded for all the groups for 5 h. The highest diuretic activity was presented by alcohol extract followed by aqueous extract. Alcohol and aqueous extracts significantly decreased K⁺ excretion. We observed a potent diuretic and electrolyte excretion activity of alcohol and aqueous extracts of *Solanum surattense* Burm. These findings suggest the possible traditional use of this plant in hypertension as diuretics are used in the management of hypertension.

Keywords: *Solanum surattense* Burm diuretic activity, electrolyte excretion, furosemide.

INTRODUCTION

Medicinal, aromatic and cosmetic plants play an important role in human health. Since prehistoric times, human beings worldwide have made efforts to influence, maintain and restore their health^{1,2}. Plants have played a prominent role in these efforts, as part of the human diet as well as in specific health and healing practices. Human-plant relations have been developed and substantiated into the knowledge, beliefs and practices of societies and subsequently conserved in both oral and written traditions and medical systems worldwide. The World Health Organization (WHO) estimates that 80% of the population in developing countries, approximately 3.5 billion people, relies on traditional, mostly plant-based, medicines for their Primary Health Care needs.^{3, 4} It is also estimated that the traditional and modern medicine uses about 50000-70000 species of plants. The availability of natural resources threatens the revenue from the wild harvest, health and welfare of the people who depend on them⁵.

By definition, diuretics are drugs that bring about an increase in urinary volume as well as in the electrolyte output. Due to this they are used to regulate both volume and composition of the milieu interieur in different affections like high blood pressure, heart failure, nephrotic syndromes among other indications. Historically, the classification of diuretics has been a medley of ideas like: place of action (loop diuretics), efficiency (high ceiling diuretics), chemical structure (thiazide diuretics), similarity of action to other diuretics (diuretics similar to thiazides), the effects upon the potassium excretion (potassium-sparing diuretic), and others.^{6,7}

There is a wide therapeutic stock of synthetic drugs that belong to each of these pharmacological groups. In spite of this, a considerable amount of decoctions and infusions of medicinal plants are used by Cuban population to this end. This is an aspect that has been transmitted from generation to generation through an ethnomedical approach^{8,9}.

The diuretic effectiveness of this kind of medicinal plants needs to be experimentally proved, because diuresis could be influenced by the form of administration (infusion or decoction) which implies the consumption of a great amount of liquids that can provoke an increase in the amount of urine excreted without a true evidence of a diuretic action.

Several preclinical studies have been carried out in our country to assay the diuretic action of the following plants: roots of *Asparagus racemosus*, *Cleistanthus collinus*, *Alocasia macrorrhiza* Linn, *Salvadora persica* L. *Abutilon indicum* Linn (sweet), *Echinops echinatus* Roxb. *Hibiscus esculentus* (okra) fresh fruits etc

Solanum surattense burm. family – Solanaceae^{10,11} is used as Antiasthmatic, aperients, alterative, astringent, digestive, diuretic, febrifuge and pungent. Used in bronchitis, cough, constipation and in dropsy^{12,13,14,15,16}. It is also used as anthelmintic, appetizer, carminative, helmenthiasis, flatulence, colic, dyspepsia, anorexia, leprosy, skin disorders, rheumatoid arthritis, pharyngitis, urolithiasis, amenorrhoea, lumbago, cardiac disorder, stomachic, anti-inflammatory, rejuvenating, epilepsy,^{13,14,16} enlargement of liver and spleen.¹⁷ Though the feedback from the patients treated by traditional healers is quite encouraging, diuretic activity of *Solanum surattense* Burm has not been scientifically investigated. Therefore, the present study was planned to investigate the diuretic effect of extracts of *Solanum surattense* Burm in Wistar rats.

MATERIALS AND METHODS

Preparation of *Solanum surattense burm* Extract

Whole plant of *Solanum surattense* Burm was collected from open field around Belgaum city in the month of September were identified and authenticated by the taxonomist Dr. Harsha Hegde and the herbarium (voucher No. RMRC-481) has been preserved at Regional Medical Research Centre Belgaum, a unit of Indian council for medical research New Delhi.

Dried plants were powdered to moderately coarse grade. The air-dried powdered whole plants of *solanum surattense* Burm were defatted with petroleum ether (60- 80 °C) to remove low polar compounds. The defatted material was further extracted with alcohol at ambient temperature and macerated with chloroform water. The extract were filtered and concentrated to a syrupy mass (Yield 8.8 and 4.8 % w/w respectively) under reduced pressure at 50-55 °C. The extract was stored in a refrigerator and used for the present study.

Phytochemical screening

A preliminary phytochemical screening of *Solanum surattense burm* was carried out. The phytochemical profile was performed as described by Wagner et. al.¹⁸ The presence of Glycosides, carbohydrates, alkaloids, proteins steroids, saponin and tannins. (Table-1)

Animals

Swiss albino mice (20–25g) and male Wistar rats (150–200) were procured from Venkatershwara Enterprises, Bangalore, Karnataka, India, and used throughout the study. They were housed in microlon boxes in a controlled environment (temperature 25 ± 2°C and 12 h dark/light cycle) with standard laboratory diet and water *ad libitum*. The study was conducted after obtaining Institutional Animal Ethical Committee clearance.

Acute toxicity studies

Acute oral toxicity (AOT) of *Solanum surattense* was determined as per OECD guidelines using Swiss albino mice. The animals were fasted for 12 h prior to the experiment and were administered with single dose of extracts dissolved in 5% gum acacia and observed for mortality up to 48 hour (short term toxicity). Based on the short-term toxicity, the dose of next animal was determined as per OECD guideline 420.

Diuretic activity

Wister albino rats of either sex weighing 150-200 gms were divided into four groups of 6 animals each. The animal was

fasted for 15 hrs, deprived of food and water. All the animals received priming dose of normal saline 25ml per kg body weight. The first group served as control and the second group received the standard drug of furosemide 20 mg per kg body weight in a normal saline. The other two groups received product containing alcoholic and aqueous extract of *Solanum surattense* dose of 200mg per kg body weight suspended in normal saline. Animals were starved since the day before administration of dose. All the substances were orally administered by gavage using a 16 G intragastric cannula. Dose volume were completed with physiological saline solution up to a total constant administration volume of 40ml/kg b.w. as described in the guidance used^{19,20}. Immediately after the respective treatment the animals placed in metabolic cages and urine was collected in a measuring cylinder up to 5 hrs. During this period no food and water was made available to animals. Then the volume of urine and Na⁺, K⁺ and Cl⁻ were estimated for assessing diuretic activity. Sodium and Potassium concentrations were determined by Flame Photometer and Cl⁻ concentration was estimated by titrated with AgNO₃ solution (0.17N) using 2 ml of Ferric alum solution as indicator^{21,22}

Diuretic Index=Mean urine volume of test/Mean urine volume of control.

Lipschitz value = Mean urine volume of test/Mean urine volume of standard

Statistical analysis

Results are expressed as Mean \pm S.E.M. The difference between experimental groups was compared by One way Analysis of Variance (ANOVA) followed by Dunnett's test. The results were considered statistically significant when $P < 0.05$.

RESULTS

Effects on Urine Output and Diuretic Action

The total urine volume over the period of 5h was measured (Table-2). Standard diuretic furosemide (20mg/kg

b.w.) Showed increased urine flow 11.20 ± 0.07 compared to control which was 3.75 ± 0.25 . Whereas the AlcE and AqE of *Solanum surattense* (200mg/kg b.w.) showed increased urine flow of 9.20 ± 0.30 and 7.35 ± 0.08 respectively comparable to that of control. The diuretic index of furosemide AlcE and AqE was found to be 3.00, 2.69 and 1.97 as compared with 1.00 of control.

Effects on Electrolyte Excretion

The diuretic responses with its electrolyte excretion potency of the extract were highly significant in comparison with control animals. The extract at doses of 200mg/kg b.w. shows increase in Na⁺, Ca²⁺ and Cl⁻ excretion, accompanied by the excretion of K⁺. (Table-3)

Effects on Urine pH

The Standard furosemide, AlcE and AqE, showed decrease in pH 6.39 ± 1.25 , 6.62 ± 2.20 and 6.89 ± 0.45 at 5th h thus making the urine more acidic. All the values were compared with that of control, 7.31 ± 0.01 .

Effects on Saluretic index

The saluretic index and Na⁺/K⁺ of the standard reference drug furosemide and AlcE was found to be highly significant

DISCUSSION AND CONCLUSION

The present finding suggests that the alcoholic extract (AlcE) of *Solanum surattense* Burm possess a demonstrable and potent diuretic potential. The data here found is reported for the first time that its ethnopharmacological effect is probably mediated through direct ability to increase urine volume and electrolyte excretion.

This study shows that AlcE of *Solanum surattense* Burm produced striking increase in total urine output over a period of 5h. It also increased the excretion of sodium, calcium, chloride accompanied with potassium significantly. Therefore AlcE has been shown to possess significant diuretic effect and Saluretic index which may be one of the bases of its therapeutic application in various ailments such as diuretic, treatment of liver disorders, ulcers and pain in muscles.

Diuretic activity may be very useful in a number of conditions like hypertension, hypercalciuria, cirrhosis of liver^{23, 24}. The diuretic activities of the extracts were highly potential when compared to control. However, there were significant differences in urinary excretion followed by diuretic action and diuretic activity. All the extracts cause increase urine elimination and increase in Na^+ , K^+ , Ca^{2+} and Cl^- excretion as compared to control. The extracts possibly act by the synergistic action mechanism of the $[\text{HCO}_3^-/\text{Cl}^-]$, $[\text{HCO}_3^-/\text{H}^+]$ and the $[\text{Na}^+/\text{H}^+]$ antiporter, to cause diuresis²⁵.

The AlcE extract increases sodium excretion to larger extent than potassium, which is a very quality of diuretic with lesser hyperkalaemic side effect. The AlcE extract of *Solanum surattense* exerted its diuretic activity possibly by inhibiting tubular reabsorption of water and accompanying anions, as such action has been hypothesized for some other plant species.²⁶ Therefore AlcE extract of *Solanum surattense* significantly increased the GFR due to (a) A detergent like interaction with structural components of glomerular membranes. (b) A decrease in renal perfusion pressure, attributable to decrease in the resistance of the afferent arteriole and/or an increase in the resistance of the efferent arteriole and/or. (c) The direct effect on the arteriole wall affecting glomerular blood flow.²⁷

Further the urine was slightly acidified. These characteristics strongly suggest these extracts are acting as loop diuretic. Loop diuretics inhibit the $\text{Na}^+/\text{K}^+/\text{Cl}^-$ co-transporter system in the thick ascending loop of nephron, thereby increasing natriuresis and kaliuresis^{28,29} and also cause acidification of urine.^{28,30}

As emphasized, diuretic properties of AlcE could be due to other active principles such as Glycosides, carbohydrates, alkaloids, proteins, steroids, saponin and tannins.³¹ It is also possible that diuretic effect of the water could be due to other secondary active(s)

metabolites(s).³² The other possibility for the observed diuretic effect of AlcE water could be due to indirect changes of some physiological parameters before blood filtration step³³ and/or the consequence of the observed glycosuria.³⁴ The observed decrease of urine osmolality could be explained by a marked increase in urinary flow, which seemed to be more important than the possible urinary electrolytes excretion. Administration of the AlcE caused a diuretic response, which was accompanied with a slight increase in GFR. This finding suggests different mechanisms of action, like a direct effect on arterial pressure which could affect GFR or glomerular blood flow by decreasing renal perfusion pressure. AlcE caused diuresis by a mechanism quantitatively similar to that of furosemide and more than one mechanism seems to be involved. The AlcE did not affect plasma urea levels, urine pH, plasma osmolality and hematocrite indicating that the rapid physiological regulation of these important parameters was not altered after RR infusion. On basis of the above results, we can conclude that AlcE treatment produced a marked diuresis when rats were acutely treated. In our study, no lethality was observed at least for the dose and duration used. However, advanced toxicological studies remain to be performed in mice and rats. It remains necessary to study eventual adverse effect(s) of this plant such as alteration of some neural, metabolic and hormonal parameters, which are undetermined in this study, before its recommendation to clinical use. The precise site(s) and the molecular and cellular mechanism(s) of AlcE action remain to be elucidated in further studies.

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Table 1: Phytochemical Screening of *Solanum surattense* Burm

Extracts	Steroid	Carbohydrate	Alkaloids	Saponin	Tannin	Protein	Glycoside
Alcohol	+++	++	++	+	+++	++	+
Aqueous	-	++	-	+	++	++	+

+++ = High concentration, ++ = medium concentration, + = low concentration, - = absent.

Table 2: Effect of oral administration of extract of *Solanum surattense* Burm on urinary volume

Groups	Dose kg,b.w. p.o	Mean urine volume (ml)	Urine pH	Diuretic index (T/C)	Lipschitz value
Control	5 ml	3.73±0.25	7.31±0.01	--	--
Standard (furosemide)	20mg	11.20***±0.07	6.39***±1.25	3.00	1.00
AlcE	200mg	10.05***±0.30	6.62***±2.20	2.69	0.90
AqE	200mg	7.35*±0.08	6.89*±0.45	1.97	0.66

Standard =furosemide. ***P < 0.001, * P < 0.05.

Table 3: Effect of oral administration of extract of *Solanum surattense* Burm on urinary Electrolytes excretion

Groups	Dose kg,b.w. p.o	Concentration (mmol/lit)				Saluretic index		
		Na ⁺	K ⁺	Cl ⁻	Na ⁺ / K ⁺	Na ⁺	K ⁺	Cl ⁻
Control	5 ml	105.57±1.08	64.28±2.01	60.74±0.22	1.64	1.00	1.00	1.00
Standard (furosemide)	20mg	128.46***±0.36	84.25***±0.31	77.06***±0.70	1.52	1.22	1.31	1.27
AlcE	200mg	125.58***±0.81	79.93***±0.36	70.09***±0.12	1.57	1.19	1.24	1.15
AqE	200mg	116.35*±0.85	70.28*±0.023	64.39*±0.23	1.64	1.10	1.09	1.06

***P < 0.001, * P < 0.05.

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