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Research Article

Phytochemical and Pharmacological Evaluation of *Solanum surattense* for Antidepressant Activity in Albino Mice

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ABSTRACT
Depression is a heterogeneous mood disorder that has been classified and treated in variety of ways. Although a number of synthetic drugs are being used as standard treatment for clinically depressed patient, the adverse effects compromise the therapeutic outcome. In the traditional systems of medicine, many plants and formulations have been used to treat depression for thousands of years. *Solanum surattense* is a commonly available plant throughout India and it has been claimed in traditional literature to be valuable plant against a wide variety of diseases. Till date no scientific data was available on the antidepressant activity of this plant. So, the present study was undertaken to investigate the effect of *Solanum surattense* (Family: Solanaceae), on depression in mice using tail suspension test (TST) and forced swim test (FST). Alcoholic and chloroform extract (50 and100 mg/kg p.o.) of *S. surattense* administered orally for 14 successive days had decreased the immobility periods significantly in a dose-dependent manner in both TST and FST, showing significant antidepressant-like activity. The activities of the extracts were found to be comparable to imipramine in both FST and TST. The results of this study indicate the potential for use of SS as an adjuvant in the treatment of depression.

Keywords: *Solanum surattense*, Antidepressant activity, Forced swim test, Tail suspension test, Depression

INTRODUCTION

Depression refers to a wide range of mental health problems characterized by the absence of positive effect (loss of interest and enjoyment in ordinary things and experiences), low mood and a range of associated emotional, cognitive, physical and behavioral symptoms[1]. Prevalence rate for all mental disorders in India was observed to be 65.4/1000 population, out of which prevalence rate for affective disorders is 31.2/1000 population[2]. Available synthetic drugs for the treatment of depression have various adverse effects and drug-drug interactions[3]; therefore, our aim was to explore the potential of plants in the treatment of depression. *Solanum surattense* Burm. f. (Solanaceae) commonly known as Kanteli, Yellow-berried nightshade, Kantakari, Nidigdhika, grows wild almost throughout India, Sri Lanka, south-east Asia, Malaysia and tropical Australia. *Solanum surattense* has been claimed in traditional literature to be valuable against a wide variety of diseases[4]. Indian Materia Medica describes the use of leaves of *Solanum surattense* as anthelmintic, anti-inflammatory, digestive, carminative, appetizer, stomachic, antihypertensive, antipyretic, antitussive, in rheumatoid arthritis, asthma, bronchitis, pharyngitis, urolithiasis, amenorrhoea, dysmenorrhoea, lumbago, haemorrhoids, cardiac disorders, rhinopathy, and catarrh[5]. It is one of the ingredient of *Dashamoola* of Ayurveda[6]. The fruits are known for several medicinal uses such as anthelmintic, antipyretic, laxative, anti-inflammatory, antiasthmatic, and aphrodisiac activities. The hot aqueous extract of dried fruits are used for treating cough, fever, and heart diseases. The fruit paste is applied externally to the affected area for treating pimples and swellings. The stem, flowers, and fruits are prescribed for relief of burning sensation accompanied by vesicular eruptions in the feet[7]. Traditionally, the juice of the leaves is used for the treatment of rheumatism, an autoimmune disorder[8]. The major constituents of roots and fruits of plants contain solanine and solanidine, besides waxy substances, fatty acids and other constituents[9]. The fruits are reported to contain a glycoalkaloid Solasonine and several steroidal alkaloids like Solanocarpine and Solamargine[10]. Other constituents caffeic acid, coumarins like aesculetin and steroids carpesterol, diosgenin, campesterol, daucosterol and triterpenes like cycloartanol and cycloartenol were reported from the fruits[11]. The Pharmacological activities reported for *Solanum surattense* are, antiasthmatic, anti microbial, hypoglycemic, hepatoprotective, anti-ulcer, cardioprotective, antifilarial and mosquito larvicidal effect[12]. The literature review reveals that no study was done on the antidepressant property of this plant scientifically. Therefore, our study focused on evaluation of antidepressant potential of *Solanum surattense* in mice. The present study was undertaken to investigate the effect of alcoholic, chloroform and pet ether extracts of *S. surattense* on despair induced depression in mice employing forced swim test and tail suspension test.

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MATERIALS AND METHODS

Collection of Plant Material and Extraction

The plant *Solanum surattense* was collected at NH-5 near Guntur. The plant was authentified by the Department of Botany, Acharya Nagarjuna University, Guntur and voucher specimen was preserved. The aerial parts were separated, dried, powdered and then extracted with alcohol as solvent by using maceration for 14days. Then the extracted drug was further evaporated using simple distillation apparatus to obtain the concentrate. To this extract aliquots of water were added and then fractionated successively using petroleum ether and chloroform by mother liquor method[13].To this extract 250ml of water was added and shaken thoroughly and then to this 100 ml of petroleum ether was added to separate the non polar constituents. This procedure was repeated until the appearance of colourless pet ether layer. All the fractions of pet ether layer were collected and evaporated to a concentrated residue. After separation of pet ether fraction, 100 ml of chloroform was added to the hydro-alcoholic extract and this procedure is repeated until the chloroform layer becomes colorless. All the fractions of chloroform layer were collected and evaporated to a concentrated residue. The left over portion is considered as hydro-alcoholic fraction.

Preliminary Phytochemical Screening

Various qualitative tests were performed for the detection of phytochemical constituents present in all three fractions, for the presence of carbohydrates, tannins, flavanoids, steroids, glycosides, alkaloids, saponins etc[14].

Animals

Swiss albino mice of either sex, 3-4 months old and weighing around 20-30 g were selected. The animals had free access to food and water, and were housed in an animal room with alternating light-dark cycle of 12 hr each. The animals were acclimatized for at least 5 days to the laboratory conditions before the commencement of behavioral experiments. Experiments were carried out between 9:00am and 5:00pm. The Institutional Animal Ethics Committee (IAEC) approved the experimental protocol and the care of laboratory animals was taken as per the guidelines of CPCSEA, Ministry of Forests and Environment, Government of India (1529/PO/A/11/CPCSEA/IAEC3/PRO-07/2014-2015).

Preparation of Standard

Imipramine was procured from Baroda Pharmaceuticals as gift sample. Stock solution was prepared by dissolving 10mg in 10 ml of distilled water, and then diluted to required dilutions

Measurement of Antidepressant activity in Albino Mice

In the present investigation, Tail Suspension test (TST) and Forced Swim test (FST) were selected as animal models for the evaluation of antidepressant activity in albino mice

Experimental Protocol

Animals were divided into 16 groups and each group consists of 6 mice.

Tail-suspension test

The total duration of immobility induced by tail suspension was measured according to the method described by steru[15], Thierry[16]. Mice were suspended on the edge of a table 50 cm above the floor by the adhesive tape placed approximately 1 cm from the tip of the tail. Immobility time was recorded during a 6min period. Animal was considered to be immobile when it did not show any movement of body and hanged passively. Each animal was used only once. The experimental protocol and treatment schedule was given in Table 1.

Forced Swim Test

Forced swim test was proposed as a model for antidepressant activity by Porsolt et al.[17,18]. Mice were forced to swim individually in a glass jar containing fresh water of 15 cm height and maintained at 25^{o}C (± 3^{o}C). A mice was considered to be immobile when it remained floating in the water without struggling, making no or minimum movements of its limbs necessary to keep its head above water. The total duration of immobility was recorded during a 6min test. The changes in immobility duration were studied in all groups of animals. The experimental protocol and treatment schedule was given in Table 2. On 14th day, at 90 min after administration of extracts, immobility period was recorded in all groups

Statistical analysis

All the results were expressed as Mean ± Standard Error (SEM). Data was analyzed using one-way ANOVA followed by Dennett's test. In all the tests, the criterion for statistical significance was $p<0.05$

RESULTS AND DISCUSSION

Ayurveda mentions a number of single and compound drug formulations of plant origin that are used in the treatment of psychiatric disorders[19,20] and are claimed to have a better acceptance than conventional drugs due to lower incidence of side effects. Various phyto-constituents like flavanoids, phenols, alkaloids and tri terpenoidal saponins are responsible for the antidepressant effect. Preliminary phytochemical screening was done for Pet-ether, Chloroform and alcoholic extracts of SS using various qualitative tests. The results of phytochemical screening are presented in Table 4. The FST and TST are the most widely used behavioral tools for assessing antidepressant activity. The development of immobility when rodents are suspended by their tail during TST and when they are placed in an inescapable cylinder of water during FST reflects the cessation of their persistent escape-directed behavior. Conventional drugs reliably decrease the duration of immobility in animals during these tests[22]. This decrease in duration of immobility is considered to have a good predictive value in the evaluation of potential antidepressant agents[17]. The results of different extracts of SS on the immobility duration in TST are presented in Table5. Administration of SSA, SSC, SSP 100mg/kg for 14 successive days decreased the immobility time in TST by 48.8%, 52.5% and 16% respectively as compared to control group. SSA, SSC, SSP 100mg/kg administration for 14 days decreased immobility time in FST by 81.2 %, 85.2% and 19.1 % respectively as compared to control group. Standard drug Imipramine 10 mg/kg, 14 days treatment decreased the immobility time by 57.5% and 85.8% respectively in TST and FST as compared to control

Table 1: Experimental protocol for Tail Suspension Test.

S. No.	Group	Treatment Schedule for TST
1.	Control	Only distilled water was administered orally for 14 days
2.	Standard	Imipramine (10mg/kg) was administered orally for 14 days
3.	SSA1	Alcoholic extract of SS (50mg/kg) was administered orally for 14 days.
4.	SSA2	Alcoholic extract of SS (100mg/kg) was administered orally for 14 days.
5.	SSC1	Chloroform extract of SS (50mg/kg) was administered orally for 14 days.
6.	SSC2	Chloroform extract of SS (100 mg/kg) was administered orally for 14 days.
7.	SSP1	Pet ether extract of SS (50mg/kg) was administered orally for 14 days
8.	SSP2	Pet ether extract of SS (100mg/kg) was administered orally for 14 days

Table 2: Experimental Protocol for Forced Swim Test.

S. No.	Group	Treatment Schedule for FST
9.	Control	Only distilled water was administered orally for 14 days
10.	Standard	Imipramine (10mg/kg) was administered orally for 14 days
11.	SSA1	Alcoholic extract of SS (50mg/kg) was administered orally for 14 days.
12.	SSA2	Alcoholic extract of SS (100mg/kg) was administered orally for 14 days.
13.	SSC1	Chloroform extract of SS (50mg/kg) was administered orally for 14 days.
14.	SSC2	Chloroform extract of SS (100 mg/kg) was administered orally for 14 days.
15.	SSP1	Pet ether extract of SS (50mg/kg) was administered orally for 14 days
16.	SSP2	Pet ether extract of SS (100mg/kg) was administered orally for 14 days

Table 3: Percentage yield of different fractions of SS extract.

Fraction	%yield
Pet ether	1.1
Chloroform	3.8
Alcohol	8.5

Table 4: Preliminary phytochemical analysis of fractions of SS extract.

Phytochemical	SSP	SSC	SSA
Alkaloids	-ve	+ve	-ve
Flavanoids	-ve	+ve	+ve
Carbohydrates	-ve	-ve	-ve
Proteins	-ve	+ve	-ve
Tannins	-ve	-ve	+ve
Steroids	+ve	+ve	-ve
Fats &oils	+ve	-ve	-ve

Table 5: Effect of SS on Immobility time in TST.

Groups	Immobility time (Sec)	% decrease in Immobility time
Control	186.3±8.02	
Standard 10 mg/kg	79.2±6.71**	57.5
SSA 50 mg/kg	111±4.87*	40.4
SSA100 mg/kg	95.3±4.12**	48.8
SSC 50 mg/kg	103.6±5.77*	44.4
SSC 100 mg/kg	88.5±4.18**	52.5
SSP 50 mg/kg	175±7.04	6.1
SSP100 mg/kg	158±5.06	16

Values are expressed as mean ± SEM, *P < 0.01, **P < 0.001Vs control group.

group (Tables 5 & 6). The decrease in Immobiltity time with pet ether extract is not significant when compared with control in both TST and FST. A dose of 100 mg/kg p.o. SSC extract showed potent antidepressant-like effect

Table 6: Effect of SS on Immobility time in FST.

Groups	Immobility time (Sec)	% decrease in Immobility time
Control	87.6±5.2	
Standard 10 mg/kg	12.5±2.17**	85.8
SSA 50 mg/kg	38.5±4.82*	56.1
SSA 100 mg/kg	16.5±3.14**	81.2
SSC 50mg/kg	21.6±2.30*	75.4
SSC 100mg/kg	13±1.5**	85.2
SSP 50mg/kg	78.5±5.02	10.4
SSP 100 mg/kg	70.6±4.24	19.1

Values are expressed as mean ± SEM, *P<0.01, **P < 0.001Vs control group.

in both TST and FST as indicated by highest decrease in immobility period. The effect was comparable to standard drug.

CONCLUSION

In the present study, the preliminary phytochemical analysis revealed that the presence of tannins and flavanoids in hydroalcoholic extract. Chloroform extract showed positive results towards flavonoids, alkaloids and steroids. Pet ether extract showed positive results towards, sterols and lipids; SSA and SSC showed decreased immobility in FST and TST indicating their antidepressant activity. Chloroform extracts of SS showed antidepressant activity, which was comparable to standard drug i.e. Imipramine (10 mg/kg). As reported earlier, SS contain many bioactive compounds and majority of these compounds are steroidal alkaloids and flavanoids that are responsible for the health benefits. The antidepressant activity of these extracts may be attributed to steroidal alkaloids. Therefore further study can be explored to evaluate the mechanism of antidepressant activity of *Solanum surattense* by measuring monoamimes and neurotransmitter levels in the brain.

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