**ABSTRACT**

**Background:** *Synedrella nodiflora* (L) Gaertn. belonging to the family Asteraceae contains steroids, reducing sugars, phenolic, flavonoids, saponins, tannins and triterpenoids. Therefore, this study is designed to investigate its antioxidant, analgesic and CNS depressant effects. **Materials and Methods:** The antioxidant activity of methanolic extract of *S. nodiflora* (SN) was determined using Folin Ciocalteu reagent, phosphomolybdenum method, free radical scavenging activity by 1,1-diphenyl-2-picryl-hydrazyl (DPPH) and the reducing power activity. Analgesic activity was done by acetic acid and formalin model and CNS depressant activity was measured by the hole cross and open field method. **Results:** The total phenols and total antioxidant capacity of SN was found to be 37.38 ± 2.01 mg/g equivalent of gallic acid and 433.37 ± 4.22 mg/gm equivalent of ascorbic acid. The percentage (%) scavenging of DPPH free radical was found to be concentration dependent and IC$_{50}$ value was 125.89 ± 2.23 µg/ml while the IC$_{50}$ value of standard ascorbic acid was found to be 16.76 ± 0.11 µg/ml. The reducing power of SN was found to be concentration dependent. Acetic acid and formalin models are peripherally acting analgesic methods. The oral administration of both doses (100 and 200 mg/kg b.wt.) of SN significantly (*p*<0.001) inhibited 40.06% and 61.83% writhing response induced by acetic acid whereas oral administration of the same doses of SN significantly (*p*<0.001) inhibited 56.96% and 62.60% itching response induced by formalin. The methanolic extract of SN, at the dose of 250 mg/kg and 500 mg/kg b.wt. produced significant (*P*<0.001) decrease of locomotion. This is the first report of CNS depressant activity of the plant. **Conclusion:** The extract showed moderate antioxidant, analgesic and CNS depressant potency. The present investigation suggests that SN may be a source of natural antioxidant with analgesic and CNS activity.

**Keywords:** *Synedrella nodiflora*, antioxidant, free radical, analgesic activity, CNS depressant.

**INTRODUCTION**

Free radicals cause depletion of immune system antioxidants, a change in gene expression and induce abnormal proteins and contribute to more than one hundred disorders in humans including atherosclerosis, arthritis, ischemia and reperfusion injury of many tissues, central nervous system injury, gastritis, cancer and AIDS.[1] It has been mentioned that the antioxidant activity of plants might be due to their phenolic, flavonoid, tannin and proanthocyanidin compounds.[2-3] Pain has been defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.[4] Pain can be constant (chronic) or fleeting and come and go (acute). There are several types of pain, namely ‘nociceptive’, ‘neurogenic’, ‘neuropathic’ and ‘psychogenic’, which are associated with a stimulation of nociceptors, damage to neuronal tissue, dysfunction of a nerve, or psychological factors, respectively.[5] The direct and indirect action of chemical mediators, such as arachidonic acid metabolites (prostaglandins and leukotrienes), peptides, serotonin, acetylcholine, cytokines, nitric oxide among others, which can be produced or released following
tissue injury or by exogenous irritants (formalin, acetic acid), are responsible for the multiplicity of events that occur during pain transmission, in both the peripheral and central nervous systems. Moreover, various free radicals as well as reactive oxygen species (ROS) are also responsible for the induction of short-term algesia and trigger some second messengers, that are involved in sensitization of dorsal horn neurons and play a fundamentally important role in neuropathic pain.

_Synedrella nodiflora_ (L) Gaertn. belongs to the family _Asteraceae_. It is a small, annual weed, native to tropical America, found in the plains of India and in the Andamans. The methanol extract showed the presence of steroids, reducing sugars, phenolic compounds, saponins and tannins. Benzene and chloroform extracts showed the presence of steroids. Petroleum ether (40° – 60°C) extracts showed the presence of steroids and triterpenoids.

The _Asteraceae_ family consists of herbs which are known to accumulate substantial amount of flavonoids and to display anti-inflammatory, antioxidant, antimicrobial, analgesic and antipyretic properties. In Ghana, _S. nodiflora_ (L) Gaertn. weed is used for the treatment of epilepsy and pain. In Malaysia and Indonesia, the plant is used for headaches, earaches, stomach aches and rheumatism.

Literature reviews indicated that no studies combining the antioxidant, analgesic and CNS depressant of the leaves of _S. nodiflora_ have so far been undertaken. Taking this in view and as a part of our ongoing research on Bangladeshi medicinal plants, the present study aimed to evaluate the antioxidant, analgesic and CNS activity of the methanolic leaves extract of _S. nodiflora_.

**MATERIALS AND METHODS**

**Plant material**

_S. nodiflora_ plants were collected from Rajshahi in March 2009 and identified by Dr. M.A. Razzaque Shah, Tissue Culture Specialist, BRAC Plant Biotechnology Laboratory, Bangladesh. A voucher specimen for this collection has been maintained in the Bangladesh National Herbarium (Voucher Specimen No-34479), Dhaka, Bangladesh.

**Preparation of the extract**

The leaves of plant were first washed with water to remove adhering dirt and then dried at 45°C for 36 hrs in an electric oven, then powdered with a mechanical grinder, passed through sieve #40, and stored in a tight container. The dried powdered material (1 kg) was taken in a clean, flat bottomed glass container and soaked in methanol for seven days. The whole mixture then underwent a coarse filtration by a piece of clean, white cotton material. The total filtrate was concentrated to dryness, _in vacuo_ at 40°C to render the methanol extract (390 g) of brownish red color.

**Drugs and chemicals**

The active drugs Indomethacin and Diazepam were generous gift samples from Square Pharmaceuticals Ltd., Bangladesh. Acetic acid was obtained from Merck, Germany. Tween-80 was obtained from BDH Chemicals, UK. Formalin was purchased from CDH, India. Normal saline solution was purchased from Beximco Infusion Ltd., Bangladesh. All chemicals used were of analytical reagent grade.

**Animals**

Young Long-Evans rats of either sex weighing about 80–120 gm were used for the experiment. The rats were purchased from the Animal Research Branch of the International Centre for Diarrhoeal Disease and Research, Bangladesh (ICDDR, B). They were kept in standard environmental conditions (at 24.0 ± 0°C & 55–65% relative humidity and 12 hour light/dark cycle) for one week for acclimation after their purchase and fed ICDDRBR formulated rodent food and water _ad libitum_. The set of rules followed for animal experiment were approved by the institutional animal ethical committee.

**Acute toxicity**

The 50% lethal dose (LD₅₀) of the SN in rats was estimated by the up and down method. Doses were adjusted up or down by a constant multiplicative factor (1.5) depending on the previous outcome.

**IN VITRO ANTIOXIDANT ACTIVITY**

**The amount of phenolic compounds**

The total phenolic content of methanolic extract of SN was determined using Folin–Ciocalteu reagent. The content of total phenolic content in the extract of SN was calculated from the regression equation of the calibration curve \(y = 0.0138x + 0.1275, r^2 = 0.988\) and expressed as Gallic acid equivalents (GAE).
Determination of total antioxidant capacity

The antioxidant activity of the extract was evaluated by the phosphomolybdenum method.\textsuperscript{[19]} The assay is based on the reduction of Mo (VI)–Mo (V) by the extract and subsequent formation of a green phosphate/Mo (V) complex at acid pH. The total antioxidant in the extract of SN was calculated from the regression equation of the calibration curve ($y = 0.0043x + 0.1503$, $r^2 = 0.8874$) and expressed as Ascorbic acid equivalent (AAE).

Free radical scavenging activity measured by 1,1-diphenyl-2-picryl-hydrazyl (DPPH)

The free radical scavenging activity of the extract, based on the scavenging activity of the stable 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical was determined by the method described by Braca.\textsuperscript{[20]} The percentage inhibition activity was calculated from $\left[ \frac{A_0 - A_1}{A_0} \right] \times 100$, where $A_0$ is the absorbance of the control, and $A_1$ is the absorbance of the extract/standard. IC\textsubscript{50} value was calculated from the equation of line obtained by plotting a graph of concentration (μg/ml) versus % inhibition.

Reducing power activity

The reducing power of SN was determined according to the method described by Oyaizu.\textsuperscript{[21]} Increased absorbance of the reaction mixture indicated increased reducing power.

\textbf{IN VIVO ANALGESIC ACTIVITY}

Acetic acid-induced writhing test

The analgesic activity of the samples was also evaluated using acetic acid-induced writhing model in rats.\textsuperscript{[22]} In this method, acetic acid is administered intraperitoneally to the experimental animals to create pain sensation. The test samples (100 and 200 mg/kg body weight) and vehicle (1% Tween-80 in water) were administered orally 30 min before intraperitoneal administration of 0.7% v/v acetic acid but indomethacin (10 mg/kg) was administered orally 15 min before injection of acetic acid. After an interval of 5 min, the rats were observed for specific contraction of body referred to as ‘writhing’ for the next 10 min. Full writhing was not always accomplished by the animal, because sometimes the animals started to give writhing but they did not complete it. This incomplete writhing was considered as half-writhing. Accordingly, two half-writhing were taken as one full writhing. The number of writhes in each treated group was compared to that of a control group while Indomethacin (10 mg/kg) was used as a reference substance (positive control). The percent inhibition (% analgesic activity) was calculated by

$$\% \text{ inhibition} = \left\{ \frac{(A - B)}{A} \right\} \times 100$$

Where, $A =$ Average number of writhing of control per group; $B =$ Average number of writhing of test per group.

Formalin test

The antinociceptive activity of the drugs was determined using the formalin test described by Sharma.\textsuperscript{[22]} Control group received 5% formalin. 20 µl of 5% formalin was injected into the dorsal surface of the right hind paw 60 min after administration of SN (100 and 200 mg/kg, p.o) and 30 min after administration of indomethacin (10 mg/kg, i.p.). The rats were observed for 30 min after the injection of formalin, and the amount of time spent licking the injected hind paw was recorded. The first 5 min post formalin injection is referred to as the early phase and the period between 15 and 30 min as the late phase. The total time spent licking or biting the injured paw (pain behavior) was measured with a stop watch. The percent inhibition (% licking activity) was calculated using the above equation.

CNS DEPRESSANT ACTIVITY

Hole cross test

The method was carried out as described by Takagi et al.\textsuperscript{[23]} A steel partition was fixed in the middle of a cage having a size of 30 x 20 x 14 cm. A hole of 3 cm diameter was made at a height of 7.5 cm in the center of the cage. Twenty animals were divided into four groups with five rats in each group. Group I animals received vehicle (1% Tween-80 in water, 10 ml kg\textsuperscript{-1} p.o.), animals of Group II received diazepam at 1 mg kg\textsuperscript{-1} body weight (p.o), while animals of Groups III and IV were treated with 250 and 500 mg kg\textsuperscript{-1} body weight (p.o) of the SN. The number of passages of a rat through the hole from one chamber to other was counted for a period of 3 min on 0, 30, 60, 90 and 120 min after oral administration of test drugs

Open field test

The animals were treated as discussed above. The experiment was carried out according to the methods described by Gupta.\textsuperscript{[24]} The floor of an open field of half square meter was divided into a series of squares each alternatively colored black and white. The apparatus
Laizuman Nahar, et al.: Antioxidant, analgesic and CNS depressant effects of Synedrella nodiflora

had 40 cm height wall. The number of squares visited by the animals were counted for 3 min, on 0, 30, 60, 90 and 120 min after oral administration of test drugs.

STATISTICAL ANALYSIS

All values were expressed as the mean ± SEM of three replicate experiments. The figure of DPPH and reducing power was done by using Graph Pad Prism (version 5.0; Graph Pad, San Diego, CA, USA). All in vivo data were analyzed by using student’s t test compared with control and each value represents the mean ± SEM of 5 experiments. *P<0.05; **P<0.001 were considered to be statistically significant.

RESULTS

The qualitative chemical analysis of \textit{S. nodiflora} showed the positive result for the presence of phenol and flavonoid.

ACUTE TOXICITY

Oral administration of graded doses of SN (500–5000 mg/kg, body weight) did not cause any death in the different dose groups. The LD$_{50}$ value for oral administration of the plant extract was found to be greater than 5000 mg/kg.

IN VITRO ANTIOXIDANT ACTIVITY

Total phenolic contents

The total phenolic content was found to be 37.38 ± 2.01 mg/g plant extract (in GAE) in crude extract of \textit{S. nodiflora}. The results are shown in Table 1.

The GAE and ASC values are expressed as means ± SEM of triplicate experiments

Total antioxidant capacity

Total antioxidant capacity of \textit{S. nodiflora} was expressed as the number of equivalents of ascorbic acid (Table 1).

![Table 1. Total amount of plant phenolic compounds and total antioxidant capacity of methanolic extract of \textit{S. nodiflora}.](#)

<table>
<thead>
<tr>
<th>Sample</th>
<th>Total Phenols mg g$^{-1}$ plant extract (in GAE)$^a$</th>
<th>Total antioxidant capacity mg g$^{-1}$ plant extract (in ASC)$^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synedrella (200 µg/ml)</td>
<td>37.38 ± 2.01</td>
<td>433.37 ± 4.22</td>
</tr>
</tbody>
</table>

$^a$Gallic acid equivalents (GAE, mg/g of each extract) for the total phenolic content.

$^b$Ascorbic acid equivalents (mg/g of each extract) for the total antioxidant capacity.

![Figure 1. Free radical scavenging activity of different concentrations of methanolic extract of SN by DPPH radicals.](#)

![Figure 2. Reducing power of MeOH extract of SN and ascorbic acid by spectrophotometric detection of Fe$^{3+}$ to Fe$^{2+}$ transformation.](#)
IN VIVO ANALGESIC ACTIVITY

Acetic acid-induced writhing test

Table 2 shows the effects of the extract on acetic acid-induced writhing in rats. The oral administration of both doses of SN significantly \( (p<0.001) \) inhibited writhing response induced by acetic acid in a dose dependent manner.

Formalin test

SN (100 and 200 mg/kg, p.o.) significantly \( (P<0.001) \) suppressed the licking activity in either phase of the formalin-induced pain in rat in a dose dependant manner (Table 3). SN, at the dose of 200 mg/kg body weight, showed more licking activity against both phases of formalin-induced pain than that of the standard drug indomethacin.

Table 2. Effect of SN on acetic acid induced writhing in rats.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Treatment</th>
<th>Dose, route</th>
<th>No. of writhing</th>
<th>% inhibition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group-I</td>
<td>1% Tween 80 in water</td>
<td>0.1 ml/10 gm body weight, p.o</td>
<td>26.33 ± 0.55</td>
<td></td>
</tr>
<tr>
<td>Group-II</td>
<td>Indomethacin</td>
<td>10 mg/kg, p.o</td>
<td>10.83 ± 1.22**</td>
<td>58.8</td>
</tr>
<tr>
<td>Group-III</td>
<td>SN</td>
<td>100 mg/kg, p.o</td>
<td>14.2 ± 1.69**</td>
<td>40.06</td>
</tr>
<tr>
<td>Group-IV</td>
<td>SN</td>
<td>200 mg/kg, p.o</td>
<td>10.05 ± 0.56**</td>
<td>61.83</td>
</tr>
</tbody>
</table>

Each value represents the mean ± SEM of 5 experiments. **P < 0.001 considered statistically significant, using student’s t test compared with control, SN represents methanolic extract of S. nodiflora.

CNs DEPRESSANT ACTIVITY

Hole cross test

The methanolic extract of SN, at the dose of 250 mg/kg and 500 mg/kg b.w. produced significant \( (P<0.001) \) decrease of locomotion from its initial value during the period of experiment (Table 4).

Open field test

Results of open field test are presented in Table 5 for the crude extract of SN. The number of squares traveled by the rats were suppressed significantly from the second observation period at both dose levels (250 mg/kg and 500 mg/kg b.w.) of SN. The results were dose dependent and statistically significant.

Table 3. Effect of SN in hind paw licking in the formalin test in rats.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Dose, route</th>
<th>Early phase (Sec)</th>
<th>% protection</th>
<th>Late phase (Sec)</th>
<th>% protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group-I (Distilled water)</td>
<td>10 ml/kg, p.o</td>
<td>35.67 ± 1.38</td>
<td>–</td>
<td>46.0 ± 1.03</td>
<td>–</td>
</tr>
<tr>
<td>Group-II (Indomethacin)</td>
<td>10 mg/kg, i.p</td>
<td>16.83 ± 0.90**</td>
<td>52.8</td>
<td>21.83 ± 0.70**</td>
<td>52.53</td>
</tr>
<tr>
<td>Group-III (SN)</td>
<td>100 mg/kg, p.o</td>
<td>28.2 ± 0.76*</td>
<td>20.94</td>
<td>19.8 ± 0.72**</td>
<td>56.96</td>
</tr>
<tr>
<td>Group-IV (SN)</td>
<td>200 mg/kg, p.o</td>
<td>15.1 ± 0.54**</td>
<td>57.66</td>
<td>17.2 ± 0.99**</td>
<td>62.60</td>
</tr>
</tbody>
</table>

Each value represents the mean ± SEM of 5 experiments. **P < 0.001 considered statistically significant, using student’s t test compared with control, SN represents methanolic extract of S. nodiflora.

Table 4. Effect of SN on hole cross test in rats.

<table>
<thead>
<tr>
<th>Group</th>
<th>Dose, Route</th>
<th>Number of movement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0 min</td>
</tr>
<tr>
<td>Group-I (1% tween80in water)</td>
<td>10 ml/kg, p.o</td>
<td>118.4 ±1.20</td>
</tr>
<tr>
<td>Group-II (Diazepam)</td>
<td>1 mg/kg, p.o</td>
<td>117.2 ± 1.15</td>
</tr>
<tr>
<td>Group-III (SN)</td>
<td>250 mg/kg, p.o</td>
<td>118.4 ± 0.81</td>
</tr>
<tr>
<td>Group-IV (SYNO)</td>
<td>500 mg/kg, p.o</td>
<td>118.0 ± 1.43</td>
</tr>
</tbody>
</table>

Each value represents the mean ± SEM of 5 experiments. **P < 0.001 considered statistically significant, using student’s t test compared with control, SN represents methanolic extract of S. nodiflora.

Table 5. Effect of SN on open field test in rats.

<table>
<thead>
<tr>
<th>Group</th>
<th>Dose, Route</th>
<th>Number of Movements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0 min</td>
</tr>
<tr>
<td>Group-I (1% tween 80 in water)</td>
<td>10 ml/kg, p.o</td>
<td>12.8 ± 1.15</td>
</tr>
<tr>
<td>Group-II (Diazepam)</td>
<td>1 mg/kg, p.o</td>
<td>11.2a ± 0.58</td>
</tr>
<tr>
<td>Group-III (SYNO)</td>
<td>250 mg/kg, p.o</td>
<td>13± 0.70</td>
</tr>
<tr>
<td>Group-IV (SYNO)</td>
<td>500 mg/kg, p.o</td>
<td>12.2a ± 0.66</td>
</tr>
</tbody>
</table>

Each value represents the mean ± SEM of 5 experiments. *P < 0.05 & **P < 0.001 considered statistically significant, using student’s t test compared with control, SN represents methanolic extract of S. nodiflora.
DISCUSSION

To determine the efficacy of natural antioxidants either as pure compounds or as plant extracts, a great number of in vitro methods have been developed in which antioxidant compounds act by several mechanisms. The knowledge of total antioxidant activity can be useful in the analysis of changes in the plasma antioxidant activity related to oxidative stress, or the understanding of structure–activity relationships of pure antioxidant species. The phosphomolybdenum method was based on the reduction of Mo(VI) to Mo(V) by the compounds having antioxidant property and was successfully used to quantify vitamin E in seeds. DPPH is a stable free radical that accepts an electron or hydrogen radical to become a stable diamagnetic molecule and is usually used as a substrate to evaluate the antioxidant activity of a compound. Based on the data obtained from this study, DPPH radical scavenging activity of SN (IC_{50} 125.89 ± 2.23 μg/ml) was lower than the standard ascorbic acid (IC_{50} 16.76 ± 0.11 μg/ml). Moreover, it was revealed that SN did show the proton donating ability and could serve as a free radical inhibitor or scavenger. The reducing properties are generally associated with the presence of reductones, which have been shown to exert antioxidant action by breaking the free radical chain by donating a hydrogen atom. Because a substance may act as an antioxidant due to its ability to reduce ROS by donating hydrogen atom, the ferric reducing property of plant extracts (Fig. 2) implies that they are capable of donating hydrogen atom in a dose dependent manner. Polyphenolic compounds, like flavonoids and phenol, commonly found in plants have been reported to have multiple biological effects, including antioxidant activity. Phenolic compounds are understood to induce the cellular antioxidant system; increase approximately 50% cellular glutathione concentration. Flavonoids are important in the modulation of γ-glutamylcysteine synthase in both cellular antioxidant defenses and detoxification of xenobiotics. Flavonoid and phenol have been reported from SN. We have also got phenol content 37.38 ± 2.01 mg/g and this may be the cause for the antioxidant activity in different models.

Acetic acid induced writhing response is a sensitive procedure to evaluate peripherally acting analgesics and represented pain sensation by triggering localized inflammatory response. Such pain stimulus led to the release of free arachidonic acid from the tissue phospholipid. The response was thought to be mediated by peritoneal mast cells, acid sensing ion channels and the prostaglandin pathways. The organic acid has also been postulated to act indirectly by inducing the release of endogenous mediators, which stimulates the nociceptive neurons that are sensitive to NSAIDs and narcotics. It is well known that non-steroidal, anti-inflammatory and analgesic drugs mitigate the inflammatory pain by inhibiting the formation of pain mediators at the peripheral target sites where prostaglandins and bradykinin are proposed to play a significant role in the pain process. In addition, it was suggested that non narcotic analgesics produce their action by interfering with the local reaction to peritoneal irritation thereby reducing the intensity of afferent nervous stimulation in the acetic acid induced writhing test, a model of visceral pain. Therefore, it is likely that SN might have exerted its peripheral antinociceptive action by interfering with the local reaction caused by the irritant or by inhibiting the synthesis, release and/or antagonizing the action of pain mediators at the target sites and this response in agreement with the previous studies with other parts of Synedrella nodiflora. The above findings clearly demonstrated that peripheral mechanisms are involved in the antinociceptive action of SN.

On the other hand, the formalin model normally postulates the site and the mechanism of action of the analgesic. This biphasic model is represented by neurogenic (0–5 min) and inflammatory pain (15–30 min), respectively. The mechanism by which formalin triggers C-fibers activation remained unknown for a relatively long time. Recently, however, it was demonstrated that formalin activates primary afferent neurons through a specific and direct on TRPA1, a member of the transient receptor potential family of cation channels, expressed by a subset of C-fiber nociceptors, and this effect is accompanied by increased influx of Ca^{2+} ions. TRPA1 cation channels at primary sensory terminals were also reported to mediate noxious mechanical stimuli. These experiments suggest that Ca^{2+} mobilization through TRPA1 cation channels is concomitant with noxious chemicals and mechanical stimuli as they produce their analgesic action. It is likely that the inhibitory effect of SN to the pain response is due to inhibiting the increase of the intracellular Ca^{2+} through TRPA1, presumably evoked by formalin. So, the leaf extract of Synedrella nodiflora may contain substances that affect the metabolism of Ca^{2+}. Literature survey revealed that tannins, triterpenoids and flavonoids are the major phytoconstituents of Synedrella nodiflora. Flavonoids, for example, have been found to suppress the intracellular Ca^{2+} ion elevation in a dose dependent manner, as well as the release of proinflammatory mediators such as TNFα.
The effect of methanol extract of *S. nodiflora* on CNS was evaluated. The result indicated that the extract significantly decreased the locomotor activity (as shown by the results of the open field and hole cross tests). The locomotor activity is a measure of the level of excitability of the CNS and any decrease of this activity may be closely related to sedation resulting from depression of the central nervous system. Gamma-aminobutyric acid (GABA) is the major inhibitory neurotransmitter in the central nervous system. Different anxiolytic, muscle relaxant, sedative-hypnotic drugs are elucidation their actions through GABAergic inhibition in the CNS via membrane hyperpolarization which leads to a decrease in the firing rate of critical neurons in the brain or may be due to direct activation of GABA receptor by the extracts. Many researches have shown that plant containing flavonoids, saponins and tannins are useful in many CNS disorders. Earlier investigation on phytoconstituents and plants suggests that many flavonoids and neuroactive steroids were found to be ligands for the GABA receptors in the central nervous system; which led to the assumption that they can act as benzodiazepine like molecules. Previous phytochemical investigations also showed the presence of such types of phytoconstituents and they are responsible for CNS depressant activity. But this is the first report demonstrating the CNS depressant activity of leaves of methanolic extract of *S. nodiflora*.

**CONCLUSION**

In conclusion, this work has demonstrated that the plant extracts from the leaf of *S. nodiflora* (L) Gaertn. (Asteraceae) possess moderate antioxidant, analgesic and CNS depressant potential, thereby lending support to the traditional use of the plant in painful and inflammatory disorders. However, further studies are needed to be conducted to understand the exact mechanisms of such actions and to isolate the active principles responsible for the observed activity.

**REFERENCES**