**In vitro** antioxidant properties of *Solanum pseudocapsicum* leaf extracts

*Solanum pseudocapsicum* (Family – Solanaceae) is a shrub distributed in the gardens of Simla, Missouri, Dun Valley, and the Nilgiris and used in homeopathy medicine to cure acute lower abdomen pain and to treat somnolence. An earlier study carried out on this plant has shown strong cytotoxic, anticancer, hepatoprotective, antimicrobial, antihypertensive, antispasmodic and antiviral properties. Several plants belonging to the genus *Solanum* including *Solanum melongena* are known to exhibit strong antioxidant properties. However, so far the antioxidant properties of *S. pseudocapsicum* have not been carried out. Hence, in the present investigation various extracts of *S. pseudocapsicum* leaves were screened for **in vitro** antioxidant activity using standard procedures.

The leaves of *S. pseudocapsicum* were collected in July 2003 from the Government Arts College grounds, Ootacamund, Tamilnadu and authenticated. The fresh leaves were shade dried, powdered and extracted (265 g) successively with 1.2 L of each of petroleum ether (60–80°C), chloroform, ethyl acetate and methanol in a Soxhlet extractor for 18–20 h. The extracts were concentrated to dryness under reduced pressure and controlled temperature (40–50°C). The petroleum ether extract yielded a dark-brown sticky solid, weighing 6.3 g (2.42% w/w). The chloroform extract yielded a brown semisolid residue weighing 6.2 g (2.39% w/w). Similarly, the ethyl acetate and methanolic extracts yielded dark-brown solid and semisolid residues, respectively, weighing, 6.15 g (2.36% w/w), and 4.76 g (18.32% w/w), respectively.

The powdered leaves (190 g) were also subjected to extraction with methanol (700 ml) in a Soxhlet extractor for 18–20 h. The extract was concentrated similarly, to yield a deep-brown semisolid residue (48.2 g, 25.37% w/w). Similarly, a crude distilled water extract was also prepared by heating powdered leaves (50 g) in a RB flask under reflux for 2 h with 300 ml distilled water. The mixture was filtered after cooling and the filtrate was concentrated similarly to yield a green semisolid (16.53 g, 33.06% w/w). All the extracts were preserved in a refrigerator till further use.

1,1-diphenyl-2-picryl hydrazyl (DPPH) and 2,2′-azino-bis (3-ethylbenzo-thiazoline-6-sulfonic acid) diammonium salt (ABTS) were obtained from Sigma Aldrich Co, St Louis, USA. Rutin and p-nitroso dimethyl aniline (p-NDA) were obtained from Acros Organics, New Jersey, USA. All other chemicals used were of analytical grade.

All the six extracts of *S. pseudocapsicum* and the three known antioxidants ascorbic acid, rutin, and butylated hydroxy anisole (BHA) were dissolved in distilled dimethyl sulfoxide (DMSO) separately and used for the **in vitro** antioxidant testing using six different methods, except the hydrogen peroxide method. For the hydrogen peroxide method, the extracts and the standards were dissolved in distilled methanol. The stock solutions were serially diluted with the respective solvents to obtain lower dilutions.

The antioxidant activity of the plant extracts and the standards were assessed on the basis of the radical scavenging effect of the stable DPPH-free radical and nitric oxide radical inhibition assay by modified Griess Ilosvay reaction. The crude methanolic extract was found to be the most potent, hence, it was screened for **in vitro** antioxidant activity using scavenging of various radicals like ABTS radical cation, hydroxyl radical (by bleaching of p-NDA method) and deoxyribose method, superoxide radical (by alkaline DMSO method) and hydrogen peroxide method.

Among the six extracts and two standards tested for **in vitro** antioxidant activity using the DPPH method and nitric oxide method, the crude methanolic extract showed potent antioxidant activity with IC50 values of 49.57±0.15 and 79.00±0.08 µg/ml, respectively. The successive ethyl acetate, petroleum ether and methanolic extracts also exhibited potent antioxidant activity in the DPPH method with IC50 values of 47.22±0.15, 91.50±1.20, and 101.50±1.18 µg/ml, respectively. The successive chloroform and methanolic extracts also exhibited potent antioxidant activity in the nitric oxide method with IC50 values of 70.80±0.96 and 97.60±1.08 µg/ml, respectively. However, none of the extracts were found to be more active than the standards (ascorbic acid and rutin) since their IC50 values were found to be higher.

The crude methanolic extract also exhibited potent antioxidant activity in scavenging of ABTS radical cation with IC50 value of 49.66±0.33 µg/ml, but it was found to be less active than the standards. The extract exhibited no activity in the

<table>
<thead>
<tr>
<th>Test compounds</th>
<th><strong>DPPH method</strong></th>
<th>Nitric oxide method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Successive extracts</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Petroleum ether (60–80°C)</td>
<td>91.50±1.20</td>
<td>&gt;700</td>
</tr>
<tr>
<td>Chloroform</td>
<td>423.00±3.05</td>
<td>70.80±0.96</td>
</tr>
<tr>
<td>Ethyl acetate</td>
<td>47.22±0.15</td>
<td>&gt;700</td>
</tr>
<tr>
<td>Methanol</td>
<td>101.50±1.80</td>
<td>97.60±1.08</td>
</tr>
<tr>
<td><strong>Crude extracts</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methanol</td>
<td>49.57±0.15</td>
<td>79.00±0.80</td>
</tr>
<tr>
<td>Water</td>
<td>&gt;1000</td>
<td>&gt;700</td>
</tr>
<tr>
<td><strong>Standards</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rutin</td>
<td>4.97±0.16</td>
<td>47.88±0.11</td>
</tr>
<tr>
<td>Ascorbic acid</td>
<td>8.80±0.16</td>
<td>–</td>
</tr>
</tbody>
</table>

Values are mean±SEM. n=10 in each group.
scavenging of hydroxyl or superoxide radicals.

Antioxidants are known to protect the body against free radical-mediated toxicities. A large number of plants have shown potent antioxidant activities.\(^2\) The present study was undertaken to test four successive and two crude extracts of \textit{S. pseudocapsicum} leaves for 	extit{in vitro} antioxidant activity using DPPH and nitric oxide methods [Table 1]. The crude methanolic extract exhibited potent antioxidant activity with low IC\(_{50}\) values in these two methods. The extract also showed potent scavenging activity against ABTS free radical. However, the activity was found to be less than the standards used. It was ineffective against scavenging of hydrogen peroxide, hydroxyl and superoxide free radicals.

The phytochemical tests indicated the presence of alkaloids, glycosides, tannins, and flavonoids in the crude methanolic extract. Several such compounds were known to possess potent antioxidant activity.\(^7\) Some of these constituents have already been isolated from this plant.\(^1\) Hence, the observed antioxidant activity may be due to the presence of any of these constituents. The plant exhibited strong anticancer, hepatoprotective and several other activities.\(^{1,1}\) These properties may be due to its antioxidant activity. The crude methanolic extract merits further experiments \textit{in vivo}.

Acknowledgments

SHD would like to thank the Department of Biotechnology, New Delhi, for awarding a ‘Junior Research Fellowship.’

\textbf{S. Badami, Om Prakash, S. H. Dongre, B. Suresh}
J.S.S. College of Pharmacy, Rocklands, Ootacamund-643 001, Tamilnadu, India.
E-mail: shridadami@rediffmail.com

\textbf{References}


\begin{table}[h]
\centering
\caption{\textit{In vitro} antioxidant activity of crude methanolic extract of \textit{S. pseudocapsicum} leaves}
\begin{tabular}{|l|c|c|c|c|c|}
\hline
\textbf{Test compounds} & \textbf{ABTS} & \textbf{p-NDA} & \textbf{Deoxyribose} & \textbf{NBT} & \textbf{H}_2\text{O}_2 \\
\hline
Crude methanol extract & 49.66 ± 0.33 & >1000 & >1000 & >1000 & 933.00 ± 16.67 \\
Ascorbic acid & 11.25 ± 0.49 & – & – & >1000 & – \\
Rutin & 0.50 ± 0.05 & 205.83 ± 8.30 & – & >1000 & 36.16 ± 0.17 \\
Butylated hydroxy anisole & – & – & 74.66 ± 1.45 & >1000 & 24.75 ± 0.14 \\
\hline
\end{tabular}
\end{table}

Values are mean±SEM. n=10 in each group.