PHYTOCHEMICAL ANALYSIS OF PORTULACA OLERACEA AND PORTULACA QUADRIFIDA EXTRACTS USING GAS CHROMATOGRAPHY–MASS SPECTROMETRY

TRUPTI P DURGAWALE1*, CHITRA C KHANWELKAR1, PRATIK P DURGAWALE2

1Department of Pharmacology, Krishna Institute of Medical Sciences Deemed to be University, Karad, Maharashtra, India. 2Department of Molecular Biology and Genetics, Krishna Institute of Medical Sciences Deemed to be University, Karad, Maharashtra, India.

Email: truptipdurgawale@gmail.com

Received: 12 February 2018, Revised and Accepted: 21 May 2018

INTRODUCTION

Portulaca oleracea L. commonly known as Purslane belongs to the family Portulacaceae as remedies against a host of diseases. Recent pharmacological investigations have revealed the importance of these plants as sources of antioxidants, essential fatty acids, and even antimicrobial agents. The objective of this study was phytochemical analysis and comparison of ethanolic extracts of these two species of Portulaca.

Methods: The ethanolic extracts of both the species were prepared using Soxhlet extraction and were analyzed using gas chromatography coupled with mass spectrometry (GC–MS). Furthermore, the ethanolic extracts of fresh and dried whole plant of P. oleracea and seed of P. oleracea were studied.

Results: The phytochemical constituents of ethanolic extracts of P. oleracea and P. quadrifida were found to be quite different from one another and contained beneficial polyunsaturated fatty acids, alkaloids among other beneficial chemical species.

Conclusion: The results of the study could be further used by researchers to assess the beneficial properties of both these species for in vitro and in vivo experiments.

Keywords: Portulaca oleracea, Portulaca quadrifida, Gas chromatography–mass spectrometry.

INTRODUCTION

Portulaca oleracea is commonly known as Purslane belongs to the family Portulacaceae. This plant might have originated in Asia and is now grown in Africa, Asia, and Mediterranean region [1]. It is found to grow as a weed in turfgrass or field crop [2,3]. It is used in salads, soups, and pickles for its sour taste. Conventionally, it has been described to be beneficial for the treatment of diseases related to intestine, liver, stomach, cough, shortness of breath, arthritis, as well as for burns and headache. It is also used for diuretic treatment, as a purgative, emollient, and as an anti-inflammatory agent [4]. Chinese traditional medicine describes the use of Purslane to resolve toxins, stanch bleeding, cool blood, and the aerial parts of the plant for the treatment of eczema, dysentery, and diarrhea [5]. Not only traditional systems of medicine but also modern investigative techniques have revealed that the Purslane weed has noticeable nutritive value. The phytochemical screening of Purslane has suggested that the plant has a higher content of beta-carotene and ascorbic acid than some of the traditional nutritive plant crops. Furthermore, the plant has been reported to be a storehouse of omega-3 fatty acids such as alpha-linolenic acid [6]. As such, the plant can be said to be a major source of dietary antioxidants and nutrients [7].

Another plant belonging to family Portulacaceae and widely distributed around Asia and Africa is Portulaca quadrifida commonly known as chickweed [8]. The plant has been traditionally used in parts of Africa for medicinal purposes to treat asthma, cough, urinary discharges, inflammations and ulcers, abdominal complaints, and hemorrhoids [9]. It has also been demonstrated to possess antifungal activity against Aspergillus fumigatus and Candida albicans [10]. The leaves of the plant are used in salad or in preparation of soup [11]. Preliminary phytochemical screening of P. quadrifida ethanolic extract has been reported to contain polyphenols such as flavonoids and alkaloids [12]. Since detailed analysis of phytochemical constituents for P. quadrifida were not found to be reported earlier, this study might help investigate this aspect in comparison with phytochemical constituents of Portulaca oleracea collected from Maharashtra state of Western part of India.

METHODS

Collection of specimen

The plants of P. oleracea and P. quadrifida were harvested from local fields of district Sangli, state Maharashtra in February–March. The specimens were authenticated by Dr. Dhanaji S. Pawar, Associate Professor, Department of Botany, M. H. Shinde Mahavidyalaya, Tisangi. For obtaining the dry powder of the P. oleracea whole plant, the plants were dried in shade and seeds from some of the P. oleracea plants were separated. The dried whole plant of P. oleracea was powdered using mortar pestle.

Extraction using Soxhlet apparatus

For each of the four specimens (namely the P. oleracea fresh whole plant, P. quadrifida fresh whole plant, powder of dried P. oleracea whole plant, and seed of P. oleracea), 20 g specimen was extracted in 200 mL of ethanol for 5–6 cycles. The extracts were then evaporated to dryness. The extracts were reconstituted in ethanol for further analysis.

Gas chromatography–mass spectrometry (GC–MS) analysis

The GC system comprised a PerkinElmer GC Clarus 500 system with an autosampler. The capillary column used for GC system was of methyl silicone 25 m in length, 0.2 mm inner diameter, and 0.33 µm film thickness. The carrier gas used was helium at a constant flow rate of...
The dried powder of fresh whole plant of *P. oleracea* was extracted using ethanol and analyzed by GC coupled to MS as shown in Table 3.

The ethanolic extract of fresh whole plant of *P. oleracea* contained esters of cyclopropa[n]pentaenanoic acid, hexanedioic acid, octadecanoic acid besides, phosphoric acid, dibutyl 3-trifluoromethyl-3-pentyl ester, n-nonadecanol, trans-2-dodecen-1-ol, 2-methyl-2,2,3,3,13-octadecadienol, and 9,12,15-octadecatrienial. As compared to the results of fresh whole plant *P. oleracea*, the content of phosphoric acid, dibutyl 3-trifluoromethyl-3-pentyl ester, and cyclopropa[n]pentaenanoic acid was found to be lower in the dried whole plant sample (Table 1).

The GC obtained for the ethanolic extract of seeds of *P. oleracea* was obtained as below along with the major identified phytochemicals (Table 4). The ethanolic extract of seeds of *P. oleracea* was found to contain esters of fatty acids such as 10-octadecenoic acid, tetradecanoic acid, 9,12-octadecadienial, and octadecanoic acid. Tributyl phosphate has been reported to possess cytotoxic activity [19].

### CONCLUSION

The results of the GC-MS analysis of phytocomponents of *P. oleracea* and *P. quadrifida* indicate the presence of many useful compounds such as polyunsaturated fatty acids including ω-3 and ω-6 fatty acids, alkaloids, and terpenoids. Although the results of GC–MS analysis of *P. oleracea* were not similar to previous reports, it must be remembered that the growth conditions and time of harvest play an important role in determining the phytochemicals and their amount. Since the plants were harvested from fields where they were neglected as weed, the growing conditions might not have been conducive for expression of high amounts of essential fatty acids in the plant. *Portulaca quadrifida* GC–MS analysis was not published earlier, and hence, this analytical report might further help researchers study its use as a source of nutrition or other pharmacological activities. Earlier, in vivo investigation on the effective doses of *P. oleracea* whole plant extract indicated that dosage levels of 500 mg/kg body weight could be used to study its pharmacological activity and dosage higher than 400 mg/kg body weight could provide for results of fresh whole plant *P. oleracea* were as mentioned below along with the major identified phytochemicals (Table 1).

The above data reveal the presence of methyl esters of polyunsaturated fatty acid 6,9,12-octadecatrienial, cyclohexanoic ester, and other methyl esters such as cyclopropa[n]pentanoic acid, 2-undecyl-, methyl ester, trans-1-(5-bicyclo[2.2.1]heptyl)ethylamine is an alkaloid which has many pharmaceutical applications and has been tested for antibacterial and antiviral properties [17].

The GC obtained for the ethanolic extract of fresh whole plant of *P. quadrifida* contained major constituents identified as Table 2.

### Table 1: Identified phytochemicals using MS coupled to GC of ethanolic extract of fresh whole plant of *P. oleracea*

<table>
<thead>
<tr>
<th>Peak No.</th>
<th>R.T. (min)</th>
<th>Area (%)</th>
<th>Molecular formula</th>
<th>Molecular weight</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9.701</td>
<td>16.44</td>
<td>C&lt;sub&gt;18&lt;/sub&gt;H&lt;sub&gt;25&lt;/sub&gt;N</td>
<td>139</td>
<td>1-{5-Bicycle[2.2.1]heptyl}ethylamine</td>
</tr>
<tr>
<td>2</td>
<td>11.378</td>
<td>26.48</td>
<td>C&lt;sub&gt;24&lt;/sub&gt;H&lt;sub&gt;34&lt;/sub&gt;O&lt;sub&gt;2&lt;/sub&gt;</td>
<td>348</td>
<td>Phosphoric acid, dibutyl 3-trifluoromethyl-3-pentyl ester</td>
</tr>
<tr>
<td>3</td>
<td>14.288</td>
<td>27.98</td>
<td>C&lt;sub&gt;29&lt;/sub&gt;H&lt;sub&gt;42&lt;/sub&gt;O&lt;sub&gt;5&lt;/sub&gt;</td>
<td>153</td>
<td>Imidazole, 2-amino-5-{[2-carboxy]vinyl}</td>
</tr>
<tr>
<td>4</td>
<td>15.993</td>
<td>23.7</td>
<td>C&lt;sub&gt;29&lt;/sub&gt;H&lt;sub&gt;42&lt;/sub&gt;O&lt;sub&gt;5&lt;/sub&gt;</td>
<td>310</td>
<td>Cyclopropa[n]pentaenanoic acid, 2-undecyl-, methyl ester; trans</td>
</tr>
<tr>
<td>5</td>
<td>16.629</td>
<td>5.39</td>
<td>C&lt;sub&gt;33&lt;/sub&gt;H&lt;sub&gt;56&lt;/sub&gt;O&lt;sub&gt;7&lt;/sub&gt;</td>
<td>368</td>
<td>6,9,12-octadecatrienial, cyclohexanoic ester; (Z, Z, Z)</td>
</tr>
</tbody>
</table>

MS: Mass spectrometry; GC: Gas chromatography. *P. oleracea: Portulaca oleracea*

### Table 2: Identified phytochemicals using MS coupled to GC of ethanolic extract of fresh whole plant of *P. quadrifida*

<table>
<thead>
<tr>
<th>Peak No.</th>
<th>R.T. (min)</th>
<th>Area (%)</th>
<th>Molecular formula</th>
<th>Molecular weight</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7.434</td>
<td>2.05</td>
<td>C&lt;sub&gt;15&lt;/sub&gt;H&lt;sub&gt;26&lt;/sub&gt;O&lt;sub&gt;2&lt;/sub&gt;</td>
<td>194</td>
<td>Tricyclo[4.3.3.1(3,8)]undecane-3-carboxylic acid</td>
</tr>
<tr>
<td>2</td>
<td>11.379</td>
<td>2.73</td>
<td>C&lt;sub&gt;15&lt;/sub&gt;H&lt;sub&gt;26&lt;/sub&gt;O&lt;sub&gt;2&lt;/sub&gt;</td>
<td>266</td>
<td>Tributyl phosphate</td>
</tr>
<tr>
<td>3</td>
<td>13.386</td>
<td>6.25</td>
<td>C&lt;sub&gt;15&lt;/sub&gt;H&lt;sub&gt;26&lt;/sub&gt;O&lt;sub&gt;2&lt;/sub&gt;</td>
<td>296</td>
<td>3,7,11,15-Tetramethyl-2-hexadecen-1-ol</td>
</tr>
<tr>
<td>4</td>
<td>13.472</td>
<td>2.72</td>
<td>C&lt;sub&gt;15&lt;/sub&gt;H&lt;sub&gt;26&lt;/sub&gt;N&lt;sub&gt;2&lt;/sub&gt;O&lt;sub&gt;2&lt;/sub&gt;</td>
<td>350</td>
<td>1-Benzoylaminonaphthalene-1-phenylpentane</td>
</tr>
<tr>
<td>5</td>
<td>13.841</td>
<td>3.76</td>
<td>C&lt;sub&gt;15&lt;/sub&gt;H&lt;sub&gt;26&lt;/sub&gt;N&lt;sub&gt;2&lt;/sub&gt;O&lt;sub&gt;2&lt;/sub&gt;</td>
<td>296</td>
<td>9-Octadecenoic acid, methyl ester</td>
</tr>
<tr>
<td>6</td>
<td>14.845</td>
<td>1.15</td>
<td>C&lt;sub&gt;15&lt;/sub&gt;H&lt;sub&gt;26&lt;/sub&gt;O&lt;sub&gt;2&lt;/sub&gt;</td>
<td>256</td>
<td>Tetradecanoic acid, 12-methyl-, methyl ester</td>
</tr>
<tr>
<td>7</td>
<td>15.943</td>
<td>6.58</td>
<td>C&lt;sub&gt;15&lt;/sub&gt;H&lt;sub&gt;26&lt;/sub&gt;O&lt;sub&gt;4&lt;/sub&gt;</td>
<td>258</td>
<td>Hexadecanoic acid, mono (2-ethylhexyl) ester</td>
</tr>
<tr>
<td>8</td>
<td>15.985</td>
<td>18.02</td>
<td>C&lt;sub&gt;15&lt;/sub&gt;H&lt;sub&gt;26&lt;/sub&gt;Br</td>
<td>380</td>
<td>2-Methylhexacosane</td>
</tr>
<tr>
<td>9</td>
<td>16.199</td>
<td>2.51</td>
<td>C&lt;sub&gt;15&lt;/sub&gt;H&lt;sub&gt;26&lt;/sub&gt;Br</td>
<td>500</td>
<td>Triacetone, 1-bromo-</td>
</tr>
<tr>
<td>10</td>
<td>17.643</td>
<td>1.94</td>
<td>C&lt;sub&gt;15&lt;/sub&gt;H&lt;sub&gt;26&lt;/sub&gt;Br</td>
<td>580</td>
<td>Octadecanoic acid, 2-(octadecyloxy) ethyl ester</td>
</tr>
</tbody>
</table>

MS: Mass spectrometry; GC: Gas chromatography. *P. quadrifida: Portulaca quadrifida*
significant hepatoprotective activity in mice [21]. Similar dosage levels have also been reported for in vivo pharmacological activities of *P. oleracea* and *P. quadrifida* extracts in mice which indicated the presence of antinociceptive and muscle relaxant activities [22]. These reports along with the present findings of phytochemical constituents could help investigators design experiments accordingly.

**ACKNOWLEDGMENT**

The authors would like to extend their gratitude toward the Department of Chemistry, Savitribai Phule Pune University for GC–MS analysis of the study samples. Authors also acknowledge the continued support provided by the Directorate of Research, Krishna Institute of Medical Sciences Deemed to be University toward completion of this project.

**FINANCIAL DECLARATION**

The study was financially supported by the Directorate of Research, Krishna Institute of Medical Sciences Deemed to be University, Karad.

**AUTHOR’S CONTRIBUTION**

The work of collection of plant material, preparation of extract, and analysis of GC–MS results was done by Trupti Durgawale. Dr. Chitra C. Khanwelkar has guided her and reviewed her work. Pratik Durgawale has worked on drafting of the manuscript and analysis of GC–MS results.

**CONFLICTS OF INTEREST**

The authors declare that they have no conflicts of interest.

**REFERENCES**
