Narcotic Alkaloids of Four Papaver Species from Iran

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Z. Naturforsch. 62c, 16–18 (2007); received August 8/September 26, 2006

Four native Papaver species of Iran, i.e. P. glaucum, P. tenuifolium, P. dubium and P. fugax, were collected from their natural habitat and subjected to HPLC analysis for determination of their morphine, codeine and thebaine content. P. dubium and P. glaucum contained all of the three mentioned narcotic alkaloids, while morphine was not found in P. fugax, and P. tenuifolium was free from codeine.

Key words: Morphine, Thebaine, Papaver

Introduction

Morphine and codeine are among the most important natural compounds which are widely used as narcotic analgesics (Carins, 2003; Kapoor, 1995; Heinrich et al., 2004). Thebaine is also considered as a precursor for the synthesis of powerful analgesics, oxycodone and buprenorphine (McNicholas and Martin, 1984; Lewis, 1973), or can serve as a substitute for morphine as starting material for the production of codeine (Theuns et al., 1986). These morphinans are classified as benzylisoquinoline alkaloids. More than 2500 benzylisoquinoline alkaloids have been found in five plant families including the Papaveraceae (Preininger, 1985; Facchini, 2001). However, only a number of closely related Papaver species has the capacity to produce morphinan alkaloids (Phillipson, 1983; Wieczorek et al., 1986). Therefore the screening of different Papaver species for the presence of morphine, codeine and thebaine is of importance.

The alkaloid contents of Papaver species from the section Rhoeadium and of Turkish origin have extensively been reviewed by Preininger (1986) and Sariyar (2002). There are also two reports relating to the existence of trace amounts of thebaine in Papaver albiflorum subsp. albiflorum collected from Southwestern Slovakia (Slavik et al., 1981), and the presence of it as a major alkaloid in a herbarium sample from Central Slovakia (Slavik and Slavikova, 1990).

In this paper the extraction and determination of morphine, codeine and thebaine from P. glaucum, P. tenuifolium, P. dubium and P. fugax as four native species of Iran are reported.

Material and Methods

Plant material

The immature fruits of four Papaver species, i.e. P. glaucum, P. tenuifolium, P. dubium and P. fugax, were collected from their natural habitats in Iran. The locality information and voucher numbers of the studied species are listed in Table I.

Table I. The locality information and voucher number of studied Papaver species.

<table>
<thead>
<tr>
<th>Species</th>
<th>Locality</th>
<th>Voucher number</th>
</tr>
</thead>
<tbody>
<tr>
<td>P. glaucum</td>
<td>Sanandaj: Sanandaj-Kermanshah road, km 3, 1500 m; May 29, 2002</td>
<td>MP-347</td>
</tr>
<tr>
<td>P. tenuifolium</td>
<td>Tehran: Tehran-Qom highway, km 60, 1300 m; May 8, 2002</td>
<td>MP-174</td>
</tr>
<tr>
<td>P. dubium</td>
<td>Tehran: Firuzkuh-Tehran road, 110 km to Tehran, 2200 m; May 23, 2002</td>
<td>MP-208</td>
</tr>
<tr>
<td>P. fugax</td>
<td>Sanandaj: Salavat-Abad mountain, 2000 m; May 30, 2002</td>
<td>MP-333</td>
</tr>
</tbody>
</table>
specimens have been deposited at the Medicinal Plants and Drugs Research Institute Herbarium, Shahid Beheshti University (Tehran, Iran).

**Extraction of total alkaloids**

Extraction of alkaloids was carried out according to a previously reported procedure (Williams and Ellis, 1989). Briefly, 20 g of the capsules were ground and extracted by methanol (80%, 200 ml) for 24 h. The mixture was acidified to pH 1 by 1 M HCl. Extraction by petroleum ether (3 ¥ 50 ml) was followed by raising the pH value of the aqueous layer to 8.5 by addition of 1 M ammonium hydroxide solution. The resulting aqueous mixture was extracted by CHCl3/i-PrOH (3:1 v/v, 3 ¥ 55 ml). The organic layer was separated and concentrated at 40 °C under diminished pressure. The resulting extract was directly subjected to HPLC analysis.

**HPLC analysis**

HPLC analysis was carried out on a Knauer HPLC system (Berlin, Germany) equipped with a C18 column (250 mm, 4 mm i. d., RP, particle size 5 μm) and a PDA detector. For elution a gradient mixture of two different solutions, (a) 2% CH3CN, 98% H2O, 0.1 M NaH2PO4, pH 2.8, and (b) 25% CH3CN, 75% H2O, 0.1 M NaH2PO4, pH 2.5, was used at the flow rate of 1.5 ml/min (Rembery and Buchbauer, 1994). Standard pure morphine and codeine were obtained from TEMAD Pharmaceutical Company (Tehran, Iran), and thebaine from Pasteur Institute of Iran.

**Results and Discussion**

Screening the total alkaloid extracts of *P. dubium*, *P. glaucum*, *P. fugax* and *P. tenuifolium* showed that these species contained few amounts of morphine, codeine and thebaine. The results are summarized in Table II where the amount of morphinans is reported in ppm (μg/g) based on the weight of the ground dry capsules. As shown, *P. dubium* and *P. glaucum* contained all of the three mentioned narcotic alkaloids. No trace amount of morphine was found in *P. fugax*. The extract of *P. tenuifolium* was free from codeine. 180 ppm of codeine was quantified in *P. fugax* and the highest amount of morphine was found in *P. glaucum* (98 ppm). An interesting finding was the presence of thebaine in all studied species where the highest amount was found in *P. tenuifolium*. Thebaine has already been found in *P. dubium* subsp. lecoqii var. lecoqii from Turkey (Unsal et al., 2006).

**Acknowledgements**

We are grateful to Shahid Beheshti University Research Council for financial support of this project. The generous help of Dr. Amani from Pasteur Institute of Iran is also gratefully acknowledged.

<table>
<thead>
<tr>
<th>Entry</th>
<th>Plant material</th>
<th>Morphine (ppm)</th>
<th>Codeine (ppm)</th>
<th>Thebaine (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>P. dubium</em></td>
<td>64.2 ± 0.3</td>
<td>30.8 ± 0.2</td>
<td>10.1 ± 0.1</td>
</tr>
<tr>
<td>2</td>
<td><em>P. glaucum</em></td>
<td>98.4 ± 0.8</td>
<td>27.2 ± 0.4</td>
<td>9.0 ± 0.1</td>
</tr>
<tr>
<td>3</td>
<td><em>P. fugax</em></td>
<td>–</td>
<td>179.6 ± 1.2</td>
<td>34.2 ± 0.3</td>
</tr>
<tr>
<td>4</td>
<td><em>P. tenuifolium</em></td>
<td>54.0 ± 0.7</td>
<td>–</td>
<td>46.7 ± 0.6</td>
</tr>
</tbody>
</table>

Table II. Morphine, codeine and thebaine contents of four native *Papaver* species of Iran.

* Calculated amount of the alkaloid (μg/g) based on the weight of the ground dry capsules (mean ± standard deviation for three replications).


