Volatile Fraction of Fool’s Watercress (Apium nodiflorum) as a New Spice Herb and Ingredient for Salads

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Abstract

This work displays the preliminary results of a study of the volatile fraction of fool’s watercress (FW) (Apium nodiflorum), an underutilized vegetable species with potential use for salads and as spice. A comparative study of the volatile fraction of FW samples from Northern Valencia periurban area and samples from relatives parsley and celery was performed by head-space solid phase microextraction (HS/SPME) and GC-MS analysis. The profile of FW was richer than the profile of celery and parsley and resulted as a mixture of those ones. Moreover, some volatiles like isothiocyanates were identified as specific of FW. Thus, the flavour of this species can be considered similar to its relatives but more intense and consequently, may be used in salads or even as spice herb.

Keywords: aroma, celery relatives, flavour, gas chromatography, mass spectrometry.

Introduction

For centuries, humans have collected wild species from the nature. Nowadays, many of them, despite being undomesticated, are part of the ethnobotanical heritage of different cultures and still remain utilized by rural population (Leonti et al., 2006). Some of those species have shown a great adaptation to new environmental conditions which are derived from human activity. Thus, watercress (Nasturtium officinale W.T. Aiton) and the less known fool’s watercress (FW) (Apium nodiflorum (L.) Lag.) grow profusely in irrigation channels and can be easily harvested and used as a complement of the diet. In particular, A. nodiflorum, a species of the Apiaceae family, is eaten fresh added in salads or even boiled in soups for increasing the taste of many dishes, in the same way than celery. In addition, its intense flavour and taste could offer new potential uses as a spice herb. Unfortunately, the knowledge about its flavour/aroma active compounds is nil, which is a key subject for breeding programs aimed to its future commercial exploitation.

Aims

The present work was aimed to perform a comparative study on the volatile fraction of FW and its relatives celery (A. graveolens L. var. dulce (Mill.) Pers.) and parsley (Petroselinum crispum (Mill.) Nyman).

Materials and Methods

A fool’s watercress population located in the irrigation channels of Camino de Vera (Universitat Politècnica de València, Valencia, Spain) was analyzed and compared with commercial samples of celery and parsley from the Central Market of Valencia. The volatile fraction was extracted with the head space/solid phase microextraction technique (HS/SPME) and analyzed by GC-MS according to the protocol described by Rodríguez-Burruezo et al. (2010). Volatiles were identified...
with reference standards, if possible, or tentatively by comparing the mass spectra with the NIST library.

**Results**

FW presented a volatile fraction which resulted as a mixture of those ones identified in celery and parsley but richer (Table 1). A total of 46 compounds were tentatively identified for FW. On the contrary, around 30 volatiles were identified in celery and parsley. Some compounds were found in the three species, especially monoterpenes, while others did not appear in at least one of them. In particular, some volatiles, i.e. β-ionone, sylvestrene and the group of isothiocyanates were specifically found in the species of study. According to these results, the flavour and aroma of fool’s watercress can be considered similar to celery but more intense and with green notes typical from parsley and carrots.

**Conclusion**

This work is the first report of the volatile fraction of *A. nodiflorum*. Particular aroma and flavour of fool’s watercress is due to a specific combination of typical volatiles from celery and

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**Table 1. Volatile profile (peak area units x10^6) of fool’s watercress (FW) and relatives parsley (Par) and celery (Cel).**

<table>
<thead>
<tr>
<th></th>
<th>RI</th>
<th>FW</th>
<th>Par</th>
<th>Cel</th>
<th></th>
<th>RI</th>
<th>FW</th>
<th>Par</th>
<th>Cel</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sesquiterpenes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Aromatic hydrocarbons</strong></td>
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</tbody>
</table>
| **RI** | FW | Par | Cel | 3-methylbutyl isothiocyanate | 1040 | 2,82 | -- | -- 
| (+)-cyclosativene | 1125 | 45,41 | t r b | -- | 4-methylpentyl isothiocyanate | 1136 | 7,91 | -- | -- 
| α-ylangene | 1221 | 1,73 | 2,38 | -- | 1-heptyl isothiocyanate | 1185 | 2,57 | -- | -- 
| α-copaene | 1222 | 227,50 | 102,94 | -- | 1-heptyl isothiocyanate | 1253 | 1,72 | -- | -- 
| α-cubebene | 1344 | 2,74 | 11,89 | -- | 1-octyl isothiocyanate | 1354 | 3,34 | -- | -- 
| δ-elemene | 1377 | 313,27 | -- | -- | nonyl isothiocyanate | 1458 | 0,94 | -- | -- 
| β-elemene | 1398 | 26,61 | -- | 4,69 | -- | -- | -- | -- |
| β-gurjunene | 1403 | 5,96 | 10,92 | -- | 3-methylhexyl isothiocyanate | -- | -- | -- | -- 
| α-bergamotene | 1430 | 0,91 | 6,25 | -- | Thiazoles | -- | -- | -- | -- 
| (Z)-β-farnesene | 1460 | 163,60 | -- | -- | 4-Ethyl-5-methylthiazole | 1021 | 6,41 | -- | -- 
| α-farnesene | 1458 | 361,61 | -- | 2,19 | -- | -- | -- | -- |
| β-caryophyllene | 1494 | 0,62 | 292,29 | 380,01 | (Z)-3-Hexen-1-ol, | 868 | 5,19 | 3,37 | 25,68 |
| **Monoterpenes** |    |        |       |        | 3-Hexen-1-ol | 868 | 34,96 | 1,84 | -- 
| β-pinene | 943 | 741,49 | 54,82 | 34,14 | (Z)-5-octen-1-ol, | 1067 | 1,80 | -- | -- 
| β-myrcene | 943 | 271,87 | 819,86 | 80,36 | phenylethyl alcohol | 1134 | 38,42 | -- | -- 
| α-pinene | 948 | 30,12 | 72,78 | 11,37 | Other compounds | -- | -- | -- | -- |
| (E)-β-ocimene | 976 | 837,70 | -- | 465,62 | | | | | |
| β-ocimene | 976 | 108,81 | 90,81 | 236,02 | | | | | |
| γ-terpinene | 998 | 255,58 | 13,78 | 112,02 | Benzeneacetaldehyde | 1081 | 11,20 | -- | -- 
| sylvestrene | 1018 | 2,02 | -- | -- | 2-nonenenitrile | 1169 | 1,65 | -- | -- 
| limonene | 1018 | 2408,75 | -- | 1801,32 | Hexahydropyrrolizine-3-thione | 1222 | 20,86 | -- | -- 
| (Z)-limonene oxide | 1031 | 8,27 | -- | -- | Benzenepropanenitrilo | 1231 | 5,43 | -- | -- 
| limonene epoxide | 1031 | 2,57 | -- | -- | 4-methylbenzyl cyanide | 1252 | 2,49 | -- | -- 
| α-terpinolene | 1052 | 3,55 | 1171,26 | 104,10 | Oxime-, methoxy-phenyl | 1301 | 5,89 | 7,05 | 5,78 |
| **Norcarotenoids** |    |        |       |        | | | | | |
| β-ionone | 1457 | 8,73 | -- | -- | | | | | |

**RI** = retention index. **tr** = traces (<0,01x10^6 peak area units). **--** = not detected
parsley, with specific grassy/green notes due to sulphur compounds isothiocyanates. The results suggest that there are real opportunities to promote this species as an ingredient for salads and/or spice use.

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References