From the leaves of *Cucumis sativus* the following C-glycosides were isolated and identified: isovitexin 2'-O-glucoside, isovitexin, isoorientin, 4'-X-O-diglucosides of isovitexin and swertiajaponin. In the flowers of the above species chromatographically (HPLC, TLC) the presence of kaempferol 3-O-rhamnoside and 3-O-glycosides of kaempferol, quercetin, isorhamnetin was revealed. The flavonoids complexes occurring in other species of *Cucumis*: *C. metuliferus*, *C. myriocarpus* and six cultivar varieties of *C. sativus* chromatographically (HPLC, TLC) were compared. © 2001 Elsevier Science Ltd. All rights reserved.

**Keywords:** *Cucumis sativus*; Cultivar varieties; *C. metuliferus*; *C. myriocarpus*; Cucurbitaceae; Flavonoids; HPLC; Chemotaxonomy

1. Subject and sources

*Cucumis sativus* L. is widely cultivated in many varieties for its edible fruit (cucumber). The aerial parts of this plant, and its cultivated varieties, including hybrid cultivars — Olimp F₁, Hela F₁, Cezar F₁, Polan F₁ and open-pollinated — Monastyrski, Delicius (Gacek, 1997) and two other species — *C. myriocarpus* Naud., *C. metuliferus* E. Mey. ex Schrad. were collected in the Medicinal Plants Garden of the Medical University of Gdańsk. The above plants are deposited at the Herbarium of the Museum of Natural History of the University of Wroclaw (Poland) with the following numbers of voucher specimens — WRSL No. 96807 (*C. sativus*), WRSL No. 96808 (*C. sativus* Olimp F₁), WRSL No. 96809 (*C. sativus* Monastyrski), WRSL No. 96810 (*C. sativus* Delicius), WRSL No. 96811 (*C. sativus* Hela F₁), WRSL No. 96812 (*C. sativus* Cezar F₁), WRSL No. 96813 (*C. sativus* Polan F₁), WRSL
No. 96814 (C. myriocarpus), WRSL No. 96815 (C. metuliferus). The cultivar varieties listed above are marketed in Poland and other countries (Monastyrski) on the basis of the Official Polish Register of Vegetable Plants Varieties (Gacek, 1997).

2. Previous study

Linard and Paris (1977) have reported the presence of flavone O- and C-glycosides in C. sativus. From the leaves of C. melo Monties et al. (1976) have isolated four flavone C-glycosides with unknown interglycosidic bonds, namely melosides A, a and L, l.

3. Present study

From the methanolic extract of the leaves C. sativus, the following compounds were separated, by preparative column chromatography on polyamide and Sephadex LH-20: isovitexin 2"-β-O-glucopyranoside (main), isoorientin, isovitexin and 4'-X–O-diglucoside isovitexin, 4'-X–O-diglucoside swertiajaponin. The first three compounds were identified by LSI-MS, FD-MS, UV and NMR including 2D experiments; \(^1\)H–\(^1\)H COSY, HMBC, HSQC. The probable structures of the latter compounds were established on the basis of LSI-MS, UV, total and partial acid hydrolysis. In the leaves of all varieties and species under investigation (HPLC,TLC), the flavone–isovitexin 2"-O–β-glucopyranoside was present (Table 1). HPLC and TLC analyses of the methanolic extracts from the flowers of C. sativus revealed the presence of flavonol O-glycosides, namely: kaempferol 3-O-glucoside, isorhamnetin 3-O-glucoside, quercetin 3-O-glucoside, kaempferol 3-O-rhamnoside.

HPLC analyses were carried out using Lichrospher RP-18 column with gradient elution for flavone C-glucosides: A-3% acetic acid B-CH\(_3\)CN, programme gradient; 0–10 min. 100–95% A in A + B, 10–20 min 95–92% A in A + B, 20–35 min 92–85% A in A + B, 35–45 min. 85–80% A in A + B and with isocratic elution for flavonol O-glycosides; MeOH : CH\(_3\)CN : H\(_2\)O : H\(_3\)PO\(_4\) (2 : 20 : 75 : 1).

4. Chemotaxonomic significance

In the Cucurbitaceae, flavone C-glucosides have been found in the species: Bryonia dioica, Bryonia alba (Krauze-Baranowska and Cisowski, 1995a), Cayaponia tayuya (Bauer et al., 1985), Cucumis melo (Monties et al., 1976), Lagenaria siceraria (Krauze-Baranowska and Cisowski, 1995b) and Wilbrandia ebracteata (Schenkel et al., 1992). On the other hand, it was noted that many plants from Cucurbitaceae, among them species of the genus Marah do not accumulate flavone C-glucosides (Nicholls and Bohm, 1982). From the leaves of melon, meloside A was isolated as isovitexin X–O-glucoside (Monties et al., 1976). In this compound the interglycosidic bond was determined presumably as 1→2, on the basis of EI-MS spectrum (Monties
Table 1
Distribution of flavone C-glycosides in some species and cultivar varieties of the genus *Cucumis*

<table>
<thead>
<tr>
<th>Compound</th>
<th>Species</th>
<th>Cultivar varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>C. sativus</em></td>
<td><em>C. sativus</em></td>
</tr>
<tr>
<td></td>
<td>Cezar</td>
<td>Hela</td>
</tr>
<tr>
<td>Isovitexin 2''-O-glucoside</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Isovitexin</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Isoorientin</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>4''-X-O-diglucoside isovitexin</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>4''-X-O-diglucoside swertiajaponin</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>
et al., 1976). Results of our investigations confirm the structure of the above flavone as isovitexin 2\''-O-β-glucopyranoside. According to Brown et al. (1969), isovitexin 2\''-O-glucopyranoside appears probably in eight further species of the genus *Cucumis*, besides those noted herein. From the chemotaxonomic point of view, it is interesting that in the species of family *Cucurbitaceae*, the leaves show a tendency to produce flavone C-glycosides and in flowers flavonol O-glycosides are biosynthesized (Imperato, 1980; Krauze-Baranowska and Cisowski, 1995b).

References