

## ORIGINAL PAPER

Application of umbelliferone molecularly imprinted polymer  
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The molecularly imprinted polymers (MIPs) were synthesised and the influence of the type of porogen, the nature of sample solvent, and the binding capacity of material were tested by high-performance liquid chromatography (HPLC). Umbelliferone was used as the template for imprint formation. Methacrylic acid was used as the monomer and acetonitrile, ethanol, and chloroform as porogen. Non-imprinted polymers (NIPs) were prepared by the same procedure. The highest value of the specific binding capacity (269 µg of umbelliferone per 100 mg of polymer) was obtained for polymers prepared in chloroform as porogen and methanol/water ( $\varphi_r = 1 : 1$ ) as the sample solvent. The group-selective MIP was used as sorbent for the SPE pre-treatment of umbelliferone from plant extracts prior to HPLC analysis. Analysis of the spiked samples showed good recoveries ( $> 77\%$ ). The limit of detection, limit of determination, and repeatability of the method were also calculated. © 2013 Institute of Chemistry, Slovak Academy of Sciences

**Keywords:** molecularly imprinted polymer, umbelliferone, binding capacity, solid phase extraction, plant samples, HPLC

### Introduction

Coumarins (benzo- $\alpha$ -pyrone derivatives) constitute an important group of natural products. Many of their analogues are found to be biologically active and have been proven to exhibit pharmacological activity, acting as calcium channel blockers, anticoagulants, and having antifungal, antipyretic, and spasmolytic effects (Hoult & Payá, 1996; Kaneko et al., 2003). Modern chemical and pharmaceutical studies have revealed that important compounds in plant samples are the coumarins, mainly including simple coumarins. Umbelliferone (7-hydroxycoumarin) (Fig. 1) is a naturally occurring product found in many plants from the *Apiaceae* (Umbelliferae) family such as carrot, coriander, and garden angelica, also in plants from other families such as mouse-ear hawkweed (*Pilosella offic-*

*inarum*, *Hieracium pilosella*). It is also found in the bark of a certain plant (*Daphne mezereum*). Umbelliferone has been reported to have antioxidant and antimicrobial properties. Coumarin derivatives are suitable for use as photoactive agents and sunscreen compositions (Jurd et al., 1971).

Several analytical methods can be used for the determination of umbelliferone. HPLC methods with spectrophotometric or MS detection have been used for the determination of umbelliferone in groups with different phenolic compounds (Dawa et al., 2008; Su et al., 2009; Nováková et al., 2010). Other methods, including two-dimensional TLC (Ciešla & Waksmundzka-Hajnos, 2009), CE with laser-induced fluorescence detection (Wang et al., 2007), capillary electrochromatography (CEC) (Fonseca et al., 2007; Chen et al., 2009), micellar electrokinetic chro-

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