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World Congress on

Chromatography

September 21-23, 2016   Amsterdam, Netherlands

A metabolomics-based strategy to screening characteristic chemical markers for quality evaluation of *Flos Chrysanthemi Indici*

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Traditional Chinese Medicine (TCM), with notable effectiveness and few side effects, is gaining greater acceptance for preventing or healing a host of ailments worldwide. However, lack of well-established criteria to quality control of TCMs has been the biggest bottleneck for the modernization and globalization of TCMs. *Flos Chrysanthemi Indici*, anthotaxy of *Chrysanthemum indicum* L. has been used widely as a heat-clearing and detoxication herb because of its anti-inflammatory and anti-bacterial activity. *Flos Chrysanthemi Indici* has more than 100 chemical components, and their relative abundances are highly variable depending on geographical origins, climate, cultivar and other factors, which make great challenge for quality control. Over the past several decades, linarin is used as the single chemical marker for quality control of the *Flos Chrysanthemi Indici* according to the Chinese Pharmacopoeia. Despite possessing easy-operation characteristics, a single chemical marker cannot provide sufficient and convincing information for herbs which contain several 100 of chemical components. Considering the synergistic effects of multiple components on the effectiveness or therapeutic function of herbs, more chemical markers or active ingredients should be considered. In the present study, an integrated strategy of global chemical profiling using ultra performance liquid chromatography coupled with tandem quadrupole time-of-flight mass spectrometry and chemometric approach was applied to screening characteristic chemical markers for quality evaluation of *Flos Chrysanthemi Indici*. The result showed that a panel of key ingredients including chlorogenic acid, 3,5-dicaffeoylquinic acid, luteolin and linarin were considered as characteristic chemical markers, which showed even better quality control ability than fingerprint analysis, to guarantee the consistency of *Flos Chrysanthemi Indici*. This metabolomics-based approach is effective to screening characteristic chemical markers for quality evaluation of TCMs.

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Development of an UPLC-MS based method for the simultaneous quantitation of phenolic components in honey using multi-walled carbon nanotubes as solid phase adsorbents

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An UPLC-MS method has been developed for the simultaneous separation, identification and determination of 22 phenolic constituents in honey from various floral sources from Yemen. Solid-phase extraction was used for extraction of the target phenolic constituents from honey samples, while multi-walled carbon nanotubes were used as solid phase adsorbent. The chromatographic separation of all phenolic constituents was performed on a BEH C18 column using a linear gradient elution with a binary mobile phase mixture of aqueous 0.1% formic acid and methanol. The quantitation was carried out in selected ion reaction monitoring acquisition mode. The total amount of phenolic acids, flavonoids and other phenols in each analyzed honey was found in the range of 338-3312, 122-5482, and 2.4-1342 µg/100 g of honey, respectively. 4-hydroxybenzoic acid was found to be the major phenolic acid. The main detected flavonoid was chrysin, while cinnamic acid was found to be the major other phenol compound. The regeneration of solid phase adsorbent to be reused and recovery results confirm that the proposed method could be potentially used for the routine analysis of phenolic constituents in honey extract.

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J Chromatogr Sep Tech 2016
ISSN: 2157-7064 JCGST, an open access journal

Chromatography 2016
September 21-23, 2016

Volume 7, Issue 5(Suppl)

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