

ORIGINAL PAPER

Modeling of supercritical fluid extraction of flavonoids
from *Calycopteris floribunda* leaves

Xiong Liu, Dong-Liang Yang, Jia-Jia Liu*, Kuan Xu, Guo-Hui Wu

Department of Pharmaceutical Engineering, College of Chemistry and Chemical Engineering, Central South University,
Changsha 410083, Hunan, China

Received 15 March 2013; Revised 28 May 2013; Accepted 5 June 2013

The aim of this study was to obtain flavonoids extracts from *Calycopteris floribunda* leaves using supercritical fluid extraction (SFE) with CO₂ and a co-solvent. Pachypodol, a potential anticancer drug lead compound separated from the extracts, was examined. Classical organic solvent extraction (CE) with ethanol was performed to evaluate the high pressure method. HPLC analysis was introduced to interpret the differences between SFE and CE extracts in terms of antioxidant activity and the concentration of pachypodol. SFE kinetics and mathematical modeling of the overall extraction curves (OEC) were investigated. Evaluation of the models against experimental data showed that the Sovová model performs the best. The supercritical fluid extraction process was optimized using a central composite design (CCD), where temperature and pressure were adjusted. The optimal conditions of SFE were: pressure of 30 MPa and temperature of 35 °C.

© 2013 Institute of Chemistry, Slovak Academy of Sciences

Keywords: *Calycopteris floribunda*, supercritical fluid extraction, mathematical modeling, HPLC, antioxidants

Introduction

Calycopteris floribunda Lam. (Combretaceae) is a large woody climbing shrub (5–10 m long) native to Bangladesh and India and also found in many other parts of south-east Asia (Yusuf et al., 1994). The leaves of *Calycopteris floribunda* as recorded in the Asian traditional medicine systems are used in colic, malaria, and diarrhea (Kirthikar & Basu, 2001). More recent pharmacological studies have demonstrated that the leaves extracts from *Calycopteris floribunda* exhibit potential bioactivity.

In order to utilize this plant material, many significant works were carried out and several flavonoid constituents were separated from different low pressure extracts of the leaves (Mayer, 1999, 2004; Wall et al., 1994). Wang et al. (2008) described a method to determine total flavonoids in the *Calycopteris floribunda* leaves. The results showed the amount of total flavonoids to be 10.8 mass %. Some researches

extracted volatile oil from the leaves of *Calycopteris floribunda* and reported it to exhibit high antimicrobial activity (Liu et al., 2009; Wang et al., 2009).

Flavonoids can act as effective free-radical scavengers and are treated as effective antioxidants and anti-inflammatory agents with numerous health benefits. Flavonoids from *Calycopteris floribunda* were reported to have an inhibitory effect on the activity of ABCG2, which can increase the effectiveness of chemotherapeutic treatment in cancer patients (Kruijtzter et al., 2002; Pick et al., 2011; Versiani et al., 2011). Some flavonoids of *Calycopteris floribunda* were used as novel lead compounds. The main flavonoid, calycopterin (Rodriguez et al., 1972), separated from *Calycopteris floribunda* has anthelmintic, antiviral (in vitro inhibition of polio virus) (Mayer, 1999), and anticancer activities (antiproliferative and anti-aromatase) (Wall et al., 1994). Lewin et al. (2011) used calycopterin to synthesize many flavones displaying high antiproliferative activity. Pachypodol, a po-

*Corresponding author, e-mail: liujj0903@163.net