Journal of Food Measurement and Characterization (2023) 17:2805–2820
https://doi.org/10.1007/s11694-023-01820-z

ORIGINAL PAPER

Combination of response surface methodology and UPLC-QTOF-MSE for phenolic compounds analysis from *Cinnamomum cassia* bark as a novel antifungal agent

Kenza Bedjaoui[1] · Amine Belbahi[1,2] · Farid Dahmoune[3] · Sabrina Djebari[1] · Magdalena Wrona[4] · Cristina Nerin[4] · Hana Soualah-alila[5] · Nassime Nabet[1] · Ourdia-Nouara Kernou[1] · Khodir Madani[1,6]

Received: 18 November 2022 / Accepted: 9 January 2023 / Published online: 31 January 2023

Abstract

Using the microwave-assisted extraction process, the presented study reports an economic optimization of total phenolic content (TPC) extraction from *Cinnamomum cassia* bark. Moreover, the investigation on the phenolic profile of extract and the antifungal activity on spoilage pathogens has been performed to boost new applications in the food and pharmaceutical industries. The generated model successfully fits the experimental data, indicating the suitability of response surface methodology in optimizing the extraction of secondary metabolites from cinnamon bark. The optimal TPC output of 153.09 mg gallic acid equivalent/g dry weight (DW) obtained at 400 W, 65 s radiation time, 54% (v/v) acetone concentration and 1:89 liquid to solid ratio was very consistent with the predicted values (151.62 mg GAE/g DW). The phenolic profile of the analyzed extract was investigated by UPLC-QTOF-MSE in the positive electrospray ionization mode and 24 molecules were tentatively identified for the first time in *C. cassia*. The obtained extract showed strong antifungal activity. The minimum inhibitory concentration (MIC) and the minimum fungicidal concentration (MFC) ranged from 0.15 to 6.25 mg/ml and 9.37 to 50 mg/ml, respectively. *Candida apicola* was the most sensitive strain to the cinnamon extract, followed by *Alternaria alternata* and *Aspergillus niger*.

Keywords *Cinnamomum cassia* bark · Microwave extraction · Non-volatile metabolites · Response surface method · Antifungal activity

✉ Amine Belbahi
amine.belbahi@univ-msila.dz

1 Laboratoire de Biomathématiques, Biophysique, Biochimie et Scientométrie (L3BS), Faculté des Sciences de la Nature et de la Vie, Université de Bejaia, 06000 Bejaia, Algeria

2 Department of Microbiology and Biochemistry, Faculty of Sciences, Mohamed Boudiaf-M'sila University, M'sila, Algeria

3 Département de Biologie, Faculté des Sciences de la Nature et de la Vie et Sciences de la Terre, Université de Bouira, 10000 Bouira, Algeria

4 Departamento de Química Analítica, Instituto de Investigacion en Ingeniería de Aragon (I3A), Universidad de Zaragoza, María de Luna 3, 50018 Saragossa, Spain

5 Université Mohamed Chérif Messadia de Souk-Ahras, Souk Ahras, Algeria

6 Centre National de Recherche en Technologie Agro-alimentaire, Université de Bejaia, 06000 Bejaia, Algeria

Introduction

The globalization of the food industry has shown a highly growing demand for functional products with added value [1]. The use of chemicals to enhance the safety of foods is of great interest to the food industry. However, the reported adverse health effects of synthetic food additives and the labelling of preservatives on food packages, which became a significant concern for consumers, led to an increasing trend in the search and application of natural active agents [2, 3]. Plant-derived bioactive compounds such as phenolic compounds renowned for their antioxidant and/or antimicrobial properties and health-promoting properties in some diseases [4–6] have lifted considerable interest among food scientists, consumers, and manufacturers [7]. Phenolic compounds, universally present in higher plants, belong to a diverse group of secondary metabolites [1] and are involved in many activities, including storing 'overflow' metabolites, monitoring photosynthesis, screening