

Composition, antimicrobial and antioxidant activity of the extracts of *Eryngium palmatum* Pančić and Vis. (Apiaceae)

Research Article

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Abstract: The chemical composition, antimicrobial and antioxidant activity of *Eryngium palmatum*, an endemic plant species from the Balkan Peninsula, were investigated. The flavonoids apigenin ($9.5 \pm 0.3 \text{ mg g}^{-1}$) and apigenin 7-O-glucoside ($2.4 \pm 0.1 \text{ mg g}^{-1}$) were determined in a methanol extract of aerial parts using HPLC analysis. The methanol extract of roots contained catechin ($5.0 \pm 0.1 \text{ mg g}^{-1}$), epicatechin ($2.9 \pm 0.1 \text{ mg g}^{-1}$), chlorogenic acid ($1.6 \pm 0.0 \text{ mg g}^{-1}$), gallic acid ($0.9 \pm 0.0 \text{ mg g}^{-1}$) and rosmarinic acid ($0.9 \pm 0.2 \text{ mg g}^{-1}$). GC-FID and GC-MS analysis of a chloroform extract of aerial parts showed that the main volatile constituents were falcarinol, linoleic acid, hexadecanoic acid and methyl linoleate (comprising 32.6%; 24.4%; 19.9; 13.2% of the volatile fraction, respectively), while octanoic acid, tetradecanol and dodecanol dominated in the chloroform extract of the roots (34.9%; 25.8%; 22.2% of the volatile fraction, respectively). Investigation of antimicrobial activity by broth microdilution showed that the methanol and chloroform extracts of aerial parts and roots exerted a significant effect (MIC 3.5–15.6 $\mu\text{g mL}^{-1}$) against tested Gram-positive and Gram-negative bacteria. The methanol extracts of aerial parts or roots exerted moderate ferric reducing antioxidant power, DPPH radical scavenging activity and hydroxyl radical scavenging activity.

Keywords: *Eryngium palmatum* • Extracts • Composition • Antimicrobial activity • Antioxidant activity

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1. Introduction

The genus *Eryngium* L. (Apiaceae) comprises about 250 species distributed in temperate regions [1]. Some *Eryngium* species are cultivated as vegetables, ornamental or medicinal plants. In traditional medicine they are used to treat various inflammatory disorders, fever, diarrhea, hypertension, oedema, sinusitis and snake or scorpion bite [2,3]. Previous investigations show that species of this genus contain flavonoids, triterpene saponins, coumarins, rosmarinic acid derivatives, polyacetylenes and essential oils [4–6]. Aqueous extracts of leaves and flowers of *E. bourgatii* Gouan exhibit antioxidant and anti-inflammatory activity [6], and ethanol extracts of different *Eryngium* species

have anti-inflammatory and antinociceptive activity [2]. The essential oil of aerial parts of *E. duriae* J. Gay has demonstrated antifungal activity [7], while the essential oils from *E. campestre* L., *E. thorifolium* Boiss. and *E. creticum* Lam. inhibit the growth of methicillin-resistant *Staphylococcus aureus* strains [8].

Eryngium palmatum Pančić and Vis. is an endemic species of the Balkan Peninsula [9]. The aim of this work was to investigate the composition and antimicrobial and antioxidant activity of extracts of the aerial parts and roots of this plant. Increasing bacterial resistance to commonly used chemotherapeutics requires a constant search for new compounds with new mechanisms of action [10]. Antioxidant compounds may be also valuable since oxidative

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