

Anatomical characteristics and antioxidant ability of *Centaurea sadleriana* reveals an adaptation towards drought tolerance

Research Article

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Abstract: The lamina, main vein and peduncle anatomical properties of *Centaurea sadleriana* Janka plants from two populations, were examined using light and scanning electron microscopy. The indumentum was comprised of glandular and non-glandular trichomes of two types. The leaves were amphistomatic, isolateral, with strongly developed palisade tissue. Secretory ducts were observed along the phloem or sclerenchyma of large vascular bundles. Collenchyma alternated with chlorenchyma in the main vein and peduncle. Large groups of strongly lignified sclerenchyma were present along the phloem of peduncle vascular bundles. These features, together with thickened walls of epidermal cells and cuticle, numerous trichomes and thick-walled parenchyma in the perimedullary zone, were perceived as a xeromorphic peduncle structural adaptation. Non-enzymatic antioxidant compounds of phenolic origin were detected in small amounts and their respective content was higher in leaves compared to inflorescences. Compounds of phenolic origin showed positive correlation with total potential of antioxidant activity indicated by the DPPH assay. Greater total quantity of polyphenols and tannins was detected in leaves of plants from Zobnatica locality, while leaves of plants from Rimski Sanac were characterized by higher content of total flavonoids and proanthocyanidins. Phytochemical analysis showed that dominant secondary biomolecules in inflorescences were phenolic pigments including anthocyanins and leucoanthocyanins, and free quinones in leaves.

Keywords: Leaf anatomy • Peduncle anatomy • Drought tolerance • Antioxidant activity • Asteraceae • *Centaurea* • Trichomes

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1. Introduction

Genus *Centaurea* L. belongs to family *Asteraceae* and comprises annual, biennial and perennial herbaceous plants. In the flora of Europe and Serbia, 221 species and 32 species have been recorded, respectively [1,2]. Ethnopharmacological studies reveal that many species were well known for their use in traditional medicine and for treatment of various diseases [3-5]. Owing to their potential use in medicine, secondary metabolites isolated from *Centaurea* species, as well as their biological activities, were the subject of numerous investigations. For this genus, the presence of sesquiterpene lactones, flavonoids, triterpenes, acetylenes, cyanogenic glycosides, alkaloids and saponins is common. Some

samples also contained triterpene alcohols and lignans. As *Centaurea* species were generally classified as essential oil-poor plants, the investigations of these and antioxidant properties are rather scarce. However, anti-inflammatory, antimicrobial, antifungal and cytotoxic activities had been found for extracts or natural products of some of the *Centaurea* species [3,5-14].

All aerobic organisms possess antioxidant defence mechanisms that provide balanced production of reactive oxygen species (ROS). ROS include superoxide radical ($O_2^{\cdot-}$), hydroxyl radical ($\cdot OH$), singlet oxygen (1O_2) and hydrogen peroxide (H_2O_2). They are generated both in oxidative metabolism of normal cells and during different stress-inducing situations. Some of them include pathogen invasion, exposure to

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