

## Chemical composition of the ethanol extracts of *Verbascum niveum* flowers and leaves

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### Introduction

One of the largest genera of the Scrophulariaceae family is the genus *Verbascum*. Species of this genus are commonly known as "mullein" (Ghahremania et al., 2020). *Verbascum* species are used in both traditional and regular medicine, in the treatment of internal and external diseases. European Medicines Agency (EMA) recommends the use of *Verbasci flosin* respiratory disorders, but traditional medicine recommends the use of the whole aerial parts of *Verbascum* species also to treat skin inflammations, wounds, and other dermatological problems. Numerous biological properties have been proven in different *Verbascum* species: anti-inflammatory, antioxidant, antimicrobial, antiviral, antinociceptive, antitussive, etc. All activities are related to plants' chemical constituents, so there are a lot of different compounds identified in *Verbascum* species, grouped into classes: saponins, iridoids, phenylethanoid glycosides, monoterpene glucosides, flavonoids, etc. (Angeloni et al., 2021). Considering the numerous biological effects of *Verbascum* species studied so far, the aim of our study was to identify the secondary metabolites of ethanolic extracts of *Verbascum niveum* flowers and leaves, a species about which there is very little literature data.

### Materials and methods

#### Materials

The plant material (flowers and leaves) was collected in the vicinity of Bosilegrad in July 2021. Botanical identification of the specimens was performed at the Faculty of Science and Mathematics, University of Niš, where the voucher specimens were stored. Extracts were prepared by percolation with 50% ethanol according to European Pharmacopeia 10.0 (2019) (European Pharmacopeia, 2019).

#### HPLC

RP-HPLC coupled with DAD detection was employed for the detection and quantification of secondary metabolites (phenylethanoid glycoside verbascoside, some iridoids, flavonoids, and phenolic acids). Chromatograms of extracts and standards were recorded under the same conditions.

### Results and discussion

According to our results, both flower and leaf extracts have a high content of phenylethanoid glycoside verbascoside (2.06 mg/g dry extracts in flowers and 73.85 mg/g dry extract in leaves) alongside significant amounts of iridoids, flavonoids, and phenolic acids. In folk medicine, verbascoside is used in the treatment of inflammations and microbial infections (Alipieva et al.,

2014). Flower extract were richer in iridoids (catalpol 85.13 mg/g dry extracts and aucubin 1.73 mg/g dry extracts), while leaf extract had a higher amount of flavonoids (luteolin 14.80 mg/g dry extracts, apigenin 1.02 mg/g dry extracts, chrysoeriol 1.32 mg/g dry extracts). Iridoids exhibit numerous biological activities such as anti-inflammatory, antiallergic, antidiabetic, hypolipidemic, antioxidant, antibacterial, antiviral, antifungal, cardioprotective, hepatoprotective, neuroprotective, gastroprotective, and wound healing activities (Thabet et al., 2022). Flavonoids are a group of polyphenols, primarily valued for their antioxidant activity, but they also possess anti-inflammatory, anticancer, and antimutagenic effects (Panche et al., 2016). Some phenolic acids (gallic acid, protocatechuic acid, and vanillic acid) were found in both extracts, while others were detected in leaves only or in flowers (i.e. p-hydroxybenzoic acid was found in flower extract; chlorogenic acid and caffeic acid in leaves extract). Phenolic acids play a wide range of protective roles such as antioxidant, anti-proliferative, and anti-inflammatory (Pana et al., 2021). All investigated secondary metabolites possess numerous biological activities, and in our extracts, they are represented in significant amounts, which indicates that the species can have numerous beneficial effects and for that, it will stay in the focus of our investigation.

## Conclusion

Although we have not found much data on this species in the literature, based on our results *Verbascum niveum* has a significant amount of various secondary metabolites, which express numerous biological effects, and is, therefore, a plant species with great potential.

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