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BIOCHEMICAL ANALYSIS OF TWO LAVENDER (LAVANDULA ANGUSTIFOLIA Mill.) CULTIVARS

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ABSTRACT

Two lavender cultivars grown in local farms, in Buzău county, were analyzed for determining bioactive compounds contents: 'Codeanca' and 'Vera'.
They were found to have different carotenoid contents, with a total amount of 20.71–26.43 mg/kg, with lutein and lycopene being the most important. β-carotene was only found in significant amounts in 'Vera' cultivar. The total phenolic compounds inventory ranged between 20,313–35,753 mg/kg, with maximum concentration in 'Vera'. Phenolic acids were dominant (69–73 %), with flavonoids forming most of the remaining amounts.
Oil amounts averaged 15,533 mg/kg in 'Vera' and 12,000 mg/kg in 'Codreanca'. Ascorbic acid content showed the widest array of variation, with an average of 1,278 mg/kg in 'Vera' and only 189 mg/kg in 'Codreanca'.
Among the two cultivars, under the local conditions,'Vera' was the richest in terms of carotenoids (total, β-carotene, lutein and xanthins), phenolic compounds (total, phenolic acids, flavonoids – including flavanols and anthocyanins, tannins, coumarins, stilbenes), oil and ascorbic acid. 'Codreanca'. Scored highest only in terms of lycopene content.

INTRODUCTION

Lavender is an aromatic shrub, belonging to the Lamiaceae family. Native to the Mediterranean region, it is nowadays grown in many parts of the world and for multiple purposes, ranging from ornamental reasons to folk medicine, aromatic, cosmetic and pharmaceutical applications. Lavender is an important crop in many regions of the world. It is cultivated for ornamental purposes, or for its volatile essential oils, used for aromatic, cosmetic, pharmaceutical and folk medicine purposes. Its preferred habitats are warm and dry areas of the world. Among existing lavender species, the most widely grown in Sotheastern Europe is *Lavandula angustifolia* Mill. together with *L. latifolia* and some hybrid cultivars (Brailko et al. 2017).

Lavender is mostly grown for its high amounts of aromatic essential oils. These are complex mixtures of terpenes (mostly mono- and sesquiterpenes), other hydrocarbons and hydrocarbon derivatives, phenolic compounds (such as flavonoids), alcohols, aldehydes, esters etc., of which more than 90% are volatile at room temperature. They give the specific aroma and also have strong antibacterial and antioxidant abilities (Orphanides et al. 2011).

However, the bioactive potential of lavender is not restricted to oils. The aim of this research was to characterize the bioactive compounds content in two common lavender cultivars grown in Southeastern Romania.

MATERIAL AND METHODS

Two lavender cultivars were analyzed.

'Codeanca' is a variety developed in Romania, at INCDA Fundulea and homologated in 1992. It is derived from to the popular and productive British variety 'Hidcote'. An early cultivar with medium size and dark purple flowers, it shows abundant flowering, rich oil production and resistance to frost (Ștefan et al. 2021).

'Vera' (also known as 'Common English') is a British cultivar, with dark blue flowers, compact growth and a sweetly fragrant oil (Ștefan et al. 2021).

Samples consisting of lavender inflorescences were collected from local farms in Gălbinași, Buzău county, in an alluvial plain area with cambic-endocalcaric chernozem soil, in 2024. Samples were dried at room temperature and ground to a fine powder prior to analysis. For most analyses, inflorescence powder was extracted in 70 % ethanol, up to a 10 % concentration of dry tissue.

Total carotenoids were calculated by diluting extracts in 80 % acetone and reading spectrophotometric absorbance (ONDA UV-21 spectrophotometer) at 470 nm. Concentrations were calculated according to literature. Concentration (mg/L) was calculated as $1000/198 \times A_{470}$ (Popoviciu et al. 2024).

Specific carotenoids were also determined: lycopene, lutein, cryptoxanthin and zeaxanthin. Extracts were diluted in acetone:petroleum ether, petroleum ether, ether, acetone, respectively ethanol and absorbances were read at 445, 446, 453, 505, 645, 663 nm; Concentrations (mg/L) were derived as $0.216 \times A_{663} - 1.22 \times A_{645} - 0.304 \times A_{505} + 0.452 \times A_{453}$, for β-carotene, $0.204 \times A_{645} - 0.0485 \times A_{663} + 0.372 \times A_{505} - 0.0806 \times A_{453}$, for β-carotene, $0.2129805 \times A_{446}$ for lutein, $0.0758 \times A453$ for cryptoxanthin and $0.40944 \times A_{445}$ for zeaxanthin, according to Braniša et al. (2014), Sujith et al. (2010), Biehler et al. (2009), Butnariu et al. (2014).

Total phenolic compounds were assesed using Folin-Ciocâlteu reaction and absorbance reading at 765 nm against a gallic acid calibration curve, with concentrations calculated as $11.4740537 + 281.1523463 \times A_{765}$ (Popoviciu et al. 2024). Total flavonoids and total phenolic acids (hydroxybenzoic and hydroxycinnamic) were determined by 10-fold dilution in of 8:2 ethanol-hydrochloric acid mixture and then reading the spectrophotometric absorbance of the mixture at 220, 275, 325, 345 and 380 nm. Concentrations were derived according to Paula et al. (2017), for flavonoids as $182 \times A_{375}$; that of hydroxybenzoic acids, as $192 \times A_{275} - 156 \times A_{345}$; that of hydroxycinnamic acids, as $129 \times A_{325} - 78 \times A_{380}$. Flavanols (catechins), by dilution in 70 % ethanol and reading at 280 nm; concentration was calculated as $(A_{280} - 0.054055)/0.0113$ (Yaneva et al. 2020). Anthocyanins, by dilution in 70 % ethanol and reading at 520 and 700 nm; concentration was calculated as $(A_{520} - A_{700}) \times 449.2$ (Braniša et al. 2014).

Tannins were determined after thermal hydrolysis in a mixture of water and hydrochloric acid and reading at 550 nm; concentrations were derived as $19.33 \times (A_{550\ \text{hydrolysed}} - A_{550\ \text{control}})$ (Moutari et al. 2018). Stilbenes, by diluting in 70 % ethanol and reading at 304 nm; calculated as $(A_{304} - 0.0697)/0.0704$ (Bancuta et al. 2015). Coumarins, by diluting in 80 % methanol and reading at 275 nm; derived as $(A_{275} - 0.03)/0.0771$ (Soares e Silva et al., 2012).

Ascorbic (and dehydroascorbic) acid concentration was determined by diluting in ethanol and reacting with ammonium molybdate and sulfuric acid, followed by absorbance reading at 494 nm; concentration (mg/L) was calculated as (A_{494}-0.0133)/0.015 (Riscahyani et al. 2019).

Total oil, on the other hand was assessed by extracting inflorescence powder in petroleum ether, filtration, solvent evaporation and gravimetry (Orphanides et al. 2011).

RESULTS AND DISCUSSIONS

The concentrations of various classes of compounds with bioactive potential are shown in Figures 1-2 and Table 1.

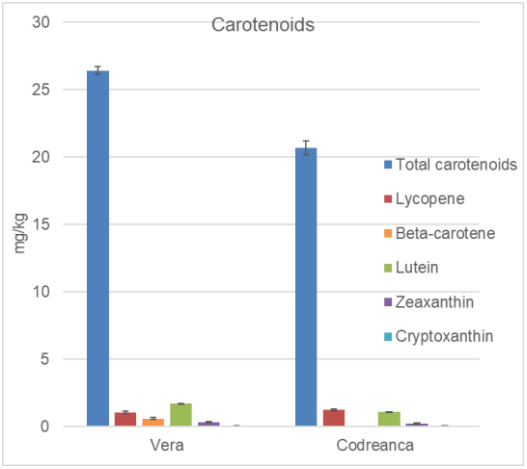

Figure 1. Concentrations of total and some individual carotenoids in lavender inflorescences (mg/kg DW).

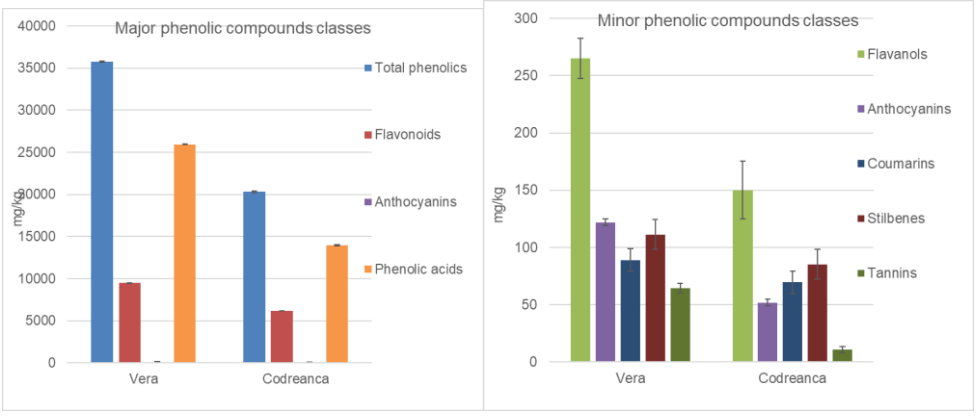

Figure 2. Concentrations of total phenolic compounds and some subclasses in lavender inflorescences (mg/kg DW).

Table 1.

Other compound classes in lavender inflorescences (mg/kg DW).

	Ascorbic acid	Total oils
'Vera'	1,278±20	15,533±306
'Codreanca'	189±4	12,000±200

The average total concentration of carotenoid compounds varied among hybrids (Fig. 1) was 26.43 mg/kg in 'Vera' and 20.71 mg/kg in 'Codreanca'. Among individual compounds, lycopene (1.05 mg/kg in 'Vera' and 1.23 mg/kg in 'Codreanca') and lutein (1.72 mg/kg in 'Vera' and 1.09 mg/kg in 'Codreanca') were the most important. β-carotene was only determined, in values above detection limits, in 'Vera', with 0.61 mg/kg. Among xanthins zeaxanthin was dominant, with 0.34 mg/kg in 'Vera' and 0.22 mg/kg in 'Codreanca'. Carotenoid content is one of the less studied parameters in lavender. However, existing data shows that they can be extremely variable, going up to over 70 mg/kg. Among them lycopene and β-carotene are known to be among the most important, with concentrations that are also highly dependent on cultivar and local conditions, up to 35 mg/kg each (Giosanu et al. 2024).

The average total phenolic concentration was even more diverse, with 35,753 mg/kg in 'Vera' and only 20,313 mg/kg in 'Codreanca'. The dominant fraction was that phenolic acids, namely hydroxycinnamic ones (hydroxybenzoic acids concentrations were below detection limits), with 29,958, respectively 13,942 mg/kg (69-73% of the phenolic inventory).

Flavonoids amounted to 9,531 mg/kg in 'Vera' and 6,206 mg/kg in 'Codreanca' (27-31 % of the phenolic inventory). Among them, flavanols were found in concentrations of 265 and 150 mg/kg, respectively, while anthocyanins were 122 mg/kg and 52 mg/kg. Coumarins were 89, respectively 70 mg/kg, while tannins, 111 and 85 mg/kg, respectively, all with the maximum values in 'Vera' cultivar.

Among aromatic and medicinal plants, lavender is known to possess an average concentration of phenolic compounds. Variations are due to cultivar, but also drying and processing conditions. For example, a study on three wild populations found 18,772-21,764 mg/kg (Falla et al. 2022), while a study on lavender crops found 28,600-35,200 mg/kg (Stanciu et al. 2019), placing the two studied cultivars towards the upper end of phenolic content range.

However, the exact makeup of the phenolic inventory is also subject to variation. Some studies point to a net dominance of phenolic acids, especially chlorogenic, ellagic, gallic and p-coumaric acids, the four compounds reaching over half of the total phenolic content (with various concentrations for each of them; Stanciu et al. 2019).

Yet, the flavonoid fraction is also subject to variation. A study on six other cultivars found 7,646–15,498 mg/kg, placing our results on 'Vera' and 'Codreanca' at the lower end of the spectrum. Tannin variation is even higher, reaching over 15,000 mg/kg in some cultivars (Giosanu et al. 2024). The same is true for anthocyanins – in some wild populations ther reached 401-607 mg/kg (Falla et al. 2022).

Oil amounts (Table 1), averaged 15,533 mg/kg in 'Vera' and 12,000 mg/kg in 'Codreanca'. 10,000-30,000 are the normal variation limits for oil content in lavender (Çolak & Çelik 2023).

Ascorbic acid, on the other hand, showed the most important difference, with 1,278 mg/kg in 'Vera' and only 189 mg/kg in 'Codreanca'. Ascorbic acid is still a less studied constituent in aromatic plants like lavender.

CONCLUSIONS

Both cultivars were found to possess rich contents of bioactive compounds.

They were found have different carotenoid contents, with a total amount of 20.71-26.43 mg/kg, with lutein and lycopene being the most important.

The total phenolic compounds inventory ranged between 20,313–35,753 mg/kg, with maximum concentration in 'Vera'. Phenolic acids were dominant (69-73 %), with flavonoids forming most of the remaining amounts.

Oil amounts averaged 15,533 mg/kg in 'Vera' and 12,000 mg/kg in 'Codreanca'. Ascorbic acid content showed the widest array of variation, with an average of 1,278 mg/kg in 'Vera' and only 189 mg/kg in 'Codreanca'.

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