



## RESEARCH ARTICLE

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# Phytochemical analysis of *Syringa vulgaris*: Quantitative analysis of natural compounds by LC-ESI-MS/MS

## *Syringa vulgaris*'in fitokimyasal analizi: LC-ESI-MS/MS ile biyoaktif bileşiklerin kantitatif analizi

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**Anahtar Kelimeler:** *Syringa vulgaris*, doğal ürünler, kantitatif analiz, LC-MS/MS

### ABSTRACT

The significant biological activity exhibited by medicinal plants is attributed to the presence of bioactive compounds, which makes them suitable for applications in the food and pharmaceutical industries. In the case of *Syringa vulgaris* flowers, a quantitative analysis of its bioactive compound content was conducted using LC-ESI-MS/MS. Among the identified compounds, hesperidin was found to be the major component, with a concentration of 0.33 mg/g extract. Additionally, the methanol extract of *S. vulgaris* flowers contained relatively high concentrations of naringenin (0.197 mg/g extract), chlorogenic acid (0.101 mg/g extract), o-coumaric acid (0.056 mg/g extract), salicylic acid (0.045 mg/g extract), and sinapic acid (0.04 mg/g extract). These findings highlight the presence of these bioactive compounds in *S. vulgaris* flowers and their potential applications in the food and pharmaceutical sectors.

### Öz

Tıbbi bitkiler, içerdikleri biyoaktif bileşikler sayesinde gıda ve ilaç endüstrisinde kullanılmalarını sağlayan önemli biyolojik aktiviteye sahiptirler. *Syringa vulgaris* çiçeklerinin biyoaktif bileşik içeriğinin kantitatif analizi LC-ESI-MS/MS yöntemiyle gerçekleştirildi. Bu analiz sonucunda, hesperidin (0,33 mg/g ekstrakt) ana bileşen olarak belirlendi. Ayrıca, *S. vulgaris* çiçeklerinin metanol ekstraktında naringenin (0,197 3 mg/g ekstrakt), klorojenik asit (0,101 mg/g ekstrakt), o-kumarik asit (0,056 mg/g ekstrakt), salisilik asit (0,045 mg/g ekstrakt) ve sinapik asit (0,04 mg/g ekstrakt) yüksek konsantrasyonlarda tespit edildi. Bu bulgular, *S. vulgaris* çiçeklerinde bu biyoaktif bileşiklerin bulunduğunu ve gıda ve ilaç sektörlerinde potansiyel uygulamalarının olabileceğini göstermektedir.

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## 1. INTRODUCTION

The plants synthesize fascinating compounds that perform many functions, such as survival, adaptation to the environment, and protection against enemies (Elmastas et al., 2004; Topçu et al., 1999). The most remarkable of the compounds synthesized by plants are the so-called secondary metabolites, which cause plants

to show biological activity and inspire synthetic chemists. With the development of spectroscopy in the 19<sup>th</sup> century, plants became the focus of science, and the purification, and elucidation of natural constituents from plants accelerated (Demirtas et al., 2013; Sahin Yaglioglu et al., 2013). Within this scope, the isolation of morphine, strychnine, and quinine from *Papaver somniferum*, *Strychnos nux-vomica*, and *Cinchona*

species respectively has been considered a milestone in natural products chemistry (Newman & Cragg 2007; Pezzuto 1997). Moreover, throughout the history of fighting cancer illness, natural compounds have played a significant role in the development of contemporary cancer chemotherapy. Paclitaxel (Taxol), vincristine, podophyllotoxin, and camptothecin incorporate some of the new chemotherapeutic agents currently available for use in clinical purposes (Cragg et al., 1997). Nowadays, natural products have been used effectively in the food and pharmaceutical industries and lots of studies have been executed to isolate the natural compounds from plants and to investigate their usability in drug development (Elmastaş et al., 2015; Erenler et al., 2015). Polyphenols, which are classified as secondary metabolites, are bioactive compounds synthesized by plant (Elmastaş et al., 2016). These compounds are produced in various plant tissues and contribute to characteristics such as color, taste, and aroma. In addition, they play a protective role against microbial pathogens and toxins, ensuring the plant's defense mechanisms (Erenler, Pabuccu et al., 2016; Erenler, Sen, Aksit et al., 2016; Erenler, Sen, Yaglioglu et al., 2016).

Flavonoids are a broad class of low molecular weight phenolics and are characterized by their flavan core. They are commonly found in all parts of plants. They protect against ultraviolet radiation, pathogens, and herbivores in plants (Erenler, Sen, Yildiz et al., 2016; Karan et al., 2016). Anthocyanins are commonly available in flowers and attract pollinating insects and are responsible for the characteristic red and blue colors of fruits and vegetables (Lopez-Martinez et al., 2009). Flavonoids have strong antioxidant effects and show a unique cardioprotective effect by preventing LDL oxidation (Panche et al., 2016).

*Syringa vulgaris* L., known as lilac, belongs to the Oleaceae family and has been used as a folk medicine in the treatment of various diseases such as gastrointestinal disorders, gout, rheumatism, bleeding wounds, and muscle pains. This plant is commonly grown in the Balkans, Europe, and America. The flowers of the lilac plant have different colors and are widely used in parks and gardens due to their outstanding scent (Ellis 1983).

Due to the importance of phenolic compounds, quantitative analysis of phenolic compounds was determined in *S. vulgaris* flowers.

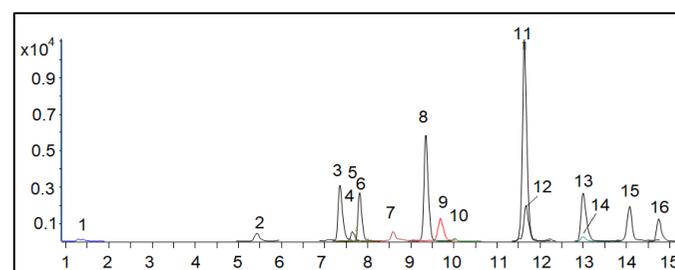
## 2. MATERIALS AND METHODS

### 2.1. Plant material

The flowers of *S. vulgaris* were obtained from Tokat province in 2022 July.

### 2.2. Quantitative analysis

The flowers of *S. vulgaris* were investigated for their phenolic compounds by LC-ESI-MS/MS (Agilent Technologies 1260 Infinity II) (Erenler et al., 2023). SB-C18 (3.0 × 100 mm, I.D., 2.7 μm) column was utilized. *S. vulgaris* flowers were dissolved in methanol (1.0 mL). After the addition of hexane, the solution was centrifugated for 15 minutes. The methanol and hexane phases were separated, and an aliquot of methanol solution (100 μL) was taken and then diluted by the addition of methanol (450 μL) and water (450 μL). After the filtration of the solution (0.22 μm filter), it was injected into the instrument. The flow rate was 0.40 mL/min and the injection volume was adjusted to 5.12 μL. The water [Formic acid (0.1%) and ammonium formate (5.0 mM)] A, methanol [formic acid (0.1%) and ammonium formate (5.0 mM)] B were employed for the mobile phase. The gradient program was fixed as 20% for 1-4 min, 55% for 5-14 min, 85% for 15-22 min, and 5% for 23-30 min for B mobile phase. The column temperature was 40°C. The nitrogen gas flow rate was 11 L/min, the capillary voltage was 4000 V, the pressure was 15 psi and the gas temperature was 300°C (Fig. 1) (Erenler et al., 2023).



**Figure 1.** LC-MS/MS spectrum of *Syringa vulgaris* flowers. 1: shikimic acid, 2: protocatechuic acid, 3: chlorogenic acid, 4: hydroxybenzaldehyde, 5: vanillic acid, 6: caffeic acid, 7: vanillin, 8: o-coumaric acid, 9: salicylic acid, 10: trans-ferulic acid, 11: hesperidin, 12: isoquercitrin, 13: kaempferol-3-glucoside, 14: fisetin, 15: trans-cinnamic acid, 16: naringenin

### 3. RESULTS AND DISCUSSIONS

Quantitative analysis of bioactive compounds in plants is a significant study for the usage of plants for medicinal purposes. The medicinal effect of the plant could be either a high concentration of the compounds or a synergistic effect of the combination of corresponding compounds (Karan et al., 2018). In this study, quantitative analysis of phenolic compounds was determined. Hesperidin (0.33 mg/g extract) was calculated as a major product in the methanol extract of *S. vulgaris* flowers. Furthermore, naringenin (0.197), chlorogenic acid (0.101 mg/g extract), o-coumaric acid (0.056 mg/g extract), salicylic acid (0.045 mg/g extract), and sinapic acid (0.04 mg/g extract) were determined in this flowers extract (Table 1).

Hesperidin is a significant natural compound that exhibits strong biological activity. Hesperidin is mostly used in folk medicine as a combination product of Daflon-500 mg consisting of hesperidin (50 mg) and diosmin (450 mg). Daflon-500 mg has a wide range of pharmacological activities such as beneficial effects in human subjects with chronic venous insufficiency. Hesperidin supplementation was reported to be effective against blood vessel disorders. In addition, hesperidin was reported to display anticancer, ultraviolet protecting, analgesic, antipyretic, antioxidant, immuno-modulatory, antiulcer, and wound healing activities (Garg et al., 2001).

Naringenin is existed in many *Citrus* fruits and has considerable biological activity such as antimutagenic, antioxidant, and anticancer (Cavia-Saiz et al., 2010). A quantitative study on *S. vulgaris* indicated that syringin and rutin were the major constituents in bark and leaf, respectively (Varga et al., 2019). In addition, the phytochemical analysis of *S. vulgaris* (bark, fruit, flower, and leaf) was accomplished using an LC-MS/MS. The major compounds were detected as caffeoyl glucaric, syringin, secologanoside, acteoside demethyl-leuropein, quercetin rutoside, syringalactone B (Woźniak et al., 2018). This study is completely different than the reported work, plant material, standard compounds, extraction techniques are different.

### 4. CONCLUSION

Phytochemical investigation of *S. vulgaris* flowers revealed that they serve as a valuable source of bioactive

**Table 1.** Quantitative analysis of natural compounds of *Syringa vulgaris* flowers (mg/g extract)

Compound	RT	Quantity
Shikimic acid	1.414	nd
Gallic acid	3.213	nd
Protocatechuic acid	5.483	0.0065
Epigallocatechin	6.901	nd
Catechin	6.896	nd
Chlorogenic acid	7.396	0.101
Hydroxybenzaldehyde	7.705	0.0108
Vanillic acid	7.797	nd
Caffeic Acid	7.843	0.0303
Syringic acid	8.367	0.040
Caffein	8.474	nd
Vanillin	8.662	0.0054
o-Coumaric acid	9.401	0.056
Salicylic acid	9.715	0.0452
Taxifolin	9.780	nd
Resveratrol	9.890	nd
Polydatine	9.897	nd
Trans-ferulic acid	10.096	0.011
Sinapic acid	10.338	0.043
Scutellarin	11.046	nd
p-coumaric acid	11.536	0.0014
Coumarin	11.486	nd
Protocatechuic ethyl ester	11.629	0.0011
Hesperidin	11.687	0.332
Isoquercitrin	11.727	0.0089
Rutin	12.273	nd
Quercetin-3-xyloside	12.238	nd
Kaempferol-3-glucoside	13.038	0.0136
Fisetin	13.066	0.0022
Baicalin	13.637	nd
Chrysin	14.213	trace
Daidzein	14.255	nd
Trans-cinnamic acid	14.154	0.0166
Quercetin	14.821	nd
Naringenin	14.780	0.197
Silibinin	15.758	nd
Hesperetin	15.705	nd
Morin	15.811	nd
Kaempferol	16.405	nd
Baicalin	17.101	nd
Luteolin	17.943	nd
Biochanin A	18.162	nd
Capcaicin	18.144	trace
Dihydrocapcaicin	18.565	trace
Diosgenin	23.517	nd

RT: retention time, nd: not detected.

compounds, with a particular emphasis on hesperidin. The presence of these bioactive compounds in *S. vulgaris* flowers suggests their potential applications in the fields of food and pharmaceuticals.

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