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ASSESSMENT OF BIOACTIVE COMPOUNDS, SOLUBLE SUGARS, ANTIOXIDANT ACTIVITY, AND YIELD OF THE ONION CULTIVAR HAMILTON F1 GROWN BY DIRECT SOWING

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ABSTRACT

Onion (Allium cepa L.*) is the most widely cultivated species of the genus Allium and one of the most consumed vegetables globally. With the aim of supporting onion cultivation practices and breeding programs, this study examined the main classes of bioactive compounds, soluble sugars, antioxidant properties (measured via TAC, CUPRAC, DPPH$^{\bullet}$ and ABTS$^{\bullet+}$ assays) and yield indicators of the widely grown onion cultivar Hamilton F1 (Bejo Zaden BV, Warmenhuizen, Netherlands) under the agroecological conditions of Vojvodina, Serbia. The onion was established by direct sowing in 4 × double-row strips, using a randomized block design with three replications. Extraction was performed with 80% methanol in order to prevent protein extraction and potential interferences with phenolics. The results revealed that total phenolic content (TPC), total flavonoid content (TFC), and soluble sugars content (SSC) were 0.76 mg/g GAE, 0.29 mg/g QE, and 106.9 mg/g Glc, respectively. The highest antioxidant activity was observed in TAC and ABTS$^{\bullet+}$ assays, with values of 6.57 mg/g AAE and 3.67 µmol/g TE, respectively. The content of total hydroxycinnamic acid derivatives was below the detection limit. The dry matter content was 8.11%. Additionally, the total yield of the Hamilton F1 onion was 108.01 t/ha, with a first-class yield of 104.4 t/ha and a high proportion of marketable bulbs. The results indicate that the Hamilton F1 cultivar is characterized by a considerable content of the examined bioactive compounds that contribute to better agronomic traits, including improved performance under stress conditions, longer storage potential and greater disease tolerance. From consumers' perspective, these compounds provide also health benefits. The findings emphasize the potential of Hamilton F1 as a reliable option for farmers and highlight the importance of breeding programs focused on developing onion cultivars with similar or improved functional properties, combining high yield potential with enhanced nutritional value.*

Key words:
sowing method, Allium cepa L., bulb, food chemistry, phenolic compounds

Abbreviations:
ABTS•+ – 2,2'-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid radical cation; CGAE – chlorogenic acid equivalents; CUPRAC – Cupric Reducing Antioxidant Capacity; DPPH• – 2,2-diphenyl-1-picrylhydrazyl radical; FW – fresh weight; GAE – gallic acid equivalents; Glc – glucose; HCAs – hydroxycinnamic acid derivatives; QE – quercetin equivalents; SSC – soluble sugars content; TPC – total phenolic content; TFC – total flavonoid content; TAC – total antioxidant capacity; TE – Trolox equivalents

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INTRODUCTION

Onion (*Allium cepa* L.) is the most widely grown species of the genus *Allium* and the second most produced vegetable in the world. Currently, onion is cultivated in over 140 countries (Ochar and Kim, 2023). In 2023, it was grown on approximately 5.9 million hectares, while the leading producers were China and India. In Serbia, onion was cultivated on around 4 022 hectares in 2023 (FAOSTAT, 2023).

Onions are the most consumed *Allium* species worldwide. Both dry bulbs and spring onions are commonly used in human nutrition. Onions have good culinary properties, allowing for a wide range of preparations, including boiling, drying, consuming raw in seasonal salads, pickling and frying, especially in forms of popular onion rings. In many cultures, onions are valued as a traditional herbal medicine (Jo et al., 2017; Ochar and Kim, 2023). The recommended daily intake of 50 g of fresh onion or 20 g of dried onion is considered to have potential beneficial effects on human health (Chakraborty et al., 2022).

Due to its popularity, onion is extensively studied in terms of both their chemical composition and biological activities. The edible part – the bulb – has the following chemical profile: water (89%), carbohydrates (5-12%), proteins (1.1%), fiber (0.73-1.7%), fat (0.15%), and ash (0.35-0.66%) (Upadhyay, 2016; Dinkecha and Muniye, 2017; Dalhat et al., 2018). Variations in chemical composition stem from different agro-ecological conditions, cultivar selection, applied agricultural practices, and the method and duration of storing edible parts (Sagar et al., 2022).

Important constituents of onion chemical composition include organosulpur, phenolic and organoselenium compounds, steroid saponins, vitamins and amino acids. These chemical compounds exhibit a wide range of biological activities, with antioxidant activity being the most frequently reported, followed by anticarcinogenic, antimutagenic, antiasthmatic, antimicrobial, anti-inflammatory, immunomodulatory, and neuroprotective properties. Consequently, onion has also been used in prevention and treatments of various diseases, including cardiovascular, gastrointestinal, chronic respiratory diseases, diabetes and mental illnesses (Dinkecha and Muniye, 2017; Bastaki et al., 2021). However, Zhao et al. (2021) stress that utilizing the medicinal potential of onion requires consideration of possible chemical and microbiological contamination of its edible parts.

Considering the health benefits of onion consumption, this study used the standard spectrophotometric methods to determine the content of soluble sugars, bioactive compounds (total phenolic content, total flavonoid content and total hydroxycinnamic acid derivative content) and antioxidant activity (TAC, CUPRAC, DPPH$^{\bullet}$ and ABTS$^{\bullet +}$) in the edible parts – fresh bulbs – of the selected onion cultivar (Hamilton F1), in order to evaluate its biological activity and yield indicators. Hamilton F1 is particularly significant for its wide cultivation by direct sowing, strong consumer preference, long storage capacity (up to 8–9 months), and suitability for both fresh consumption and processing, making it an important target for detailed characterization (Bejo Zaden, 2025).

Despite its extensive cultivation, the agronomic performance and bioactive profile of the Hamilton F1 cultivar under the agroecological conditions of Vojvodina Province (Serbia) remain insufficiently explored. Given its recognized quality and high consumer demand, a detailed analysis of its antioxidant and bioactive compound content is needed. These insights could provide a foundation for developing new onion cultivars with comparable or enhanced functional properties. The Hamilton F1 cultivar is characterized by its round, uniform bulb shape and dark bronze-colored dry outer skin. The inner scales are firm, white to pale yellow, with a mild and sweet taste, making it suitable for both fresh consumption and industrial processing. It is a long-day onion cultivar, adapted to temperate regions, with medium resistance to to fusarium wilt (*Fusarium oxysporum* f. *sp. cepae*) and pink root rot (*Phoma terrestris*) (Bejo Zaden, 2025).

Most previous studies on onion cultivars have focused on plants grown from seedlings (Petrovic et al., 2020; Amir et al., 2023; Zhang et al., 2024), while research involving direct sowing remains limited. This gap is particularly important, as direct sowing is widely used in commercial onion production, and findings from seedling-based studies may not always translate effectively to field conditions.

Therefore, the aim of this study was to provide a comprehensive characterization of the Hamilton F1 onion cultivar grown by direct sowing under the agroecological conditions of Vojvodina. The investigation assessed cultivation parameters, environmental influences, and biochemical composition, including bioactive compounds, soluble sugars, and antioxidant activity. The findings are intended to contribute to optimizing production practices and to serve as a foundation for future breeding programs aimed at developing onion cultivars with enhanced functional and storage properties.

MATERIAL AND METHODS

Study Site and Experimental Procedures

A field experiment was conducted during 2022 growing season in the village of Gospođinci (Vojvodina Province, Serbia) on the Salonski family farm, a significant onion producer in the region. The study focused exclusively on the Hamilton F1 cultivar (Bejo Zaden BV, Warmenhuizen, Netherlands), known for its dark bronze-colored dry outer skin and suitability for long-term storage (8–9 months). The experiment was carried out in an open field using a randomized block design with three replications. Each experimental plot (one replication) measured 1.5 m × 6.67 m (10 m²), while the total experimental area covered 30 m² (Figure 1a).

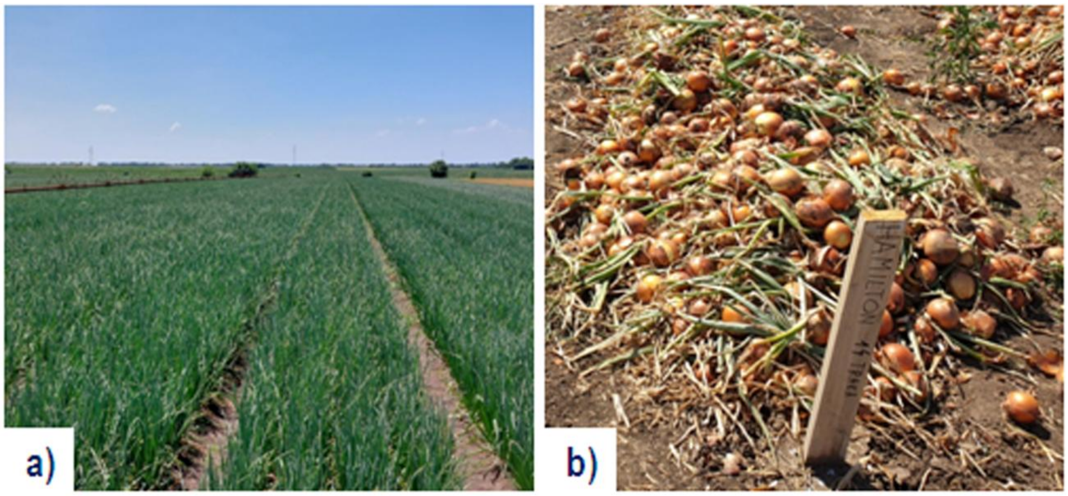

Figure 1. Experimental field with the Hamilton F1 cultivar during vegetation (4 July 2022) – a, and harvested bulbs (17 August 2022) - b at the locality of Gospođinci (45.4059° N, 19.9892° E), Serbia (photo by Đ. Vojnović.)

The preceding crop at the site was long-type pepper (*Capsicum annuum* L. var. *longum*). Before primary soil tillage, a basal dose of NPK 16:16:16 fertilizer was applied at a rate of 400 kg/ha, supplying 64 kg/ha of N, P, and K. On the same day, the field was plowed to a depth of 30 cm. In mid-January, winter furrow closing was performed to minimize soil evaporation. The first pre-sowing soil preparation was carried out using a seedbed cultivator fourteen days before sowing, followed by a second preparation seven days later.

Sowing was conducted in the second decade of March using a pneumatic seeder in eight-row strips. The row spacing was as follows: 50 cm spacing between strips, 35 cm between double rows within each strip, 10 cm between rows in a double row, and 4–6 cm between plants within a row.

Simultaneously with sowing, drip irrigation tapes were installed and used for both irrigation and fertigation. Throughout the growing season, NPK fertilizers were applied in five equal doses through the fertigation system. Additionally, during the bulb formation stage, a seaweed-based biostimulant was applied, as recommended by Vojnović et al. (2023a).

The applied pesticides included herbicides based on bromoxynil and fluoxypyr, fungicides containing copper oxide and boscalid + pyraclostrobin, and insecticides formetanate hydrochloride and imidacloprid. Due to the waxy coating on onion leaves, a wetting agent (composed of ethoxylated fatty alcohols and polydimethylsiloxane) was used in combination with fungicides and insecticides. Additionally, to optimize herbicide effectiveness on waxy-leaved weeds, another wetting agent (isodecyl alcohol ethoxylate) was applied.

Onions were harvested on August 17, 2022 (Figure 1b). Yield was measured based on all plants from the experimental plot. Onion bulbs were classified into first and second class according to the Regulation on the Quality of Fruit and Vegetable Products (Official Gazette SFRY 29/79, 53/87, 1979). The dry matter content was determined by drying samples in a drying oven (SLW 240 ECO) at a temperature of 105 °C until constant weight was achieved, following the Regulation on Food Analysis (Official Gazette SFRY No. 29/83, 1983). For biochemical analyses, 15 bulbs per replication were randomly selected. The samples were transported to the Faculty of Agriculture, University of Novi Sad, where they were peeled, cut into 10 × 10 × 10 mm cubes, and frozen until further analyses.

During the experiment, the highest amount of precipitation was recorded in July, resulting in harvest delay of two to three weeks (Figure 2). This month also had the highest average daily temperatures, while the lowest temperatures were recorded in March. Regarding air humidity, the highest levels were observed in April, whereas the lowest values were measured in March.

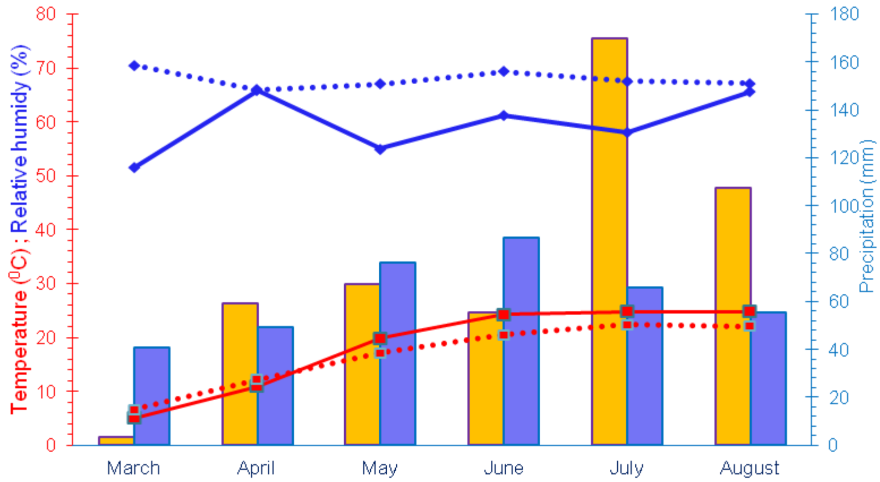

Figure 2**.** Meteorological data during the onion field experiment (2022). The orange bars represent monthly precipitation, while the purple bars indicate the long-term average precipitation. The solid red line shows the average temperature, whereas the dashed red line represents the long-term average temperature. The solid blue line illustrates relative air humidity, while the dashed blue line indicates the long-term average relative humidity.

Phytochemical characterization of onion bulb

The cultivar Hamilton F1 (*A. cepa*) was examined for total phenolic content (TPC), total flavonoid content (TFC), total hydroxycinnamic acid derivative content (HCAs), and total soluble sugars (TSS).

Hamilton F1 bulbs, grown under direct sowing cropping method, were obtained in frozen form and subjected to extraction immediately after arriving at the laboratory (Figure 3). In order to prepare a representative sample, 10 bulbs were selected, crushed (Figure 3a, b) and extracted with 80% methanol (1:10, w:v) in plastic cuvettes (Figure 3c) protected from the light. The extraction procedure lasted for 3 h and was repeated twice in order to enhance isolation of bioactive compounds. After extraction, the sample was centrifuged (2000 g) and the obtained supernatant was used for further proximate phytochemical characterization.

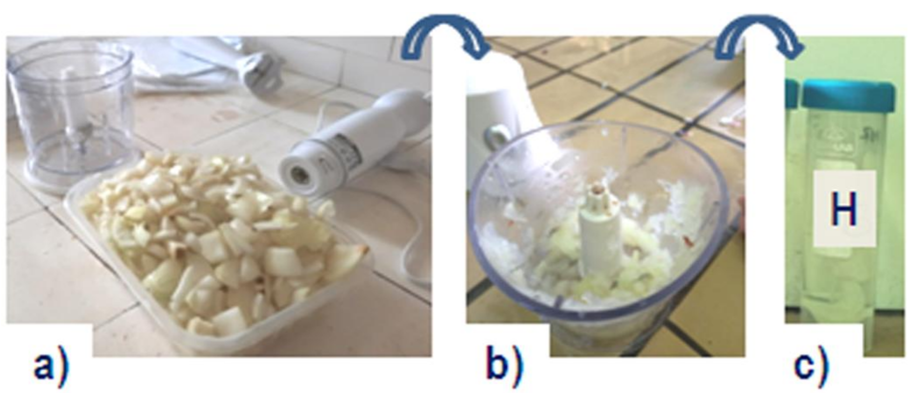

Figure 3. Preparation of Hamilton F1 extract: cut bulbs (a), chopped bulbs (b), and extracted bulbs (c)

Total phenolic content (TPC)

In order to determine TPC, 180 μL of appropriately diluted extract was mixed with 900 μL of Folin-Cicolteu solution (2N) and left in the dark for 5 minutes. After that, 900 μL of 7.5% sodium carbonate solution was added, and the sample was left in the dark for 90 min to develop color. Absorbance was recorded at 765 nm. The obtained result was calculated based on a calibration curve (y = 0.0087x + 0.0627) and expressed as mg/g gallic acid equivalents (GAE) based on fresh weight (FW) of onion (Ng et al., 2000).

Total flavonoid content (TFC)
For TFC determination, 750 µL of undiluted sample was mixed with 750 µL of 2% aluminum chloride (prepared in acidified methanol). The sample was left in the dark for 10 min, as proposed by Chalbi et al. (2023). Absorbance was read at 430 nm. The obtained result was calculated based on a calibration curve ($y = 0.00029x + 0.0082$) and expressed as mg/g quercetin equivalents (QE) based on fresh weight (FW) of onion.

Total hydroxycinnamic acid derivative content (HCAs)
This parameter was determined following the method described by Kostić et al. (2023). The obtained result was calculated based on a calibration curve ($y = 0.00235x + 0.0922$) and expressed as mg/g chlorogenic acid equivalents (CGAE) based on fresh weight (FW) of onion.

Total soluble sugar (TSS) content
TSS was assessed using a phenol method, as proposed in the literature (DuBois et al., 1956; Aluta et al., 2023) with certain modifications. Namely, appropriately diluted extracts (200 µL) were mixed with same volume of 5% phenol. After that, 3 mL of conc. sulphuric acid was carefully added. The reaction mixture was left in the dark to react for 30 minutes. The developed color was measured at absorbance of 490 nm. The obtained result was calculated based on a calibration curve ($y=0.00206 + 0.1747$) and expressed as mg/g glucose based on fresh weight (FW) of onion.

Antioxidant properties of Hamilton F1 (*A. cepa*) bulb
The antioxidant properties of extracts obtained from *A. cepa* bulbs were evaluated using four standard antioxidant assays:
1. *In vitro* phosphomolybdenum total antioxidant capacity (TAC)
2. Cupric Reducing Antioxidant Capacity (CUPRAC)
3. Quenching of 2,2-Diphenyl-1-picrylhydrazyl radical ($DPPH^{\bullet}$)
4. Quenching of 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid radical cation ($ABTS^{\bullet+}$)

as described in the previous study by Kostić et al. (2023). Quantification for the listed assays was based on the following calibration curves: $y =0.0053x - 0.0259$ (TAC), $y =0.00166x +0.132$ (CUPRAC), $y =0.8678x +7.596$ ($DPPH^{\bullet}$), and $y= 0.5944 + 2.7296$ ($ABTS^{\bullet+}$).

Statistical Analysis
The obtained data were subjected to descriptive statistical analysis. Mean values and standard deviations were calculated to evaluate the yield and quality parameters of the Hamilton F1 onion cultivar. All statistical calculations were performed using Microsoft Excel 2007 (Microsoft Corporation, Redmond, WA, USA).

RESULTS AND DISCUSSION

The Hamilton F1 cultivar is widely cultivated in commercial production owing to its high yield potential, good storage performance, and consumer-preferred quality.
In this study, the total yield of the Hamilton F1 onion was 108.01 t/ha (Table 1), with the first-class yield reaching 104.4 t/ha, accounting for 96.66% of the total yield. First-class bulbs are defined as healthy, well-shaped bulbs with a diameter larger than 40 mm (Official Gazette SFRY 29/79, 53/87, 1979), representing the most desirable fraction for both fresh markets and long-term storage. Vojnović et al. (2023b) reported that the average first-class yield of the Elenka F1 cultivar was 71.4 t/ha, highlighting the superior performance of Hamilton F1 under similar conditions. The second-class yield was only 3.61 t/ha (3.34%), consisting of bulbs with a diameter below 40 mm (Official Gazette SFRY 29/79, 53/87, 1979). This class is mainly used for industrial purposes, such as pickling or as feedstock for biogas production. The low proportion of second-class bulbs further emphasizes both the high genetic potential of the Hamilton F1 cultivar and the effectiveness of the applied cultivation practices. A total of 876,333 bulbs per hectare were recorded, indicating successful crop establishment and optimal plant density. A higher number of bulbs per hectare significantly contribute to the overall yield, especially when combined with a high proportion of marketable bulbs.
The average bulb weight was 123.37 g, meeting market requirements and confirming the suitability of the cultivar for commercial production. Dry matter content is a crucial indicator of onion quality, as it affects both storability and processing performance. In this study, the dry matter content was 8.11%, suggesting good storage potential and suitability for processing. Additionally, when recalculated as the yield of dry onions at 8% moisture content (Niketić-

Aleksić, 1982), the yield amounted to 9.52 t/ha, confirming the excellent productivity and overall quality of the harvested crop.

Table 1. Yield and yield components of Hamilton F1

Parameters	Results
Yield of first-class bulbs (t/ha)	104.4
Yield of second-class bulbs (t/ha)	3.61
Total yield (t/ha)	108.01
Share of first-class bulbs (%)	96.66
Share of second-class bulbs (%)	3.34
Total number of bulbs (plants)	876333.3
Average bulb weight (g)	123.37
Dry matter content (%)	8.11
Yield of dried onion at 8% moisture (t/ha)	9.52

Phytochemical characteristics

The phytochemical composition of methanolic extracts from the Hamilton F1 onion cultivar bulbs was analyzed to assess their bioactive potential. Key parameters, including total phenolic content (TPC), total flavonoid content (TFC), hydroxycinnamic acid content (HCA), and total soluble sugar content (TSS), are presented in Table 2.

Table 2. Proximate phytochemical composition and antioxidant properties of Hamilton F1 bulbs

Parameters	Results
Phytochemical composition	
TPC (mg/g GAE FW)*	0.76 ± 0.05
TFC (mg/g QE FW)	0.29 ± 0.00
HCAs (mg/g CGAE FW)	n.d.
TSS (mg/g glucose FW)	106.90 ± 0.10
Antioxidant activity	
TAC (mg/g AAE FW)	6.57 ± 0.30
CUPRAC (mg/g AAE FW)	0.31 ± 0.02
$ABTS^{\bullet+}$ (μmol/g TE FW)	3.68 ± 0.07
$DPPH^{\bullet}$ (μmol/g TE FW)	1.746 ± 0.03

Legend: FW – fresh weight; TPC – total phenolic content; TFC – total flavonoid content; HCA – total dyhydroxicinnamic acid derivative content; GAE – gallic acid equivalents; QE – quercetin equivalents; CGAE – chlorogenic acid equivalents; TAC – total antioxidant capacity determined via *in vitro* phosphomolybdenum assay; CUPRAC – Cupric Reducing Antioxidant Capacity; $ABTS^{\bullet+}$ – 2,2′-Azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) radical cation; $DPPH^{\bullet}$ – 2,2-diphenylpicrylhydrazyl radical; TE – Trolox equivalents; AAE – ascorbic acid equivalents;
Values are the means of three different measurements (n = 3) ± standard deviation; n.d. - not detected

The results show that TPC and TFC were 0.76 mg/g GAE FW and 0.29 mg/g QE FW, respectively, while HCA derivatives were not detected. Phenolic synthesis in onion bulbs is shaped by genetic diversity, environmental conditions, agronomic practices, and both pre- and post-harvest treatments, all of which influence phenolic accumulation and enhance nutritional and health benefits (Ren and Zhou, 2021). Ren and Zhou (2021) reported significant variations in specific phenolic content among onion cultivars, with genotype playing a key role, as colored red, pink and yellow varieties generally had higher concentrations of these compounds compared to white ones. Lisanti et al. (2016) examined TPC in purple, golden, and pale yellow onion cultivars, finding that purple and golden cultivars had comparable phenolic levels (6.61 and 6.53 mg/g GAE DW, respectively), both exceeding the value of a pale yellow cultivar (4.71 mg/g GAE DW). In the study by Cheng et al. (2013), it was reported that yellow onions had higher TPC compared to red onions, with the outer layers showing higher phenolic levels than the inner ones, suggesting that phenolic content increases with the aging of the outer layers of the bulb. The same distribution pattern was observed for flavonoids in the bulb (Lee et al., 2008; Cheng et al., 2013). Onions are among the most significant dietary sources of flavonoids, with quercetin aglycone identified as one of the major pigments in several cultivars (Slimestad et al., 2007). Several studies have explored the differences in TFC across various onion cultivars, with genetics playing a key role. For instance, onion bulbs from eighteen Korean cultivars were reported to have TFC values ranging from 1.85 to 2.13 mg QE/g FW (Sharma et al., 2014). Similarly, a study by Sagar et al. (2020) found that among fifteen cultivars, colored varieties had higher TFC compared to the white cultivars. The same authors also emphasized that the highest flavonoid content was found in the non-edible skin (dry peel), which is often considered a by-product, but has potential applications as a natural additive to enhance the nutritional and functional properties of various products. The absence of HCAs could be attributed to genetic factors and environmental growing conditions. Kim et al. (2024) reported that while caffeic acid, as an HCA, was not detected in the bulbs of five Korean onion varieties, it was a major phenolic compound in the dry peel and was found in smaller amounts in the roots. These findings collectively demonstrate that genetic factors strongly influence the phenolic and flavonoid composition of onion bulbs, highlighting the importance of cultivar selection in optimizing their bioactive compound content and potential health benefits. In this context, the Hamilton F1 onion cultivar analyzed in our study provides further insight into how genetic variation shapes phytochemical accumulation. The data obtained from this cultivar can be leveraged to select onion varieties with higher phenolic and flavonoid content, which can be further applied in the development of value-added food products or natural additives, enhancing the nutritional and functional properties of these products. Additionally, determining the TSS content in onion bulbs is essential for assessing their quality and flavor profile. The high TSS content (106.90 mg/g glucose FW) contributes substantially to the sweetness and overall taste of the Hamilton F1 cultivar bulbs.

Antioxidant characteristics of onion bulbs

Antioxidant properties of various onion cultivars have been previously reported in the literature. The health benefits of onions are increasingly recognized for their antioxidant content. Studies indicate that regular consumption of onions may reduce the risk of neurodegenerative diseases, various cancers, cataracts, and cardiovascular conditions, by combating harmful free radicals (Roldán et al., 2008; Malla et al., 2013). These beneficial properties of onions are largely attributed to their phenolic compounds, especially flavonoids, with quercetin being the most prevalent flavonoid in onion bulbs (Hertog and Hollman, 1996; Vijayalakshmi et al., 2021; Kumar et al., 2022). Cheng et al. (2013) noted that the distribution and quantity of phenolic compounds and flavonoids in onion layers are correlated with antioxidant potential, with higher activity found in the outer tissues of the bulb. However, despite extensive research, the information on the antioxidant activity of Hamilton F1 bulbs remains scarce. Therefore, Table 2 presents the results of a comprehensive analysis of the antioxidant properties of Hamilton F1 methanolic extracts, evaluated using *in vitro* phosphomolybdenum total antioxidant capacity (TAC) and cupric reducing antioxidant capacity (CUPRAC), along with two free radical scavenging assays – DPPH$^{\bullet}$ and ABTS$^{\bullet+}$. TAC was 6.57 mg/g AAE FW, while CUPRAC was relatively lower at 0.31 ± 0.02 mg/g AAE FW. Kotenkova and Kupaeva (2019) investigated TAC in aqueous and ethanolic extracts of onion bulbs, reporting 9.60 and 41.45 µmol equivalents of Trolox/g, respectively. Kaur et al. (2009) found CUPRAC values in onion cultivars ranging 1.07–7.6 mmol Trolox/g and 1.23–7.0 mmol Trolox/g in two consecutive harvest years, with red cultivars scoring higher than white ones, and this performance correlated closely with phenolic content. In the present study, radical scavenging assays revealed ABTS$^{\bullet+}$ and DPPH$^{\bullet}$ scavenging capacities of 3.68 ± 0.07 µmol/g TE FW and 1.746 ± 0.03 µmol/g TE FW, respectively. Lisanti et al. (2016) revealed significant differences in DPPH• results for ethanolic extracts among red, golden, and white onion cultivars – Rossa di Toscana, Dorata di Parma, and Borettana di Rovato. The red cultivar exhibited the highest activity, with significantly greater DPPH• scavenging capacity compared to the golden and white cultivars (22.90, 15.08, and 15.67 mmol Trolox equivalents/g bulb DW, respectively). Similarly, five onion cultivars – Tank, Bomul, Gujji, Cobra, and Hongbanjang – showed significant variation in bulb DPPH$^{\bullet}$ values, ranging from 3.75 to 8.71 mg VCE/100 g FW (Kim et al., 2024). In the same study, ABTS$^{\bullet+}$ values for these cultivars ranged from 38.02 to 45.78 mg VCE/100 g FW.

These findings indicate that the antioxidant potential of onion cultivars is strongly influenced by genotype, suggesting that genetic factors play a significant role in determining the accumulation of bioactive compounds, which affects the overall antioxidant activity of different onion types. Variations in assay results can be attributed to differences in the extraction methods and solvent choice, making comparison of the cultivars more difficult. However, findings in the present study suggest that the Hamilton F1 cultivar holds potential as a valuable source of bioactive compounds with antioxidant properties, which could improve human health by reducing oxidative stress and supporting overall well-being. Given its moderate antioxidant capacity, this cultivar may be considered for use in functional food products or nutraceuticals aimed at promoting health. Further investigation into its phenolic profile and genetic characteristics could support the development of targeted health-promoting derived products. Furthermore, the results provide a basis for development of agronomic strategies aimed at improving the phytochemical profile of this cultivar, as targeted agronomic measures could enhance the accumulation of beneficial compounds, thus optimizing its antioxidative potential.

CONCLUSION

Hamilton F1 onion cultivar demonstrated excellent yield performance under the agroecological conditions of Vojvodina, producing a high proportion of uniform, first-class bulbs suitable for both fresh consumption and industrial processing. Along with favorable agronomic traits, the cultivar contained bioactive compounds, including phenolics and flavonoids, which contribute to its antioxidant potential and nutritional value. Although the content of these compounds is moderate compared to colored onion cultivars, the combination of stable yields, good storage capacity, and desirable quality characteristics makes Hamilton F1 a reliable choice for farmers. Additionally, the results highlight the importance of breeding programs focused on developing onion cultivars with similar or improved functional properties, combining high yield potential with enhanced nutritional value and storage stability.

Authors' Contribution: Conceptualization: Đ.V. and J.P-Đ.; Methodology: Đ.V. and A.K.; Validation: S.K., Đ.V. and A.K.; Formal Analysis: S.K. and A.K.; Investigation: S.V.; Resources: Đ.V.; Data Curation: J.P-Đ.; Writing – Original Draft Preparation: S.V., S.K. and Đ.V.; Writing – Review & Editing: J.P-Đ.; Visualization: J.P-Đ; Supervision: J.P-Đ; All authors have read and agreed to the published version of the manuscript.

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Data availability statement (optional): The data presented in this study are available upon request from the authors.

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Conflict of interest: The authors declare that they have no conflict of interest.

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