DOI: 10.46793/SBT30.17GP

EVALUATION OF PHYSICAL AND CHEMICAL PROPERTIES OF QUINCE (*Cydonia oblonga* Mill.) FRUIT

Gorica Paunović, Radmila Ilić, Ivan Glišić, Jelena Mladenović

Abstract: This study evaluated the physical and chemical properties of three quince (*Cydonia oblonga* Mill.) cultivars—'Asenica,' 'Hemus,' and 'Leskova ka'—grown under the agroecological conditions of the a ak region, Serbia. During two growing sesons (2023 and 2024), physical traits analyzed included fruit weight, height, and width, while chemical properties were assessed in two time periods: immediately after harvest and after 15 days of storage at room temperature. The chemical analysis included soluble solids content (SSC), total organic acids (TOA), and the ripening index (RI). The results revealed significant differences among cultivars, as well as between the two years of study. Fruit weight ranged from 252.7 g ('Hemus') to 289.5 g ('Leskova ka'), with significant year-to-year variations. The SSC content was highest in 'Hemus' (16.27%) in the second sampling period, while 'Asenica' had the highest OA levels (1.194 g/100 cm^3) immediately after harvest. The ripening index increased after storage, with 'Hemus' showing the highest values, making it the most suitable for fresh consumption and processing. The interaction between cultivar and year significantly influenced most parameters, highlighting the importance of environmental conditions. These findings contribute to a better understanding of quince fruit quality and provide recommendations for the optimal cultivation and post-harvest handling of these cultivars in this region.

Keywords: quince, fruit quality, storage.

Introduction

Serbia is the leading quince producer in Europe. Quince is cultivated on approximately 1,600 hectares in Serbia, with an increase of 200 hectares recorded in 2022, indicating a growing trend in quince cultivation.

Despite Serbia's highly favorable agroecological conditions for quince production and the high value of its fruit, quince is still grown on a limited scale. In Serbia's fruit production structure, quince accounts for only 0.8%. Farmers are often reluctant to establish new orchards due to quince's high

[1]University of Kragujevac, Faculty of Agronomy, Cara Dušana 34, Čačak, Serbia (name.surname@kg.ac.rs)

susceptibility to fire blight, caused by *Erwinia amylovora*. However, quince offers several advantages over other fruit species. Its late blooming period, typically in mid-May, allows it to avoid late spring frosts (Miloševi , 1996). Due to its late flowering and modest requirements for agro-technical and pomological practices, quince can be cultivated in areas where other fruit species yield poorer results.

Quince cultivation is a profitable venture. The fruit is large, which facilitates an easy harvest lasting up to two weeks. While only about 20% of quince is consumed fresh, the majority is processed into juice, preserves, jams, compotes, jellies, and quince brandy. Quince brandy is highly valued for its distinctive aroma. Additionally, quince fruits are highly transportable, have a long shelf life, and retain their characteristic fragrance and aroma. The tree bears fruit regularly literatura.

The aim of this study is to examine the physical and chemical properties of the fruit of three quince cultivars ('Asenica,' 'Hemus,' and 'Leskova ka') grown under the agroecological conditions of the a ak region, contributing to the expansion of this valuable fruit species with exceptional characteristics.

Materials and methods

The study was conducted in an experimental-commercial quince orchard during the 2023 and 2024 growing seasons. The orchard is located in the village of Bresnica, near a ak (43°52'16" N latitude; 20°35'16" E longitude) on inclined terrain at an altitude of 265 m.

The quince orchard was established in the spring of 2019. The seedlings were "hand-grafted" in March of the same year and grown in a nursery until transplanting to a permanent location. The rootstock used was the Provence (Angers) quince clone BA 29. The planting distance was 5 m between rows and 3.5 m within rows, corresponding to a density of 570 trees per hectare. The soil was maintained using a combination of grass cover and a herbicide strip. Disease and pest management was carried out through multiple treatments with different fungicides, acaricides, and insecticides.

Three quince cultivars were studied: Leskovačka, Asenica, and Hemus.

The physical properties of quince fruits were assessed using standard measurement techniques. Fruit mass (g) – Measured using a Kern technical scale (Kern & Sohn GmbH, Balingen, Germany) with an accuracy of 0.1 g. Fruit height and fruit width (mm) – Determined using a Starrett 727 Series digital calliper. Soluble solids content and total acids in fruits were measured at 2 times: after

harvest and after 15 days of storage at room conditions. Soluble solid content (SSC, °Brix) – Determined from a few drops of fruit juice using a handheld refractometer (Milwaukee MR 200, ATC, Rocky Mount, USA) . Total acidity (TA, % malic acid equivalent) – Determined by potentiometric titration with 0.1 mol L^{-1} NaOH to pH 8.1 using a pH meter (Consort C860, Turnhout, Belgium).

The collected data were statistically analyzed using one-way analysis of variance (ANOVA) in Microsoft Excel (Microsoft Corporation, Roselle, IL, USA). When the *F*-test indicated significance, mean values were compared using the least significant difference (LSD) test at significance levels of $P \leq 0.05$ and $P \leq 0.01$.

Results and discussion

Physical properties

The physical properties of the studied quince cultivars were evaluated based on fruit weight, height, and width. The data presented in Table 1 indicate significant differences in the physical characteristics of the fruit, which may have implications for cultivation, market value, and consumer preferences.

Fruit weight is a crucial qualitative trait that affects both yield and consumer acceptance (Durmaz et al., 2010). This characteristic is highly influenced by the genotype, environmental conditions, and applied cultivation technology. Significant variation in fruit weight was observed among the studied cultivars, ranging from 252.7 g in the 'Hemus' cultivar to 289.5 g in the 'Leskovačka' cultivar. Other researchers who have examined, among other aspects, the fruit weight of these cultivars (Nikoli , 1996; Mratini et al., 2009; Radovi et al., 2015) concluded that 'Asenica' had the highest fruit weight, while 'Leskovačka' had the lowest. These findings differ from our results; however, our first-year data align with their findings. The differences became more pronounced in the second year, where 'Leskovačka' exhibited low yield, resulting in larger fruit, while the other two cultivars, 'Asenica' and 'Hemus,' experienced significant overproduction, leading to smaller fruits. As a result, the average fruit weight was significantly higher in the first year (292.4 g) compared to the second year (257.3 g).

Fruit length and width also varied among cultivars and across years. The Leskova ka cultivar exhibited the highest average fruit length (81.30 mm), while Asenica had the highest fruit width (85.88 mm). These dimensions are important for market acceptance, as consumers often prefer larger and more uniformly shaped fruits (Radovi et al., 2015).

Table 1. Physical properties of quince fruit

Factor	Fruit weight (g)	Fruit length (mm)	Fruit width (mm)
Cultivar (A)			
'Asenica'	282.3 ± 15.64 b	79.80 ± 5.14 b	85.88 ± 3.79a
'Hemus'	252.7 ± 18.70 c	81.01 ± 6.09 a	81.67 ± 4.05 c
'Leskovačka'	289.5 ± 17.99 a	81.30 ± 4.98 a	84.22 ± 4.46 b
Year (B)			
I	292.4 ± 15.84 a	82.85 ± 5.16a	81.07 ± 4.41 b
II	257.3 ± 15.97 b	78.56 ± 4.88 b	86.78 ± 3.89 a
ANOVA			
A	*	*	*
B	*	*	*
A × B	*	*	*

The same lowercase letters in the same column indicate that the differences between the means are not statistically significant at $P \leq 0.05$ by the LSD test. *: asterisk indicates significant differences at $P \leq 0.05$ by the LSD test.

The effect of the year was statistically significant for all analyzed fruit parameters. In the first growing year, higher fruit weight (292.4 g) was recorded, whereas the second growing year showed a significantly lower average fruit weight (257.3 g). This variability can be attributed to weather conditions and yield load—during the second year, the 'Leskova ka' cultivar had lower fruit set, resulting in larger individual fruits, whereas 'Asenica' and 'Hemus' had high fruit loads, leading to smaller fruit sizes. Similar trends were observed in previous studies, where years with higher yields were associated with smaller average fruit sizes (Nikoli , 1996).

The significant interaction between cultivar and study year indicates that variations in the physical properties of quince fruit are not solely due to genetic factors but are also influenced by specific growing conditions in a given year. These findings align with those of Durmaz et al. (2010), who highlighted that environmental factors, particularly rainfall and temperature regimes, can substantially impact the physical characteristics of quince fruit.

Chemical properties

The quality of quince cultivars was determined based on their chemical properties. The chemical composition of quince fruit is a crucial characteristic, as a significant proportion of quince production is intended for processing.

The soluble solids content (SSC) varied significantly between cultivars and sampling terms (Table 2). On avarage for both years, in the first sampling (SSC I), Hemus (15.25%) and Leskova ka (15.20%) had significantly higher values than Asenica (14.77%). However, in the second sampling (SSC II), SSC increased in all cultivars, with Hemus reaching the highest value (16.27%). These findings align with Radovi et al. (2015), who reported that SSC in quince varies between 14.30% and 17.45%, depending on the cultivar and environmental conditions. The higher SSC II is likely due to prolonged fruit maturation, allowing for increased sugar accumulation, which is a critical factor for consumer preference and processing quality (Mratini et al., 2009).

Regarding variations per year (Table 2), SSC I showed no significant differences between years. On the other hand, SSC II was significantly higher in the second year compared to the first year. This suggests that environmental factors, particularly temperature and rainfall, may have influenced carbohydrate accumulation. Similar findings were reported by Durmaz et al. (2010), who noted that climatic conditions significantly affect SSC in pome fruits.

Our research results show higher SSC values compared to those reported by Mratini et al. (2009), who recorded SSC values for 'Asenica' at 14.05%, 'Leskovačka' at 14.00%, and 'Hemus' at 13.70%. In studies of eight quince cultivars, Radovi et al. (2015) found SSC values ranging from 14.30% to 17.45%. These authors classified quince cultivars into groups with low, medium, high, and very high SSC content. According to their findings, the SSC for 'Asenica' was 16.95%, for 'Leskovačka' 15.58%, and for 'Hemus' 16.85%, which are considerably higher than the values recorded in our research.

Organic acids are essential for the sensory profile and storage potential of quince. The results in Table 2 indicate that 'Asenica' had the highest total organic acid content in both samplings (1.194 g/100 cm^3 in TOA I and 1.129 g/100 cm^3 in TOA II), while 'Hemus' had the lowest values (1.122 g/100 cm^3 and 1.082 g/100 cm^3, respectively). These differences were statistically significant and confirm that TOA is highly cultivar-dependent (Nikoli , 1996).

The differences became more pronounced in the second year, during which 'Leskova ka' displayed a low yield, resulting in larger fruit, whereas the other

two cultivars, 'Asenica' and 'Hemus,' experienced significant overproduction, leading to smaller fruit. As a result, the average fruit weight was significantly higher in the first year of the study (292.4 g) compared to the second year (257.3 g). This trend is consistent with previous studies indicating that organic acid content tends to decrease as fruits mature and experience warmer growing conditions (But and Klimenk, 2001).

Table 2. Chemical properties of quince fruit

Factor	SSC I (%)	SSC II (%)	TOA I (g/100 cm^3)	TOA II (g/100 cm^3)	RI I	RI II
Cultivar (A)						
'Asenica'	14.77 ± 1.15 b	14.37 ± 1.05 b	1.194 ± 0.01 a	1.129 ± 0.01 a	12.47 ± 0.55 b	12.87 ± 0.71 b
'Hemus'	15.25 ± 1.07 a	16.27 ± 1.11 a	1.122± 0.01 c	1.082 ± 0.00 c	13.39 ± 0.65 a	15.02 ± 0.74 a
'Leskovačka'	15.20 ± 1.11 a	16.10 ± 1.08 a	1.170 ± 0.02 b	1.110 ± 0.02 b	12.99 ± 0.72 a	14.52 ± 0.66 a
Year (B)						
I	14.79 ± 1.25 a	14.76 ± 1.09 b	1.171± 0.01 a	1.118 ± 0.01 a	12.73 ± 0.67 a	13.32 ± 0.62 a
II	14.82 ± 1.22 a	16.40 ± 1.12 a	1.153 ± 0.01 b	1.096 ± 0.01 b	12.89 ± 0.59 a	14.95 ± 0.67a
ANOVA (*F*тест) (A × B)						
A	*	*	*	*	*	*
B	ns	*	*	*	ns	ns
A × B	ns	*	*	*	ns	ns

The same lowercase letters in the same column indicate that the differences between the means are not statistically significant at ⁋ 0.05 by the LSD test. *: asterisk indicates significant differences at P ≤ 0.05 by the LSD test.

Abbreviations:

I-first term; II-second term

The ripening index (RI), calculated as the SSC/OA ratio, is a key indicator of fruit maturity and taste balance. The results show that Hemus had the highest RI values in both samplings (13.39 and 15.02), followed by Leskova ka (12.99 and 14.52), while Asenica had the lowest values (12.47 and 12.87). Higher RI values indicate a sweeter taste with lower acidity, which can be more appealing to consumers and favorable for processing (Mratini et al., 2009).

The effect of the year on RI was not statistically significant, suggesting that cultivar characteristics had a dominant influence on this parameter. However, a slight increase in RI in the second year, particularly in SSC II and RI II, suggests that the fruits were harvested at a more advanced maturity stage, leading to increased sweetness. This is in agreement with studies by Radovi et al. (2015),

who noted that SSC accumulation and organic acid degradation occur progressively during fruit ripening.

During the study, the cultivars were also examined for fruit rot susceptibility during storage at room temperature. Observations indicated that 'Asenica' had the highest number of rotten fruits, while 'Leskovačka' had the lowest. Therefore, special attention should be given to the storage of the 'Asenica' cultivar, which cannot be successfully stored under room conditions.

Conclusion

This study revealed significant differences in the physical and chemical properties of three quince cultivars ('Asenica,' 'Hemus,' and 'Leskovačka') grown under the agroecological conditions of the Čačak region. The 'Leskovačka' cultivar had the highest average fruit weight, while 'Hemus' and 'Asenica' exhibited different characteristics depending on the study year and growing conditions. Chemical analyses showed that soluble solids content was highest in 'Hemus' after storage, whereas 'Asenica' had the highest total organic acid levels immediately after harvest. The ripening index was highest in 'Hemus,' indicating its greater potential for fresh consumption and processing.

The interaction between cultivar and study year significantly influenced most parameters, highlighting the importance of environmental factors in defining quince fruit quality. The results contribute to a better understanding of quince fruit quality and can serve as recommendations for the optimal cultivation and post-harvest handling of these cultivars in the Čačak region.

Acknowledgement

This research is finacialy supported by the Ministry of science, technological development and innovation of the Republic of Serbia, Project Ref. No. 451-03-66/2024-03/200088.

References

But A., Klimenko S. (2001). Capability for the self-pollination of the quince's sorts of the selection of the National Botanical Garden in Kyev. Proceedings of 9th International Conference of Horticulture, Lednice, Czech Republic, 31-36.

Durmaz G., Çam M., Kutlu T., Hi il Y. (2010). Some physical and chemical changes during fruit development of five common apricot (*Prunus armeniaca* L.) cultivars. Food science and Technology Research, 16(1): 71-78.

Khoubnasabjafari M., Jouyban A. (2011). A review of phytochemistry and bioactivity of quence (*Cydonia oblon*ga Mill.).Journal of Medicinal Plants Research, 5, 16: 3577-3594.

Milošević T. (1996). Specijalno voćarstvo. Agronomski fakultet, Čačak. Zajednica za voće i povrće, Beograd.

Mratinić E., Milatović D., Đurović D. (2009). Biološke osobine sorti dunje u beogradskom Podunavlju. Zbornik radova II Savetovanja „Inovacije u voćarstvu ", Poljoprivredni fakultet Beograd, 147-152.

Mratinić E. (2010): Dunja. Partenon, Beograd.

Nikolić M., Stančević A. (1992). Važnije biološko –pomološke osobine novijih sorti i hibrida dunje, Jugoslovensko voćarstvo,30,115-116,237-244.

Nikolić M. (1996). Važnije biološko-pomološke osobine novijih sorti i hibrida dunje. Jugoslovensko voćarstvo, 30, 115-116 (3-4), 237-244.

Nikolić M. (2009). Dunja u Srbiji – stanje i perspektive. Zbornik radova II Savetovanja ,,Inovacije u voćarstvu,,, Poljoprivredni fakultet, Beograd, 169-176.

Radović A., Nikolić D., Milatović D., Đurović D., Đorđević B. (2015): Osobine ploda sorti dunje u beogradskom Podunavlju. Voćarstvo, 49, 189-190, 15-19.