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Comparison of Asian and European Plum Cultivars in Terms of Storability

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ABSTRACT

Plums are an important fruit that is widely grown in temperate climates in Europe, such as the Czech Republic. Currently, stone fruits, including plums, are more susceptible to ongoing climate changes, which leads to a lower production. One possible solution is to cultivate Asian species, which show greater resistance in that regard. The fruit of Asian plum trees feature a higher variability of fruit – size, aroma and color. To support more significant distribution of such species in the European temperate zone, it is necessary to monitor their resistance as well as the potential of storing the fruits. The low storage temperature of 1°C vs. 20°C (shelf-life) had a more significant effect on carbon dioxide and ethylene production than the composition of the ultra low oxygen (ULO) atmosphere vs. random atmosphere (RA). Based on the physiological response observed, the "Sorriso Di Primavera" fruit can be classified as having a suppressed climacteric phase.

KEYWORDS
Prunus; storage; atmosphere; CO_2; ethylene

Introduction

Plum, like other stone fruits (apricot, cherry and peach), is a member of the *Prunus* genus (Byrne, 2012). Based on species, there are three groups of plum trees – European, American and Asian or Japanese (*Prunus salicina* Lindl. var. *salicina*) (Topp et al., 2012). Most commercially cultivated plums are classified as European (hexaploid) and Japanese (diploid). European plum cultivars are among the most widespread fruit species in temperate climates (Okie and Hancock, 2008). Asian plum cultivars are an economically important group of fruit trees (Jaiswal et al., 2013). Native to the Yangtze River basin, China (Yoshida, 1987), the Asian cultivars were spread throughout eastern China (Hedrick, 1911) and subsequently to Japan – where they have been cultivated since ancient times (Faust and Surányi, 1999; Yoshida, 1987) – and to the United States in the late 1800 s (Das et al., 2011; Karp, 2015). In California, Luther Burbank crossed *Prunus salicina* with *Prunus simonii* Carriere and other native North American diploid plums. In the late nineteenth and early twentieth centuries, Burbank selected cultivars such as "Beauty", "Eldorado", "Formosa", "Gaviota", "Santa Rosa", "Shiro" and "Wickson" from these hybridizations, some of which are still cultivated (Burbank, 1915; Das et al., 2011; Hartmann and Neumüller, 2009; Karp, 2015; Okie and Hancock, 2008).

Eating fruit on a regular basis protects against many diseases thanks to the high content of antioxidant compounds, including polyphenols; the fruit of the Asian plum (*Prunus salicina* Lindl.) contains over 40 phenolic compounds, subject to the cultivar and site (Valderrama-Soto et al., 2021). The production of phenolic compounds is associated with tissue pigmentation (Howell, 1974;

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Konczak-Islam et al., 2003) and resistance to biotic and abiotic stress (Beckman, 2000; Howell, 1974; Jeandet et al., 2002). Phenolic compounds are responsible for much of the organoleptic properties – bitterness, astringency and color (Shulaev et al., 2008; Verdu et al., 2014).

In recent years, as climate change evolves, several Asian species from the stone fruit group, including plums, appear to be more resistant to drought and spring frost (Bhattacharjee et al., 2022). Since Asian plum trees feature high fruit variability and differ from European ones in size, aroma and color (Blažek, 2007; Okie and Hancock, 2008), there is an opportunity to deliberately increase the cultivation of these species in European temperate zones and to monitor their storability.

Storage and shelf life of *Prunus salicina* can be extended with many postharvest technologies (Controlled Atmosphere, Modified Atmosphere Packaging, Gamma irradiation treatment). Efforts to be made to combine different technologies, either alone or in combination with other technologies, will prolong the storage and shelf life (Şahin, 2021). The aim of this study was to compare the physiological parameters of the fruits of Asian and European plum cultivars and to optimize the storage conditions for the long-term sustainability of the fruits.

Materials and methods

Plant material

The fruits of four Asian plum cultivars "Santa Rosa", "Sorriso Di Primavera", "Shiro" and "Aphrodite" and one European cultivar "Toptaste" were harvested in the orchards of the Faculty of Horticulture in Lednice, Mendel University in Brno (GPS: 48°47.52′ N, 16°47.70′ E, 172 m a.s.l.) see Figure 1. The site is located in a temperate climate zone with 503 mm of precipitation per year, 2004 h of sunlight per year and an average temperature of 11.4°C, based on the 3-year average (Nečas et al., 2021). A total of 40 kg of fruits of each cultivar were harvested, all at technological ripeness, fully firm and resistant to mechanical damage.

As part of the experiment, two storage options were applied.

Short-term storage

The fruits were harvested and stored under shelf-life (SL) conditions at 20°C for 7 days: 21% O_2, 0.04% CO_2, 78% N_2, φ = 0.6 (RH: 60%), 20°C. At the beginning of storage (0) and at the end of storage (0 + 7), selected physicochemical parameters of the fruits were compared during ripening under market conditions.

Long-term storage

For this option, the fruits of two Asian plum cultivars "Sorriso Di Primavera", "Aphrodite" and one European plum cultivar "Toptaste" were selected. After harvesting, the fruits were first stored for 24 h at 1°C and then in two atmosphere regimes: Random Atmosphere (RA): 21% O_2, 0.04% CO_2, 78% N_2, φ = 0.88–0.92 (RH: 88%–92%), and Ultra Low Oxygen (ULO): 1% O_2, 1% CO_2, 98% N_2, φ = 0.88–0.92 (RH: 88%–92%) at 1°C; after 10, 20 and 30 days the fruits were subjected to analysis. Each time after 10, 20 and 30 days, part of the fruits were also stored for 7 days under shelf-life conditions at 20°C, φ ~ 0.60 (RH: 60%) (10 + 7, 20 + 7, 30 + 7) and then analyzed for individual parameters.

Methods

The ethylene and CO_2 contents were measured using Gas Chromatography (GC) – Agilent 4890C, where a Thermal Conducting Detector (TCD) was used for CO_2 and Capillary Gas Chromatography (CGC) with a Flame Ionisation Detector (FID) for ethylene. On the sampling day, three batches of 10 fruits were weighed, each put into three hermetically sealed respiratory containers (three repetitions).

Figure 1. Cultivars included in the study: "Santa Rosa", "Sorriso Di Primavera", "Shiro", "Aphrodite" and "Toptaste".

The containers were placed in the same storage conditions as were the fruits for 1 h before the measurement. Injecting volume was 1 mL. Column HP-PLOT Q (30 m, I.D. 0.53 mm; 40 mm film) was used for ethylene and column HP-AL/KCL (30 m, I.C. 0.53 mm, a 15 μm film) was used for CO_2. The amount of gases was determined in mg/kg/h for CO_2 and in μl/kg/h for ethylene. Subsequently, the fruit firmness was determined using a penetrometer (TA.XTPlus, Stable Micro Systems, United Kingdom) with a 2 mm diameter punch and soluble solids content (SSC) was detected using a digital refractometer (PR-32 α, Atago, Japan). Titratable acidity (TA) was determined by potentiometric titration using 0.1 M NaOH and converted to fresh weight of fruits by pH-meter (inoLab pH 7310, WTW, United Kingdom) with electrode SenTix 81. All analyses were conducted according to Híc et al. (2023) and Horák et al. (2016).

Statistics

Average values and standard deviations were calculated from three repetitions of ten fruits. Statistical data were analyzed by analysis of variance (ANOVA), applying Tukey's multiple range test for making comparisons with Statistica CZ 14.0015 and MS Excel 2016 software, at the 0.05 level of significance.

Results

Short-term storage

Carbon dioxide (CO_2)

Fruits of "Toptaste" had lower initial CO_2 production than those of Asian plum cultivars (36 ± 3 mg/kg/h) and after 1 week of storage, the values increased to 48 ± 13 mg/kg/h (Table 1). Slightly higher values were measured for the "Sorriso Di Primavera" fruits (58 ± 3 mg/kg/h) and "Shiro" fruits (47 ± 1 mg/kg/h), which showed a decrease in production (56 ± 19 and 42 ± 13 mg/kg/h) after 1 week of storage (Table 1). The highest initial CO_2 production was found in "Santa Rosa" fruits (73 ± 9 mg/kg/h), which is a statistically significant difference ($p = 0.05$) compared to "Toptaste", "Sorriso Di Primavera" and "Shiro" (Table 1). The "Santa Rosa", "Aphrodite" and "Toptaste" fruits showed an increase in respiration during 7 days of storage at 20°C.

Ethylene

Very low ethylene concentrations (below 1.2 μl/kg/h) were found in the fruit of four cultivars after harvest, except for "Aphrodite" where the ethylene concentration measured was 25 ± 18 μl/kg/h. After 1 week of storage, ethylene production increased in fruit of all five cultivars; for "Toptaste" it increased 700-fold from the initial value and was even slightly higher than for "Aphrodite" (Table 1). This made the European cultivar fruits significantly different compared with the

Table 1. Carbon dioxide and ethylene production, soluble solids content (SSC), titratable acidity (TA), firmness and weight loss (WL) of fruits of four Asian plum cultivars and one European plum cultivar at harvest day (0) and after short-term storage for 7 days at 20°C (0 + 7).

Cultivar	Days	CO_2 (mg/kg/h)	Ethylene (μl/kg/h)	SSC (%)	TA (%)	Firmness (N/mm^2)	WL (%)
Santa Rosa	0	73 ± 9^{d}	1.18 ± 0.24^{b}	11.5 ± 0.1^{a}	1.80 ± 0.04^{c}	0.89 ± 0.23^{c}	0
	0 + 7	85 ± 18^{de}	8.42 ± 2.40^{c}	11.5 ± 0.4^{a}	1.72 ± 0.06^{c}	0.23 ± 0.11^{a}	4.8 ± 0.6^{a}
Sorriso Di Primavera	0	58 ± 3^{c}	0.20 ± 0.02^{a}	11.3 ± 0.2^{a}	1.09 ± 0.04^{a}	0.29 ± 0.07^{a}	0
	0 + 7	56 ± 19^{bc}	8.07 ± 3.61^{c}	10.8 ± 0.2^{a}	1.04 ± 0.02^{a}	0.13 ± 0.02^{a}	5.1 ± 0.7^{a}
Shiro	0	47 ± 1^{b}	0.09 ± 0.01^{a}	10.8 ± 0.6^{a}	1.66 ± 0.02^{c}	0.69 ± 0.13^{c}	0
	0 + 7	42 ± 13^{ab}	0.31 ± 0.18^{a}	11.1 ± 0.8^{a}	1.64 ± 0.03^{c}	0.42 ± 0.08^{b}	4.9 ± 1.6^{a}
Aphrodite	0	66 ± 27^{cde}	25 ± 18^{d}	13.3 ± 0.4^{b}	2.51 ± 0.07^{d}	1.17 ± 0.58^{cd}	0
	0 + 7	91 ± 7^{e}	86 ± 23^{e}	13.2 ± 0.3^{b}	2.47 ± 0.19^{d}	0.67 ± 0.59^{bcd}	5.1 ± 0.7^{a}
Toptaste	0	36 ± 3^{a}	0.13 ± 0.09^{a}	17.3 ± 0.7^{c}	1.25 ± 0.01^{b}	1.45 ± 0.13^{e}	0
	0 + 7	48 ± 13^{ab}	97 ± 34^{e}	20.8 ± 0.4^{d}	1.23 ± 0.02^{b}	0.52 ± 0.30^{b}	6.7 ± 1.4^{b}

For the difference symbols ($^{a–e}$), the values were statistically different at the 0.05 level of significance.

Asian cultivars because the very low initial concentration increased extremely after 7 days of storage at 20°C (Table 1). A statistically significant difference ($p = 0.05$) in ethylene production was found between the fruits of "Aphrodite" along with "Toptaste" after 7 days storage and all other cultivars (Table 1).

Soluble solids content (SSC)

The soluble solids content of all fruits of Asian cultivars ranged between 10.8% and 13.3%, with virtually no change after 1 week of storage max. of ± 0.5% (Table 1). For the European cultivar "Toptaste" the initial value was higher and after a week of storage it increased to (Table 1). The reason may be higher weight losses than in other cultivars and also the change of starch to sucrose. A statistically significant difference in the value of soluble solids content was found between the "Toptaste" fruits and the fruits of all other cultivars, as well as between the "Aphrodite" fruits and the fruits of all other cultivars.

Titratable acidity (TA)

Titratable acidity ranged between 1.1% and 2.5% (Table 1). The Asian cultivar fruits had statistically comparable or higher titratable acidity compared to the "Toptaste" fruits (Table 1). The highest TA values were measured in the fruits of "Aphrodite". The lowest acid concentration was measured in the fruits of "Sorriso Di Primavera". No statistically significant differences were found between the values at harvest and after 7 days of storage for all cultivars (Table 1).

Firmness

A decrease in fruit firmness was observed for all cultivars during 7 days of storage (Table 1). "Toptaste" fruits showed the highest firmness at the beginning of storage; after 7 days of storage there was a statistically significant decrease to a value of (Table 1). The lowest fruit firmness was measured for "Sorriso Di Primavera" (Table 1), where after 7 days of storage the fruit firmness was very low, similar to that of "Santa Rosa", making the fruits of these cultivars not appropriate for this type of storage, as shown by the statistically significantly lower firmness of the other three cultivars (Table 1). "Shiro" had the lowest CO_2 and ethylene production after 7 days of storage, and, as well, the decrease in fruit firmness was the lowest after 7 days; as a result, "Shiro" appears to be a suitable cultivar for this type of storage.

Weight loss (WL)

Fruit weight loss after 1 week of storage ranged between 4.80% and 5.12% for the Asian cultivars (Table 1). For the European cultivar "Toptaste", the weight loss was higher6. Fruits of this cultivar were statistically significantly different from those of Asian cultivars (Table 1).

Long-term storage at low temperature

Carbon dioxide (CO_2)

Storage at low temperature (1°C) resulted in a statistically significant reduction in CO_2 production for all the cultivars studied (in order "Toptaste", "Sorriso Di Primavera" and "Aphrodite") from the initial values in the order of tens (35.8, 57.7 and 65.9 mg/kg/h) to the order of units (1.9–6.5 mg/kg/h) in each of the three storage periods at 1°C (10; 20 and 30 days); (Figure 2). When the temperature (1°C) was changed from RA/ULO to shelf-life conditions, CO_2 production again statistically significantly increased for all the three cultivars. For example, values of 33.8–59.0 mg/kg/h were measured for "Toptaste", which was comparable to the postharvest concentration (36 mg/kg/h). The same applied to "Sorriso Di Primavera". After removal from the store, the respiration rate of "Sorriso Di Primavera" and "Toptaste" was higher under RA than ULO conditions in almost all cases, and for "Aphrodite" fruit this was true only on day 10 of removal from storage. These differences between the use of RA or ULO were not statistically significant $p = 0.05$ (Figure 2).

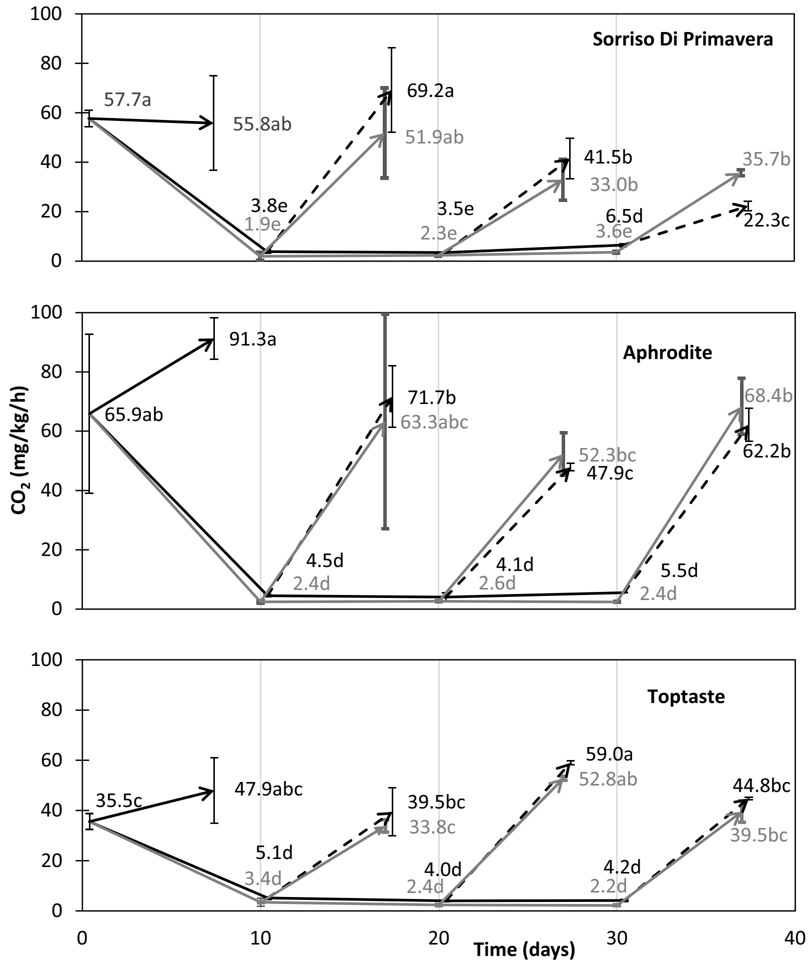

Figure 2. Production of CO_2 at harvest day (day 0) and during storage in a cold room (10, 20 and 30 days) under ULO (gray) and RA (black) conditions and then after removal to shelf-life conditions (10 + 7, 20 + 7, 30 + 7 days) for fruits of two Asian plum cultivars and one European plum cultivar. Difference symbols (a-e) indicate statistically significant differences ($p = 0.05$) between values and were determined for each cultivar separately.

Ethylene

Placement in RA and ULO conditions with 1°C resulted in a decrease in ethylene production in fruit of all cultivars. For “Sorriso Di Primavera”, a decrease was detected from the initial concentration (0.203 µl/kg/h) to (0.003–0.030 µl/kg/h); see Figure 3. On day 10 after removal to shelf-life conditions (10 + 7), there was an increase in ethylene production to values around 15 µl/kg/h (RA and ULO), where this value was statistically higher than all others at any of the times (except for shelf life after 7 days). On days 20 and 30 (20 + 7; 30 + 7), ethylene production values were significantly lower compared to day 10 (10 + 7). The highest ethylene production was found for “Toptaste” (114 µl/kg/h and 107 µl/kg/h) on day 20 after removal from ULO and RA to shelf-life conditions (20 + 7). For “Aphrodite” fruits, the highest ethylene production was on day 30 after removal from ULO to shelf-life conditions (98.6 µl/kg/h). The same trend in ethylene production was found for fruit of all cultivars, with a decrease in production from initial values after placement under ULO and RA conditions at reduced temperature. For “Toptaste” and “Aphrodite”, the ethylene production significantly increased when the fruits were placed under shelf-life conditions.

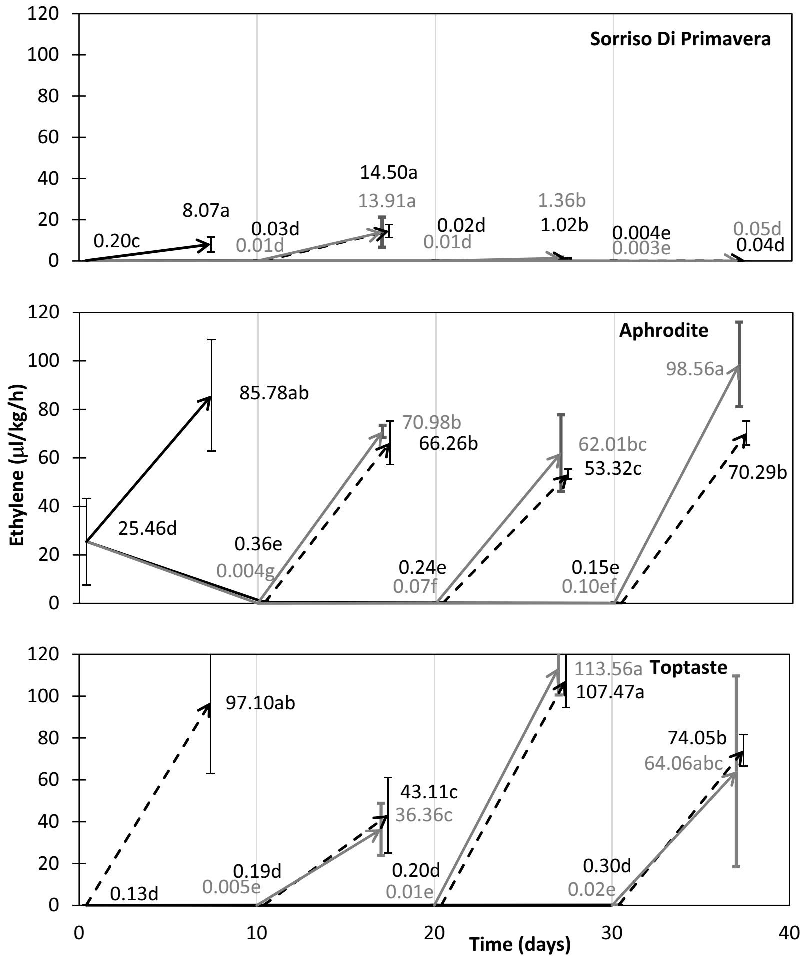

Figure 3. Production of ethylene at harvest day (day 0) and during storage in a cold room (10, 20 and 30 days) under ULO (gray) and RA (black) conditions and then after removal to shelf-life conditions (10 + 7, 20 + 7, 30 + 7 days) for fruits of two Asian plum cultivars and one European plum cultivar. Difference symbols (a-e) indicate statistically significant differences ($p = 0.05$) between values and were determined for each cultivar separately.

The later the "Sorriso Di Primavera" fruits were removed to shelf-life conditions (storage days 20 and 30), the more production dynamics were delayed and the ripening rate was reduced. Based on the physiological response observed, the "Sorriso Di Primavera" fruit can be classified as having a suppressed climacteric phase.

Soluble solids content (SSC)

During storage under ULO and RA conditions, the soluble solids content of "Toptaste" did not change significantly. Storage under shelf-life conditions always resulted in a statistically significant increase in soluble solids content: above 20% (higher values for ULO compared with RA) see Figure 4. The Asian cultivar fruits had lower soluble solids contents at the beginning of storage ("Aphrodite": 13.3% ± 0.4%; "Sorriso Di Primavera": 11.3% ± 0.2%). During storage under RA and ULO conditions and also under shelf-life conditions, no statistically significant differences ($p = 0.05$) were found for "Aphrodite" in terms of soluble solids content.

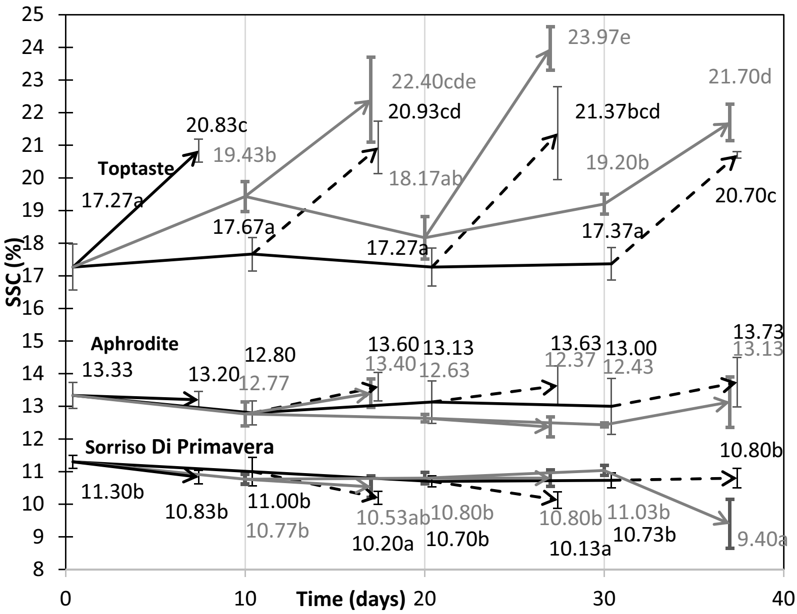

Figure 4. Soluble solids contents at harvest day (day 0) and during storage in a cold room (10, 20 and 30 days) under ULO (gray) and RA (black) conditions and then after removal to shelf-life conditions (10 + 7, 20 + 7, 30 + 7 days) for fruits of two Asian plum cultivars and one European plum cultivar. Difference symbols (a-e) indicate statistically significant differences ($p = 0.05$) between values and were determined for each cultivar separately.

Titratable acidity (TA)

After removing the fruits of the Asian cultivar "Aphrodite" to shelf-life conditions, a decrease in acid content was observed at all dates (10 + 7; 20 + 7; 30 + 7), each time to a value of around 2% see Figure 5. There were statistically significant declines for each of the three times (10 + 7; 20 + 7; 30 + 7). The acidity content of "Sorriso Di Primavera" was almost constant (1.0%–1.2%) throughout the storage period under RA/ULO conditions. A statistically significant decrease was not observed before removal to shelf-life conditions (30 + 7), when the acid content decreased to 0.4% (RA) and 0.7% (ULO). The European cultivar "Toptaste" differed from the Asian cultivars in that a slight increase in acid concentration was observed when stored under shelf-life conditions.

Firmness

A statistically significant decrease in fruit firmness between cold room storage and shelf-life conditions was observed for all the three cultivars. The firmness of the cold-stored fruits ranged throughout the storage period between 0.8 and 1.0 N/mm^2 "Aphrodite" and 1.1–1.3 N/mm^2 "Toptaste". When stored under shelf-life conditions, the fruit firmness of both cultivars decreased to 0.2–0.5 N/mm^2. A similar trend was noted for "Sorriso Di Primavera", where there was a decrease from the initial value of 0.30 N/mm^2 to 0.10–0.15 N/mm^2. No statistically significant difference was found between ULO and RA type atmospheres in terms of firmness. The only exceptions were three times (20 + 7; 30 + 0 and 30 + 7) for "Toptaste". At all times, fruits retained greater firmness in the ULO atmosphere than in the RA atmosphere.

Weight loss (WL)

Fruit weight loss during cold room storage increased with storage duration (10, 20 and 30 days) for all cultivars; the ranges were as follows: 0.49%–6.91% "Aphrodite"; 1.77%–5.73% "Toptaste"; 1.14%–4.78% "Sorriso Di Primavera". In all cases, the weight loss in the RA atmosphere was higher than in the ULO atmosphere. For example, for the "Aphrodite" fruit there was a difference

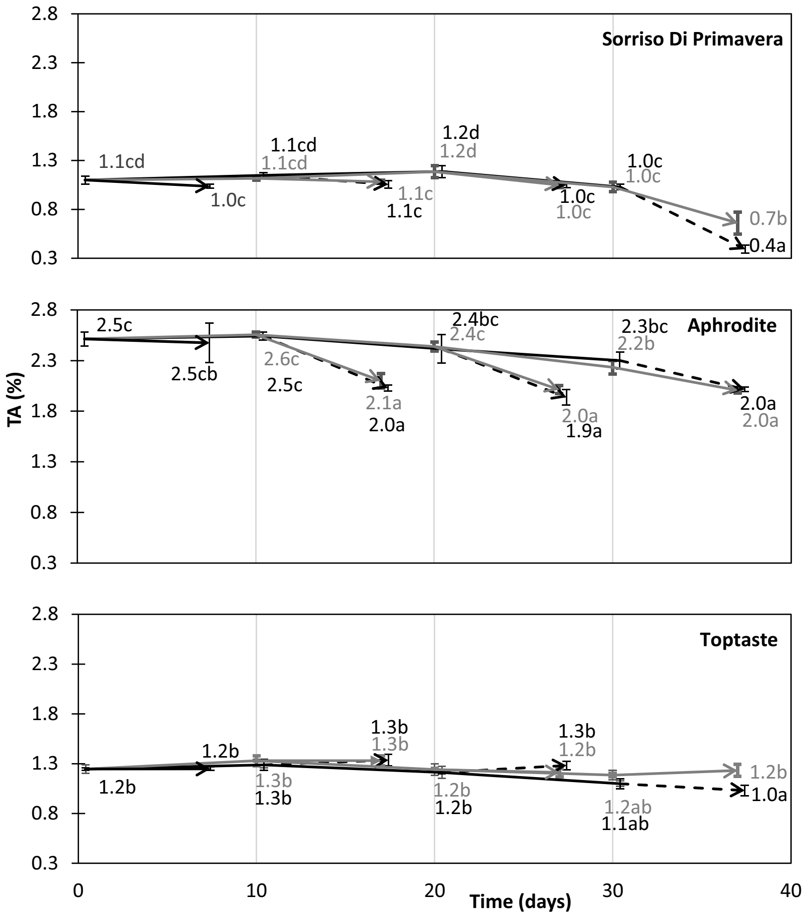

Figure 5. Titratable acidity at harvest day (day 0) and during storage in a cold room (10, 20 and 30 days) under ULO (gray) and RA (black) conditions and then after removal to shelf-life conditions (10 + 7, 20 + 7, 30 + 7 days) for fruits of two Asian plum cultivars and one European plum cultivar. Difference symbols (a-d) indicate statistically significant differences ($p = 0.05$) between values and were determined for each cultivar separately.

of up to 5% (1.89% vs. 6.91%). After 30 days of storage in the RA atmosphere, "Aphrodite" was found to feature the highest weight loss (6.91%) and "Sorriso Di Primavera" the lowest (4.78%). After 30 days of storage in the ULO atmosphere, the highest weight loss was found for "Toptaste" (5.26%) and the lowest for "Aphrodite" (1.88%).

In particular, the low storage temperature (1°C) had a significant effect on the production of gases (CO_2 and ethylene), as well as on the soluble solids content, titratable acidity, firmness and weight loss. The ULO atmosphere was essential for maintaining greater fruit firmness as well as for reduced weight loss.

Discussion

To slow down ripening and preserve the quality of plums, rapid cooling down and storing the fruits at 0–1°C is recommended. However, if the fruit is stored for long periods at temperatures below zero, symptoms of chilling injury may develop (Manganaris et al., 2008). Conversely, a higher temperature (5°C) is not low enough to significantly reduce the rate of ripening, resulting in a limited storage period (maximum of 2 weeks) (Singh, 2010).

Carbon dioxide (CO_2)

As is known, low temperature and the use of ULO atmosphere with low oxygen content have a significant effect on the reduction of fruit respiration rate (Tzortzakis and Metzidakis, 2012). This was confirmed by results where CO_2 production was lower at 1°C than at 20°C (around 4 mg/kg/h vs. 50 mg/kg/h) and even slightly lower for ULO than RA. Luo et al. (2010) measured carbon dioxide content within an 18-day storage period in the tens of mg/kg/h; more specifically, the range was 20–55 mg/kg/h.

Ethylene

The increased value corresponded to some extent with higher CO_2 production. This fact has also been confirmed for other fruits (Goliáš et al., 2015). In contrast, Luo et al. (2010) analyzed the potential of Hot Air Treatment (HAT) instead of refrigeration for the "Qingnai" cultivar, where ethylene concentrations were up to 50 µl/kg/h during 18 days of storage (average of our three measured cultivar is around 40 µl/kg/h).

Soluble solids content (SSC)

Kwon et al. (2018) examined the fruit of 63 Asian plum cultivars. For the evaluation of fruit characteristics, 30 fruits from each cultivar were used in every instance. The soluble solids content was evaluated as well. The average value of soluble solids content of "Santa Rosa" was 11.9%. For Asian cultivars measured by Xiao et al. (2024), soluble solids contents ranged between 9.4% and 15%. In their European plum cultivar study, Taiti et al. (2019) found a soluble solids content of 8.7%–15.9%, while "Toptaste" showed a similar value (17.3%). Zhu et al. (2023) measured similar soluble solids content ranging from 10% to 14% at 20 days storage. Luo et al. (2010) measured a soluble solids content of 12.5% for the "Qingnai" plum cultivar, which was similar to "Aphrodite"/"Sorriso Di Primavera" (around 12%). Hao et al. (2024) addressed the storage of "Guofeng No.7" (*Prunus salicina* Lindl.) plum fruit. The fruits were stored for 49 days and monitored for soluble solids contents, which ranged between 16% and 20%, which in the present study corresponds to the values found for "Toptaste" (around 21%).

Titratable acidity (TA)

In their European plum cultivar study, Taiti et al. (2019) measured a slightly lower titratable acidity (0.49%–1.09%) than in the "Toptaste" fruits harvested at technological ripeness (around 1.2%). Xiao et al. (2024) observed Asian cultivars fruits at consumption ripeness, where the titratable acidity was half that, at 0.5%–1.2%. Zhu et al. (2023) monitored the acid content during 20 days of storage, which decreased in the course of storage. For 49 days storage of "Guofeng No.7", an Asian plum cultivar, Hao et al. (2024) measured the titratable acidity to be around 1.8%, which in the present study corresponds to the values found for "Aphrodite" (around 2% for 37 days).

Firmness

Zhu et al. (2023) monitored three plum cultivars during storage at 20°C for 20 days, where fruit firmness decreased from initial values of 0.6–1.1 N/mm^2 to 0.2–0.8 N/mm^2 during storage (from our five measured cultivar after 7 days it was from 0.29–1.45 N/mm^2 to 0.13–0.67 N/mm^2).

Conclusion

The Asian cultivars, compared to the European cultivar "Toptaste", shared the feature of high content of titratable acidity in the fruit at the time of technological ripeness along with a greater fruit firmness, suitable for market handling or extending the shelf life in cold room storage.

Based on the physiological response observed, the “Sorriso Di Primavera” fruit can be classified as having a suppressed climacteric phase. On the other hand, fruits of the Asian cultivar “Aphrodite” responded to removal from cold storage and ULO conditions to shelf-life conditions (20°C) in the same manner as fruits of the European cultivar “Toptaste”, each time with a rapid commencement of ethylene production and ripening of the fruit, i.e. with the climacteric phase.

In particular, the low storage temperature (1°C) had a significant effect on the production of gases (CO_2 and ethylene), as well as on the soluble solids content, titratable acidity, firmness and weight loss.

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