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Effect of The Storage Period on the Antioxidant Properties of Different Watermelon Cultivars Grown in Tunisia[#]

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ABSTRACT

Postharvest storage conditions frequently affect nutritional quality of fruits and vegetables. Temperature and storage duration are the most important factors to extend shelf life and maintain quality of fresh watermelon. This study was conducted to determine the changes in the antioxidant properties of watermelon during storage. Fruits of the watermelon cultivars were harvested and stored at 5ºC for a period of 15 days. During storage antioxidant contents (lycopene and total phenolics) and total antioxidant activity were evaluated. The objective of this work was to determine the content of the antioxidant properties in different watermelon genotypes at four different postharvest storage periods (0, 5, 10 and 15 days). Furthermore, the nutritional quality is strongly influenced by the storage period. The cv Mahdia was the most suitable for extended storage periods.

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Introduction

Fruits and vegetables are rich in functional components such as minerals and bioactive phytochemicals. Increased intake of fresh fruits and vegetables is linked to a lower risk of contracting major degenerative diseases such as cancer, cataracts, diabetes, Alzheimer and Parkinson disease (Ilahy et al., 2011; Tlili et al., 2011; Liu., 2013; Tomé-Carneiro and Visioli., 2016; Sevindik et al., 2017; Kına et al., 2021; Uysal et al., 2021). Watermelon is now widely regarded as a "functional food" and popular fruit that contains key nutritional and bioactive elements that provide a variety of health advantages.

Melon has a wide range of antioxidants.The accumulation and degradation of antioxidant compounds in fruits are influenced by cultivars, cultural practices, maturity at harvest and storage condition. Post-harvest losses and quality degradation lead to nutritional loss in stored fruits. Fresh produce's nutritional quality indicators fluctuate with time, and measurement is required to estimate shelf life (Baltazari et al., 2019).

Depending on storage conditions, various metabolic processes such as respiration lead to deterioration and can significantly impact the quality and shelf life of fruits and vegetables. Cold storage is the most frequently used practice to decrease metabolic activity (Ziv and Fallik., 2021).

In recent years, a large number of studies have been conducted regarding the postharvest conservation of various fruits. (Araújo et al 2017) however, research on the impact of environmental variables on the functional quality of watermelon fruits is limited.

Materials and Methods

Watermelon Harvest and Sampling

Four watermelon cultivars consisting of three commercial cultivars Giza, Mahdia, Local Sidi Bouzid, and the recently developed hybrid P P608 F1 were used from the trials conducted at the Teboulba Research and Experimental Station in Monastir, Tunisia. Sampling was performed from mature watermelon fruits. A number of 3 injury-free watermelon fruits were randomly hand harvest per cultivar and replicate. Watermelon fruits were stored in the dark at 5 ± 0.5 ° C in a refrigerator, for variable time periods (0, 5, 10 and 15 days), to simulate common retail outlets and home storage temperatures.

Extraction Procedure

Lycopene

Tlili et al. (2011) described the extraction and determination of lycopene. The approach employs an hexane/ethanol/acetone (2/1/1 by volume) mixture containing 0.05% BHT. Some measures were taken throughout the extraction procedure, such as operating in a low-light environment and enclosing glass items in aluminum foil to prevent lycopene loss due to photooxidation. The absorbance of the hexane extract was measured at 503 nm using a PG 60 Instruments spectrophotometer and lycopene molar extinction e = 17.2* 104 M^{-1} cm^{-1} in n-hexane was used to determine lycopene concentration, which was given as mg/kg fw.

Total phenols

Total phenols were extracted using triple separate sample (0.3 g) of each fraction as outlined by Tlili et al. (2011). Each sample received 5 mL of 80 percent aqueous methanol and 50 L of 37 percent HCl. The extraction was carried out for 2 hours at 4°C with continual shaking (300 rpm). For 15 minutes, samples were centrifuged at 10000 g. The total phenols test was carried out on duplicate 50 L aliquots of supernatant using the Folin-Ciocalteu reagent described by Spanos and Wrolstad (1990). A PG 60 Instruments spectrophotometer was used to measure absorbance at 750 nm. The standard curve's linear reading ranged from 0 to 300 g gallic acid equivalent/mL. The results were given in milligrams of gallic acid equivalent (GAE) per kilogram of wheat. Because sugars may interact with total phenolic content in samples with high sugar levels, total phenolic contents were determined.

Total antioxidant activity assay

The antioxidant activity of hydrophilic and lipophilic extracts (HAA and LAA) was determined using the ABTS (2, 2'-Azino-Bis-3-Ethylbenzothiazoline-6-Sulfonic Acid diammonium salt) decoloration technique (Pellegrini et al., 2007). Hydrophilic and lipophilic antioxidants were extracted from three replicated samples of 0.3 g homogenous juice for 12 hours at 4° C and 300 rpm continuous shaking using 50 % methanol or 50 % acetone, respectively. The samples were centrifuged at 10000 g for 7 minutes, and the varied supernatants were quantified. The antioxidant activity was measured at 734 nm using a PG 60 Instruments spectrophotometer, and the data were reported as total antioxidant activity (TAA = HAA + LAA) and given as µM Trolox 100 g^{-1} fw.

Results and Discussion

Lycopene Content

The lycopene content of the watermelon cultivars over the storage period ranged from 49.16 to 70.64 (Mahdia), 66.27 to 114.71 (Giza), 63.91 to 83.41 (P608 F1) and 23.03 to 47.99 mg kg^{-1} fw (Local Sidi Bouzid) (Figure 1).

Regardless the storage period, significant variation ($P<0.05$) was recorded for lycopene content in watermelon cultivars. The values for lycopene ranged from 47.99 - 114.71 mg 100^{-1} g fw in freshly harvested fruits. Regardless of the variety, there was a remarkable (31.76%) decrease in lycopene content after 15 days storage at 5°C. The lycopene content showed a small decrease during 5 ° C storage for the first five days, and showed some decline towards the end of the storage period. The decrease started to become significant only after 10 days of storage, when it diminished by about 9-30%. The most remarkable decrease was found in the local variety Sidi Bouzid for which the lycopene content was reduced by approximately 52%. For P608 F1, the losses is less remarkable, and was around 24 %. The present results are in conformity with the finding of Perkins-Veazie and Collins (2006) who reported that the bioactive antioxidant compounds in watermelons can be affected by temperature and storage and that the amounts of lycopene produced decreased at 5° C storage temperatures. Previously, Perkins-Veazie and Collins (2004) also highlighted the excellent stability of watermelon lycopene during storage. They evaluated lycopene stability and other quality factors in fresh-cut watermelon held for different periods of storage at 2°C. When fresh-cut watermelons were stored over 2 days, they found practically no decrease in lycopene content. The decrease starts to become significant only after 7 days of storage, when it diminished by about 6-11%. Fresh-cut watermelon held for 7 or more days at 2°C had also a slight loss of soluble solids content.

Total Phenolics

The total phenolics in watermelon cultivars over the storage period ranged from 163.32 to 301.88 (Mahdia), 154.13 to 236.87 (Giza), 184.98 to 308.98 (P608 F1) and 142.31 to 257.03 mg GAE kg^{-1} fw (Local Sidi Bouzid) (Figure 2). Regardless the storage period, significant variation ($P<0.05$) was recorded for total phenolic content in the studied watermelon cultivars. The values for lycopene ranged from 236.87 -308.98 mg/100g in freshly harvested =fruits. Regardless of the variety, a remarkable decrease of 35.5% in phenol content was observed after storage at 5 °C for 15 days. Fresh watermelon held for the first five days at 5 °C had also a slight loss of total phenolic content. The decrease starts to become significant only after 10 days of storage, when it diminished by about 7-29%. The highest decrease was found in cultivar Mahdia for which the total phenolics was reduced by approximately 46%. For cultivar Giza, the decrease is less remarkable and was around 35%. Therefore, cultivar Mahdia was the most suitable for prolonged storage periods. To our knowledge, the effects of storage duration on total phenolics have not been yet investigated and these results are the first reported.

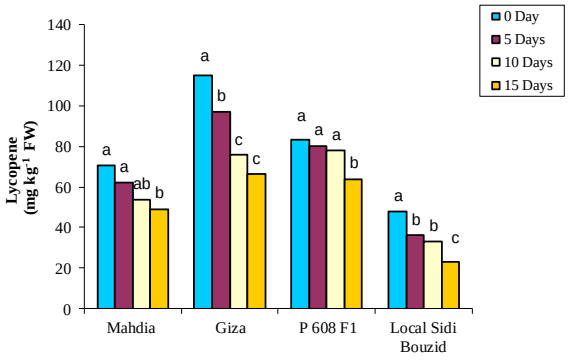

Figure 1. Lycopene content (mg kg^{-1} fw) in different watermelon cultivars during postharvest storage period (0, 5, 10 and 15 days).

Results are average of three independent replicates. Bars marked with the same letter are not significantly different (LSD test, P<0.05).

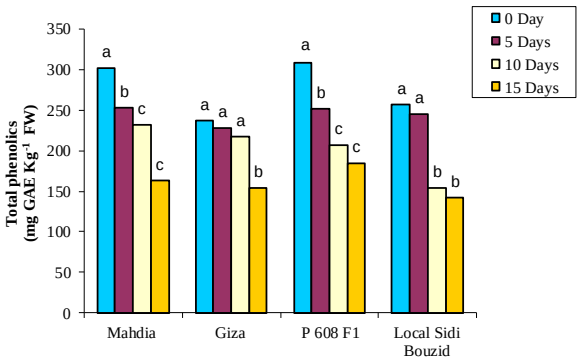

Figure 2. Total phenolics content (mg GAE kg^{-1} fw) in different watermelon cultivars during postharvest storage period (0, 5, 10 and 15 days).

Results are average of three independent replicates. Bars marked with the same letter are not significantly different (LSD test, P<0.05).

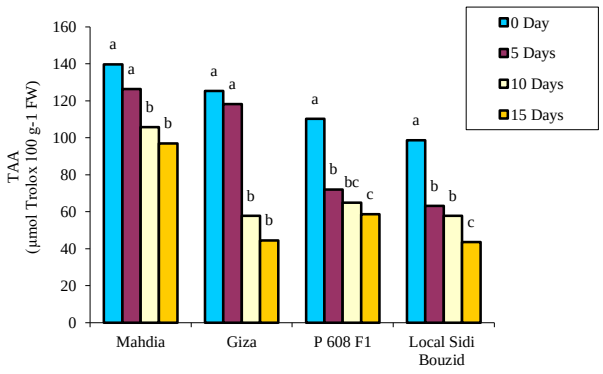

Figure 3. Total antioxidant activity (µM Trolox 100 g^{-1}) in different watermelon cultivars during postharvest storage period (0, 5, 10 and 15 days).

Results are average of three independent replicates. Bars marked with the same letter are not significantly different (LSD test, P<0.05).

Total antioxidant activity

The total antioxidant activity (TAA) in watermelon cultivars over the storage period ranged from 96,92 to 139,6 (Mahdia), 44.46 to 125.37 (Giza), 58.68 to 110.26 (P608 F1) and 43.57 to 98.70 µmol Trolox 100g^{-1} fw (Local Sidi Bouzid) (Figure 3). Regardless of the storage period, significant variation (P<0.05) was recorded in TAA in the watermelon cultivars. The values for lycopene ranged from 98.7-139.6 µmol Trolox 100 g^{-1} fw in freshly harvested fruits. Regardless of the variety, a remarkable decrease of 51.4% in TAA was observed after storage at 5 °C. for 15 days. Fresh watermelon held for the first five days at 5 °C had also a slight loss of TAA. The decrease started to become significant only after 10 days of storage, when it diminished by about 9-24%. The most important decrease was found in the Giza variety for which TAA was reduced by approximately 65%. For the Mahdia variety, the decrease is less remarkable at around 30%. The presented data are considered as a first insight on the variation of antioxidant activities in watermelon cultivars during storage time.

Conclusion

The nutritional quality of watermelon fruit is strongly influenced by the storage period.This study indicated that watermelon may be stored at 5°C for up to 10 days without marketability and/or nutritional quality compromise. Therefore, watermelon fruits can be considered as fresh between 5-10 days of storage but quality deterrioration may occurs beyond that.

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References

Araújo LDS, Costa EMR, Soares TL, Dos Santos IS, De Jesus ON. 2017. Effect of time and storage conditions on the physical and physico-chemical characteristics of the pulp of yellow and purple passion fruit. Food Sci. Technol 37(3) https://doi.org/10.1590/1678-457X.20616

Baltazari A, Mtuia HD, Mwatawalaa MW, Chovec LM, Msogoyaa T, Samwela J, Subramaniand J. 2020. Effects of Storage Conditions, Storage Duration and Post-Harvest Treatments on Nutritional and Sensory Quality of Orange (Citrus sinensis (L) Osbeck) Fruits. International Journal of Fruit Science, 20(4): 737-749 https://doi.org/10.1080/15538362.2019.1673278

Ilahy R, Hdider C, Lenucci MS, Tlili I and Dalessandro G. 2011. Phytochemical composition and antioxidant activity of high-lycopene tomato (Solanum lycopersicum L.) cultivars grown in Southern Italy. Scientia Horticulturae, 127(3), 255-261. https://doi.org/10.1016/j.scienta.2010.10.001

Kına E, Uysal İ, Mohammed FS, Doğan M, Sevindik M. 2021. In-vitro antioxidant and oxidant properties of *Centaurea rigida*. Turkish Journal of Agriculture-Food Science and Technology, 9(10): 1905-1907.

Liu RH. 2013. Health-Promoting Components of Fruits and Vegetables in the Diet. Advances in Nutrition, 4: 384S–392S. https://doi.org/10.3945/an.112.003517

Pellegrini N, Colombi B, Salvatore S, Brenna O, Galaverna G, Del Rio D. 2007: Evaluation of antioxidant capacity of some fruit and vegetable foods: efficiency of extraction of a sequence of solvents. J. Sci. Food Agr, 87:103-111. https://doi.org/10.1002/jsfa.2682

Perkins-Veazie P, Collins JK. 2004. Flesh quality and lycopene stability of fresh-cut watermelon. Postharvest Biology and Technology, 31(2): 159-166. https://doi.org/10.1016/j.postharvbio.2003.08.005

Perkins-Veazie P, Collins JK. 2006. Carotenoid changes of intact watermelons after storage. Journal of agricultural and food chemistry, 54(16): 5868-5874. https://doi.org/10.1021/jf0532664

Sevindik M, Akgul H, Pehlivan M, Selamoglu Z. 2017. Determination of therapeutic potential of *Mentha longifolia* ssp. *longifolia*. Fresen Environ Bull, 26(7): 4757-4763.

Spanos GA, Wrolstad RE. 1990. Influence of processing and storage on the phenolic composition of Thompson Seedless grape juice. J. Agric. Food. Chem. 38: 1565-1571. https://doi.org/10.1021/jf00097a030

Tlili I, Hdider C, Lenucci M S, Ilahy R, Jebari H and Dalessandro G. 2011. Bioactive compounds and antioxidant activities of different watermelon (Citrullus lanatus (Thunb.) Mansfeld) cultivars as affected by fruit sampling area. Journal of food composition and analysis, 24: 307-314. https://doi.org/10.1016/j.jfca.2010.06.005

Tomé-Carneiro J, Visioli F. 2016. Polyphenol-based nutraceuticals for the prevention and treatment of cardiovascular disease: Review of human evidence. Phytomedicine, 23(11):1145-74. https://doi.org/10.1016/j.phymed.2015.10.018

Uysal İ, Mohammed FS, Şabik AE, Kına E, Sevindik M. 2021. Antioxidant and Oxidant status of medicinal plant *Echium italicum* collected from different regions. Turkish Journal of Agriculture-Food Science and Technology, 9(10): 1902-1904.

Ziv C, Fallik E. 2021. Postharvest Storage Techniques and Quality Evaluation of Fruits and Vegetables for Reducing Food Loss. Agronomy, 11(6):1133 https://doi.org/10.3390/agronomy11061133