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Effect of postharvest edible coating materials on sugar and organic acid content of fresh-cut melons grown with different fertilizer treatments

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Abstract: The demand for convenient and ready-to-eat food has increased, including fresh-cut fruit and vegetables. At the same time, people are also becoming more health-conscious and are aware of the positive impact of healthy food choices on their well-being. Fresh-cut fruit and vegetables are seen as a healthy and convenient option that allows people to meet their nutritional needs without sacrificing their busy lifestyles. This study examines the use of sustainable fertilization practices for growing melons and the application of edible coatings on fresh-cut fruit to preserve their freshness and levels of sugar and organic acids during storage. The cv. '*Kırkağaç*' melon was used as the plant material. In the current study, the materials needed for preharvest fertilizer applications (humic acid, liquid worm fertilizer, and organomineral fertilizer) were obtained from a commercial company. The materials needed for postharvest edible coating (sodium alginate, pectin, and carob gum) were obtained from a different company. According to the results, the total sugar content of the melons increased as they ripened, but the application of an edible pectin coating helped to control this increase in sugar content better than the other treatments. This is because the pectin coating slowed down the ripening process by reducing the rate of respiration and ethylene release. The results of the study indicated that there were significant differences ($p < 0.05$) observed between the control group and the samples treated with edible coatings in all parameters measured. In summary, this study suggests that sustainable fertilization practices could be a viable option for cultivating melons, and that edible coatings could be used as novel materials in commercial treatments to maintain the quality of fresh-cut melons during storage.

Key words: Edible coating, fresh-cut, melon, organic acid

1. Introduction

Melon (*Cucumis melo* L.) is a popular vegetable of the Cucumis genus in the Cucurbitaceae family that is grown in tropical, subtropical and temperate regions worldwide. The global production of melons is 28,467,920 t on an area of 1,068,238 ha. Turkey is the second-largest producer of melons, following China, producing 1,724,856 ton an area of 76,129 ha. (Anonymous, 2020). Studies have shown that melons have several health benefits, such as antidiabetic, anticancer, antiplatelet, antiparasitic, antioxidant, antiinflammatory, hepatoprotective, diuretic and analgesic properties (Vouldoukis et al., 2004; Cui et al., 2007; Lester, 2008; Chan et al., 2010; Milind and Kulwant, 2011; Rodriguez-Perez et al., 2013; Ittiyavirah et al., 2015).

Melons are sweet and refreshing fruits that are known for their high sugar content. However, they also contain a variety of organic acids, which can provide a number of health benefits. Organic acids found in melons include citric acid, malic acid, and tartaric acid. These acids give melons their characteristic sour taste and can help to stimulate the production of saliva and stomach acid, which can aid in digestion (Mennah-Govela and Bornhorst, 2021). They also play a role in the metabolism of sugars, helping to regulate blood sugar levels and prevent the spike in blood sugar associated with consuming high sugar foods. Citric acid is one of the most common organic acids found in melons. It has been shown to have antioxidant properties and may help to protect against cell damage caused by free radicals. Wu et al. (2020) found that cantaloupe melons were a rich source of antioxidants, including citric acid. Malic acid is another organic acid found in melons. It is believed to have antiinflammatory effects and may help to reduce muscle soreness and fatigue. Tartaric acid is also present in melons, and it has been found to have antioxidant properties and may help to prevent cell damage caused by free radicals. Salas-Millán et al. (2022) found that watermelon was a rich source of antioxidants including tartaric acid.

In addition to organic acids, melons are also a good source of sugars, including fructose and glucose. These

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sugars provide a quick source of energy and can help to fuel muscle and brain function. Manchali et al. (2021) found that melons were a good source of sugars and had a high sugar content. In summary, melons are rich in organic acids and sugars which provide many health benefits such as antioxidant properties, anti-inflammatory effects, and help to regulate blood sugar levels. Studies have shown this in different species of melons such as cantaloupe, watermelon, and honeydew melons. Melons are a nutritious and refreshing fruit that are packed with essential vitamins and minerals. They are an excellent source of vitamin C, vitamin A, and potassium, which are all important for maintaining optimal health. Additionally, melons are a good source of antioxidants, which can help protect the body against damage from free radicals.

Melons are a good source of hydration, as they are mostly composed of water and electrolytes. This makes them an ideal fruit for people who engage in sports activities, or for people living in hot climates. Melons are also low in calories, making them a good choice for people who are trying to manage their weight (Jiang et al., 2023). Melons are also a good source of dietary fiber, which helps promote healthy digestion. Fiber is important for maintaining regular bowel movements, which can help to prevent constipation and other digestive problems. A single cup of melon provides about 2 g of dietary fiber (Maletti et al., 2022).

The decrease in agricultural land and the rapid increase in human population have led to concerns about insufficient production of food and agricultural products that are essential for human nutrition. The increase in demand for food and agricultural products has accelerated the use of conventional farming, using intensive synthetic inputs, but it has been widely recognized that this production method causes harm to the environment and human health in the long term. These issues have led to the need for environmentally friendly practices.

Organic farming is a production method that is protective of human health and the environment, preserves soil structure, controls diseases and pests with biological methods, and aims to increase productivity as well as improving quality (Kurtar and Ayan, 2004; Çakmakçı and Erdoğan, 2005). In organic farming, unlike the fertilizers used in conventional agriculture, fertilizers that do not harm the environment are used. The goal of organic fertilization is to increase the amount of organic matter and microbial activity in the soil (Gül et al., 2000).

The increase in demand for high-quality and reliable agricultural products as a result of changing living standards cannot be met solely by increasing agricultural production. In addition to production, it is also important to preserve the product without losing its quality during storage. In this context, the importance of treatments called edible films or coatings has increased in recent years to extend the shelf life of products and preserve their freshness and quality (Hashemi et al., 2021).

As a result of modern technology, “fast” living has become a necessity for people. People are also becoming more aware of which foods have a positive or negative effect on health. Therefore, on the one hand, individuals demand safe and healthy food; on the other hand, the demand for ready-made food is increasing since it is practical and makes life easier. This situation has especially accelerated the trend towards sliced fresh fruits and vegetables. The demand for fresh-cut melons has increased due to the large size of the fruit and their high cost. In this study, sustainable fertilization practices are used to grow melon, and edible coatings are applied to fruit after slicing in order to preserve fresh-cut fruit and the amount of sugar and organic acids during storage.

The postharvest maintenance of organic acids in fruit important for several reasons: a) Flavor and taste-Organic acids play a crucial role in determining the flavor and taste of fruit. Maintaining the levels of organic acids in fruit postharvest helps to preserve their taste and quality (Zhang et al., 2021). b) Preservation - Organic acids act as natural preservatives by inhibiting the growth of harmful microorganisms and slowing down the oxidation process. Maintaining the levels of organic acids in fruit post-harvest helps to extend their shelf life (Ben Braïek and Smaoui, 2021). c) Nutritional value-Organic acids are important components of fruit, contributing to their nutritional value. Maintaining the levels of organic acids in fruit postharvest helps to preserve their nutritional quality (Maldonado-Celis et al., 2019). d) Market demand-Consumers increasingly demand high-quality, flavorful, and nutritious fruit. Maintaining the levels of organic acids in fruit postharvest helps to meet these consumer expectations and increase market demand (Liu et al., 2022). e) Shelf life-Organic acids help to preserve the fruit and prevent spoilage, thus increasing its shelf life (Ben Braïek and Smaoui, 2021). f) Economic benefits-Maintaining the levels of organic acids in fruit postharvest helps to reduce waste and increase profitability by increasing the shelf life and marketability of the fruit (Jurić et al., 2023).

To our knowledge, there have been no studies including both preharvest and postharvest sustainable agricultural practices. Therefore, this study includes both preharvest and postharvest sustainable practices and is expected to pave the way for both future studies and commercial implementation to meet the demand for ready and safe food.

2. Material and methods

In the current study, the cv. ‘*Kırkağaç*’ melon was used as the plant material. The materials needed for preharvest fertilizer applications (humic acid, liquid worm fertilizer, and organomineral fertilizer) were obtained from a commercial company. The materials needed for postharvest edible coating (sodium alginate, pectin, and carob gum) were obtained from a different company. Cultivation studies were conducted in Atalan village of Gevaş district, Van province (latitude 38.3216 and longitude 43.1519) in 2020 and 2021. The study area consisted of a total of 9 plots. The plots were 5 m × 5 m in area. Melon seedlings were planted in a single row on a raised bed on May 15th. The row spacing was set at 1.5 m and the plant spacing was set at 0.5 m and 33 plants were planted in each plot.

2.1. Preharvest treatment

Before planting the seedlings, all plots were treated with 2000 cc/da of humic acid through a drip irrigation system for soil preparation. Therefore, only humic acid treated plots were considered as control group. Fifteen days after planting, the other plots were treated with 2000 cc/da of liquid worm fertilizer and 2000 cc/da of organomineral fertilizer through the drip irrigation system. The harvesting process was carried out by hand picking the fruits by drying the auricles and leeches on the fruit stalk (when the peel colour turned from green to light yellow).

2.2. Postharvest treatment

The edible coating solutions, sodium alginate (1% + 1% glycerin), pectin (1% + 1% glycerin), carob gum (1% + 1% glycerin) were prepared in ultra-pure water. Glycerin was added to coating materials to enable them flexibility and adhesive properties. In the study, the samples were taken from at least 5 different fruit per repetition in 3 repetitions, cut into 500 g cube slices with a sharp knife. The whole cut fruit were dipped in the advance-prepared coating solution for 2 min and then dried at 5 °C for 2 h through a ventilator. After drying process, coated-fruit and the control fruit (without treatment) were placed in plastic bags and stored at +5 °C with 90%–95% relative humidity for 12 days. Measurements and analyses were carried out every 4 days.

2.3. Organic acid

Six different stock solutions (oxalic, citric, tartaric, malic, succinic, and fumaric) were prepared by dissolving in 50 mL of pure water in a brown volumetric flask. These stock solutions were then gradually diluted to create five different concentrations (50, 100, 200, 400, and 800 mg L^{-1}).

In the organic acid analysis, the method given by Bevilacqua and Califano, (1989) was used with modifications. Two g of samples were taken and homogenized with 10 mL of ultra-pure water, then centrifuged at 12,000 g for 15 min. The supernatant obtained from the centrifugation was filtered through a 0.45 µm membrane and transferred to vials for reading. High-performance liquid chromatography with a diode array detector (HPLC-DAD) was used to determine specific organic acids (oxalic, citric, tartaric, malic, succinic, and fumaric) in apricot fruit. In summary, 20 µL samples were injected and analyzed on an Inertsil C18 ODS-3 column with a 5 µm particle size (4.6 mm × 250 mm, made in Japan). The chromatographic separation was performed using isocratic analysis at a wavelength of 210 nm and a column temperature of 40 °C, with a flow rate of 4 mL min^{-1} for 35 min. The mobile phase used was 0.009 N H_2SO_4. However, tartaric acid was not found in apricot fruit during analysis. Results were calculated as mg 100 g^{-1}.

2.4. Sugar analysis

The method used in the study was modified from the one used by Melgarejo et al. (2000). In the research, fruit that were pureed with the help of a mixer were weighed at 0.0001 g on a sensitive scale and 20 mL of 85% acetone was added and homogenized in a homogenizer. Then, it was centrifuged at 12,000 rpm for 10 min. The separated liquid portion was first filtered through a coarse filter paper, then through a 0.45 µm membrane filter. The sugars in the obtained fruit samples were determined on an HPLC (Agillent 1100) device with a refractive index detector (IR) with the help of 85% acetonitrile liquid phase at 25 °C with a flow rate of 1 mL/min by using a µBondapak - NH_2 column. The concentrations were calculated based on external standards.

2.5. Statistical analysis

The study, both preharvest and postharvest, was conducted as a completely randomized design with three replications during 2020 and 2021. Years, fertilizer and edible coating treatments were considered as factor. Data was expressed mean ± Standard Error of the Mean (SEM) and were subjected to one-way factorial ANOVA. Duncan's multiple range test comparisons was also used to identify different levels of different groups. Statistical significance level was considered as 5%, and IBM® SPSS 20.0 statistical program (IBM, NY, USA) was used.

3. Results

3.1. Oxalic acid

As shown in Table 1, oxalic acid content decreased regardless of treatment during storage, though, a higher significant ($p < 0.05$) was observed in coated-fruit compared to control fruit. The highest oxalic acid content was found in fruit cultivated with organomineral, liquid vermicompost, and humic acid alone in both years, respectively. On the other hand, pectin-treated fruit resulted in higher oxalic acid content at the end of storage period. There were significant ($p < 0.05$) differences between coated-fruit and control fruit during storage period (Table 1).

3.2. Citric acid

There was a decrease in citric acid content during storage for all treatments compared to the beginning of storage. In

Table 1. Changes in oxalic acid content (mg 100 g^{-1}) during storage. Data are shown as means ± SEM.

	Storage period (d)					
Preharvest treatment	**Postharvest treatment**	**0**	**4**	**8**	**12**	**Means**
			2020			
HA	Control	2.63 ± 0.04 z	2.22 ± 0.04 Bz	2.12 ± 0.01 Dy	1.52 ± 0.05 Dz	2.12 ± 0.12 B
	Carob	2.63 ± 0.04 z	2.47 ± 0.04 Az	2.32 ± 0.01 Bz	2.08 ± 0.02 By	2.37 ± 0.06 Ay
	Sodium alginate	2.63 ± 0.04 z	2.31 ± 0.02 Bz	2.23 ± 0.01 Cz	1.97 ± 0.02 Cy	2.28 ± 0.07 ABy
	Pectin	2.63 ± 0.04 z	2.52 ± 0.01 Az	2.39 ± 0.01 Ax	2.22 ± 0.02 Ax	2.44 ± 0.05 A
LV	Control	2.88 ± 0.06 y	2.42 ± 0.01 Dy	2.15 ± 0.02 Dxy	1.71 ± 0.03 Dy	2.29 ± 0.13
	Carob	2.88 ± 0.06 y	2.58 ± 0.02 By	2.44 ± 0.01 Ay	2.24 ± 0.01 Ax	2.54 ± 0.07 xy
	Sodium alginate	2.88 ± 0.06 y	2.48 ± 0.01 Cy	2.39 ± 0.01 By	2.08 ± 0.01 Bx	2.46 ± 0.09 xy
	Pectin	2.88 ± 0.06 y	2.66 ± 0.01 Ay	2.33 ± 0.01 Cy	1.95 ± 0.02 Cy	2.46 ± 0.11
OM	Control	3.09 ± 0.04 x	2.61 ± 0.03 Cx	2.19 ± 0.02 Cx	2.00 ± 0.02 Cx	2.47 ± 0.13
	Carob	3.09 ± 0.04 x	2.87 ± 0.01 Ax	2.50 ± 0.01 Ax	2.11 ± 0.02 By	2.64 ± 0.11 x
	Sodium alginate	3.09 ± 0.04 x	2.70 ± 0.01 Bx	2.51 ± 0.01 Ax	2.08 ± 0.02 Bx	2.60 ± 0.11 x
	Pectin	3.09 ± 0.04 x	2.84 ± 0.03 Ax	2.35 ± 0.02 By	2.27 ± 0.02 Ax	2.64 ± 0.10
			2021			
HA	Control	2.64 ± 0.03 z	2.28 ± 0.01 Cz	2.13 ± 0.01 Cz	1.98 ± 0.03 Cz	2.26 ± 0.07 y
	Carob	2.64 ± 0.03 z	2.39 ± 0.01 Bz	2.26 ± 0.01 Bz	2.25 ± 0.01 Ay	2.39 ± 0.05 y
	Sodium alginate	2.64 ± 0.03 z	2.42 ± 0.01 Bz	2.34 ± 0.01 Az	2.18 ± 0.02 ABz	2.40 ± 0.05 y
	Pectin	2.64 ± 0.03 z	2.49 ± 0.01 Az	2.36 ± 0.01 Az	2.15 ± 0.03 Bz	2.41 ± 0.06 y
LV	Control	3.09 ± 0.05 y	2.48 ± 0.02 Dy	2.27 ± 0.01 Dy	2.15 ± 0.02 Dy	2.49 ± 0.11 xy
	Carob	3.09 ± 0.05 y	2.70 ± 0.01 By	2.62 ± 0.01 Ay	2.46 ± 0.01 Ax	2.72 ± 0.07 x
	Sodium alginate	3.09 ± 0.05 y	2.62 ± 0.02 Cy	2.44 ± 0.01 Cy	2.25 ± 0.01 Cy	2.60 ± 0.09 y
	Pectin	3.09 ± 0.05 y	2.76 ± 0.01 Ay	2.52 ± 0.02 By	2.38 ± 0.01 By	2.69 ± 0.08 x
OM	Control	3.22 ± 0.02 x	2.76 ± 0.02 Dx	2.62 ± 0.01 Dx	2.33 ± 0.01 Dx	2.73 ± 0.10 x
	Carob	3.22 ± 0.02 x	2.99 ± 0.02 Ax	2.85 ± 0.01 Ax	2.41 ± 0.02 Cx	2.87 ± 0.09 x
	Sodium alginate	3.22 ± 0.02 x	2.86 ± 0.01 Cx	2.73 ± 0.01 Bx	2.52 ± 0.01 Ax	2.83 ± 0.08 x
	Pectin	3.22 ± 0.02 x	2.92 ± 0.01 Bx	2.67 ± 0.01 Cx	2.46 ± 0.01 Bx	2.82 ± 0.09 x

Different capital letters indicate the difference among 'coating materials' for the same fertilizer application and storage time. Different lowercase letters indicate the difference among 'fertilizer applications' for the same storage time and coating material ($p < 0.05$). HA: humic acid, LV: Liquid vermi compost and OM: organomineral.

harvested fruit, the highest citric acid level was obtained from fruit cultivated-liquid vermicompost in 2020, whereas from fruit cultivated-organomineral fertilizer in 2021 (Table 2). During the storage period, the citric acid content was better preserved and showed less change in the fruit treated with sodium alginate and pectin. Significant differences were observed not only among fertilizers treatments but also among coatings treatments in both years ($p < 0.05$).

3.3. Malic acid

Malic acid content decreased in all treatments during storage, though, a higher significant ($p < 0.05$) was observed in pectin-treated fruit. A similar pattern was observed in malic acid as was in citric acid. In other words, the highest malic acid level was obtained from fruit cultivated-liquid vermicompost in 2020, whereas from fruit cultivated-organomineral fertilizer in 2021 (Table 3). Significant ($p < 0.05$) differences existed between coated fruit and control fruit during storage. In addition, significant differences were found among fertilizers treatments in both years.

3.4. Succinic acid

The fruit treated with edible coatings resulted in a higher content of succinic acid when compared with the untreated control fruit at the end of the storage period. The highest

Table 2. Changes in citric acid content (mg 100 g^{-1}) during storage. Data are shown as means ± SEM.

	Storage period (d)					
Preharvest treatment	**Postharvest treatment**	**0**	**4**	**8**	**12**	**Means**
			2020			
HA	Control	231.58 ± 1.69 z	207.77 ± 1.62 Dz	205.25 ± 0.60 Dz	200.73 ± 0.92 Cz	211.33 ± 3.65 By
	Carob	231.58 ± 1.69 z	215.48 ± 0.56 Cz	214.07 ± 0.88 Cy	208.40 ± 2.24 Bz	217.38 ± 2.67 ABz
	Sodium alginate	231.58 ± 1.69 z	220.38 ± 0.74 Bz	217.62 ± 0.93 Bz	212.85 ± 1.51 Bz	220.60 ± 2.15 Az
	Pectin	231.58 ± 1.69 z	225.54 ± 1.04 Az	223.16 ± 0.89 Az	218.13 ± 0.99 Ay	224.60 ± 1.54 Az
LV	Control	321.99 ± 2.01 x	271.25 ± 1.64 Dx	263.39 ± 1.18 Cx	252.36 ± 1.75 Dx	277.25 ± 8.08 x
	Carob	321.99 ± 2.01 x	288.47 ± 2.61 Bx	278.70 ± 7.00 ABx	263.05 ± 0.86 Cx	288.05 ± 6.72 x
	Sodium alginate	321.99 ± 2.01 x	280.99 ± 1.45 Cx	274.23 ± 1.47 BCx	267.02 ± 0.89 Bx	286.06 ± 6.46 x
	Pectin	321.99 ± 2.01 x	299.51 ± 1.81 Ax	288.97 ± 2.87 Ax	272.24 ± 1.05 Ax	295.68 ± 5.51 x
OM	Control	266.05 ± 4.70 y	221.31 ± 1.74 Cy	216.51 ± 1.53 Cy	211.36 ± 1.24 Cy	228.81 ± 6.67 y
	Carob	266.05 ± 4.70 y	234.63 ± 1.44 By	224.87 ± 1.28 By	216.50 ± 0.51 By	235.51 ± 5.76 y
	Sodium alginate	266.05 ± 4.70 y	244.70 ± 0.89 Ay	238.66 ± 2.30 Ay	222.55 ± 0.93 Ay	242.99 ± 4.84 y
	Pectin	266.05 ± 4.70 y	241.29 ± 1.22 Ay	233.55 ± 1.28 Ay	221.10 ± 1.19 Ay	240.50 ± 5.07 y
			2021			
HA	Control	272.55 ± 3.33 z	253.12 ± 0.92 Bz	241.47 ± 1.70 Cy	227.82 ± 2.19 C	248.74 ± 5.04 y
	Carob	272.55 ± 3.33 z	266.45 ± 1.93 Az	253.80 ± 0.97 Az	237.95 ± 1.30 By	257.69 ± 4.09 y
	Sodium alginate	272.55 ± 3.33 z	258.97 ± 2.39 Bz	250.06 ± 0.77 Bz	234.51 ± 0.59 Bz	254.03 ± 4.26 z
	Pectin	272.55 ± 3.33 z	266.32 ± 2.03 Az	257.43 ± 0.91 Az	246.21 ± 0.84 Az	260.63 ± 3.11z
LV	Control	301.25 ± 2.18 y	274.43 ± 1.80 Dy	245.50 ± 1.77 Cy	228.84 ± 0.82 C	262.50 ± 8.38 Bxy
	Carob	301.25 ± 2.18 y	281.99 ± 1.41 Cy	268.37 ± 0.56 By	237.73 ± 1.02 By	272.34 ± 7.00 ABy
	Sodium alginate	301.25 ± 2.18 y	287.53 ± 1.09 By	278.08 ± 1.95 Ay	253.06 ± 2.00 Ay	279.98 ± 5.36 ABy
	Pectin	301.25 ± 2.18 y	293.06 ± 0.92 Ay	285.04 ± 4.57 Ay	256.98 ± 1.26 Ay	284.08 ± 5.15 Ay
OM	Control	322.72 ± 1.41 x	283.39 ± 2.07 Cx	279.09 ± 4.52 Cx	231.87 ± 3.35 C	279.27 ± 9.80 Bx
	Carob	322.72 ± 1.41 x	299.43 ± 1.09 Bx	290.52 ± 1.94 Bx	263.63 ± 1.29 Bx	294.07 ± 6.41 ABx
	Sodium alginate	322.72 ± 1.41 x	312.29 ± 1.91 Ax	294.48 ± 1.72 Bx	276.61 ± 1.21 Ax	301.53 ± 5.34 Ax
	Pectin	322.72 ± 1.41 x	317.24 ± 0.82 Ax	303.68 ± 0.75 Ax	283.47 ± 3.00 Ax	306.78 ± 4.62 Ax

Different capital letters indicate the difference among 'coating materials' for the same fertilizer application and storage time. Different lowercase letters indicate the difference among 'fertilizer applications' for the same storage time and coating material ($p < 0.05$). HA: humic acid, LV: Liquid vermi compost and OM: organomineral.

content of succinic acid was found in the pectin-treated fruit, followed by sodium alginate-treated fruit after 12 days of storage period. On the other hand, the highest succinic acid level was observed from fruit cultivated-organomineral fertilizer in harvested fruit. Significant differences ($p < 0.05$) were observed not only among fertilizers treatments but also among coatings treatments in both years (Table 4).

3.5. Fumaric acid

The content of fumaric acid in fruit reduced in all treatments as storage time increases. However, the fumaric acid were significantly higher ($p < 0.05$) in coated-fruit during storage (Table 4). A similar pattern was observed in malic acid as was in succinic acid, that is, the highest fumaric acid content was obtained from fruit cultivated-organomineral fertilizer in both years. Significant differences were observed among fertilizers treatments during 2020 and 2021 (Table 5).

3.6. Fructose

Fructose content in fresh-cut melon was found to increase during storage in all treatments during storage, however, coated-treated fruit was shown the lower a increase compared to other treatments and control fruit. During storage, the lowest increase was found in sodium alginate-

Table 3. Changes in malic acid content (mg 100 g^{-1}) during storage. Data are shown as means ± SEM.

	Storage period (d)					
Preharvest treatment	Postharvest treatment	0	4	8	12	Means
			2020			
HA	Control	213.91 ± 2.35 y	204.48 ± 0.65 By	189.07 ± 1.23 Cy	177.61 ± 0.59 Cz	196.27 ± 4.25
	Carob	213.91 ± 2.35 y	206.94 ± 0.94 Bz	196.54 ± 0.50 Bz	185.42 ± 0.58 By	200.70 ± 3.30 y
	Sodium alginate	213.91 ± 2.35 y	211.05 ± 1.22 Ay	204.15 ± 0.89 Ay	194.60 ± 1.37 Ay	205.92 ± 2.34 y
	Pectin	213.91 ± 2.35 y	211.82 ± 0.71 Az	205.47 ± 0.61 Az	193.20 ± 0.58 Az	206.10 ± 2.50 y
LV	Control	238.17 ± 5.34 x	219.05 ± 1.08 Dx	195.24 ± 0.64 Dx	186.06 ± 0.73 Dx	209.63 ± 6.27 B
	Carob	238.17 ± 5.34 x	223.92 ± 0.90 Cx	207.25 ± 1.49 Cx	192.59 ± 0.41 Cx	215.48 ± 5.31 ABx
	Sodium alginate	238.17 ± 5.34 x	229.96 ± 0.81 Bx	217.18 ± 1.49 Bx	202.38 ± 0.52 Bx	221.92 ± 4.25 ABx
	Pectin	238.17 ± 5.34 x	235.69 ± 0.68 Ax	223.10 ± 0.85 Ax	205.10 ± 0.61 Ax	225.52 ± 4.12 Ax
OM	Control	222.10 ± 1.32 y	204.57 ± 1.80 Cy	195.96 ± 1.89 Cx	183.01 ± 1.01 Cy	201.41 ± 4.33
	Carob	222.10 ± 1.32 y	214.01 ± 1.55 ABy	202.18 ± 0.64 By	193.52 ± 0.98 Bx	207.95 ± 3.33 xy
	Sodium alginate	222.10 ± 1.32 y	210.21 ± 0.59 By	199.49 ± 0.38 Bz	195.12 ± 0.21 By	206.73 ± 3.16 y
	Pectin	222.10 ± 1.32 y	215.53 ± 0.56 Ay	208.09 ± 0.30 Ay	198.09 ± 0.41 Ay	210.95 ± 2.71 y
			2021			
HA	Control	267.47 ± 1.79 z	244.51 ± 1.83 Bz	241.38 ± 0.98 Cy	227.24 ± 1.61 Dy	245.15 ± 4.40 y
	Carob	267.47 ± 1.79 z	252.86 ± 0.99 Az	244.47 ± 0.46 ABz	238.16 ± 0.43 Bz	250.74 ± 3.34 y
	Sodium alginate	267.47 ± 1.79 z	247.58 ± 0.63 Bz	243.57 ± 0.73 BCz	234.06 ± 0.87 Cy	248.17 ± 3.70 y
	Pectin	267.47 ± 1.79 z	254.62 ± 0.49 Az	246.93 ± 0.88 Az	242.34 ± 0.71 Ay	252.84 ± 2.91 y
LV	Control	275.36 ± 1.72 y	255.20 ± 0.82 Dy	245.30 ± 0.87 Dy	231.84 ± 1.55 Dy	251.93 ± 4.82 Bxy
	Carob	275.36 ± 1.72 y	262.99 ± 0.95 By	255.41 ± 1.83 By	244.27 ± 0.71 By	259.51 ± 3.46 ABxy
	Sodium alginate	275.36 ± 1.72 y	269.49 ± 0.91 Ay	260.98 ± 0.42 Ay	253.68 ± 1.43 Ax	264.88 ± 2.54 Ax
	Pectin	275.36 ± 1.72 y	258.62 ± 0.26 Cy	250.13 ± 0.27 Cy	237.65 ± 0.30 Cz	255.44 ± 4.15 ABy
OM	Control	283.31 ± 0.68 x	262.08 ± 1.13 Cx	256.21 ± 1.51 Cx	242.65 ± 0.78 Dx	261.06 ± 4.44 x
	Carob	283.31 ± 0.68 x	269.01 ± 0.30 Bx	263.88 ± 0.95 Bx	252.65 ± 0.78 Bx	267.21 ± 3.34 x
	Sodium alginate	283.31 ± 0.68 x	272.84 ± 0.57 Ax	267.26 ± 0.56 Ax	250.54 ± 0.30 Cx	268.49 ± 3.58 x
	Pectin	283.31 ± 0.68 x	270.31 ± 0.11 Bx	264.89 ± 0.42 ABx	255.60 ± 0.50 Ax	268.53 ± 3.03 x

Different capital letters indicate the difference among 'coating materials' for the same fertilizer application and storage time. Different lowercase letters indicate the difference among 'fertilizer applications' for the same storage time and coating material ($p < 0.05$). HA: humic acid, LV: Liquid vermi compost and OM: organomineral.

treated fruit in 2020, whereas found in pectin-treated fruit in 2021. Fructose content was significantly lower ($p < 0.05$) in coated-fruit compared to untreated fruit. On the other hand, the highest fructose content was determined in fruit cultivated-organomineral, liquid vermicompost, and humic acid, respectively. Furthermore, there were significant differences among fertilizer treatments during storage (Table 6).

3.7. Glucose

A similar pattern was observed in glucose content as was in fructose. In other words, glucose content in fresh-cut melon increased in all treatments as storage time

Table 4. Changes in succinic acid content (mg 100 g^{-1}) during storage. Data are shown as means ± SEM.

	Storage period (d)					
Preharvest treatment	Postharvest treatment	0	4	8	12	Means
			2020			
HA	Control	67.33 ± 0.77 z	46.43 ± 0.58 Dz	41.20 ± 0.65 By	32.98 ± 0.84 Cz	46.98 ± 3.84 y
	Carob	67.33 ± 0.77 z	58.94 ± 1.02 Az	47.61 ± 0.89 Az	43.22 ± 0.37 Az	54.27 ± 2.88 y
	Sodium alginate	67.33 ± 0.77 z	50.48 ± 0.57 Cy	45.77 ± 0.95 Ay	39.81 ± 0.68 By	50.85 ± 3.10 y
	Pectin	67.33 ± 0.77 z	54.33 ± 1.23 Bz	45.24 ± 0.73 Az	44.69 ± 0.47 Az	52.90 ± 2.79 z
LV	Control	80.99 ± 1.48 x	63.63 ± 0.75 Dx	54.69 ± 0.60 Dx	50.96 ± 0.35 Cx	62.57 ± 3.51 Bx
	Carob	80.99 ± 1.48 x	71.25 ± 0.55 Bx	65.35 ± 0.79 Bx	56.71 ± 0.94 Bx	68.57 ± 2.70 ABx
	Sodium alginate	80.99 ± 1.48 x	68.43 ± 0.54 Cx	59.24 ± 0.57 Cx	54.47 ± 0.67 Bx	65.78 ± 3.07 ABx
	Pectin	80.99 ± 1.48 x	75.78 ± 0.65 Ax	69.15 ± 0.54 Ax	62.71 ± 1.06 Ax	72.16 ± 2.12 Ax
OM	Control	73.53 ± 0.53 y	59.11 ± 0.84 Cy	54.02 ± 0.87 Cx	46.96 ± 0.59 By	58.40 ± 2.95 x
	Carob	73.53 ± 0.53 y	64.41 ± 0.60 By	59.02 ± 1.13 By	53.14 ± 1.05 Ay	62.53 ± 2.29 x
	Sodium alginate	73.53 ± 0.53 y	67.24 ± 0.23 Ay	59.27 ± 0.41 Bx	54.27 ± 1.24 Ax	63.58 ± 2.25 x
	Pectin	73.53 ± 0.53 y	64.71 ± 0.43 By	62.71 ± 0.56 Ay	54.74 ± 1.01 Ay	63.92 ± 2.04 y
			2021			
HA	Control	76.70 ± 0.77 y	63.63 ± 0.08 By	61.29 ± 0.73 By	50.82 ± 0.45 Dz	63.11 ± 2.79
	Carob	76.70 ± 0.77 y	67.53 ± 0.65 Ay	64.10 ± 0.50 Ay	58.20 ± 0.43 By	66.63 ± 2.04
	Sodium alginate	76.70 ± 0.77 y	65.17 ± 0.78 By	62.07 ± 0.52 By	55.13 ± 0.11 Cy	64.76 ± 2.36 y
	Pectin	76.70 ± 0.77 y	68.49 ± 0.46 Ay	64.75 ± 0.20 Az	61.35 ± 0.24 Az	67.82 ± 1.73 y
LV	Control	84.41 ± 1.02 x	70.60 ± 0.33 Cx	64.82 ± 0.26 Cx	56.55 ± 1.13 By	69.09 ± 3.08
	Carob	84.41 ± 1.02 x	74.92 ± 1.09 Bx	67.28 ± 0.76 BCx	61.86 ± 0.51 Ax	72.12 ± 2.58
	Sodium alginate	84.41 ± 1.02 x	78.34 ± 0.50 Ax	70.82 ± 0.34 Ax	64.17 ± 0.97 Ax	74.43 ± 2.33 x
	Pectin	84.41 ± 1.02 x	73.58 ± 0.72 Bx	68.43 ± 1.40 ABy	64.78 ± 0.85 Ay	72.80 ± 2.27 xy
OM	Control	82.62 ± 0.70 x	70.57 ± 0.38 Bx	65.10 ± 0.37 Cx	59.35 ± 0.48 Cx	69.41 ± 2.60
	Carob	82.62 ± 0.70 x	73.99 ± 0.44 Ax	65.47 ± 0.49 Cxy	61.68 ± 1.38 BCx	70.94 ± 2.46
	Sodium alginate	82.62 ± 0.70 x	75.62 ± 1.63 Ax	69.46 ± 0.36 Bx	63.79 ± 0.69 Bx	72.87 ± 2.15 x
	Pectin	82.62 ± 0.70 x	75.31 ± 0.43 Ax	72.64 ± 0.54 Ax	67.93 ± 0.45 Ax	74.62 ± 1.62 x

Different capital letters indicate the difference among 'coating materials' for the same fertilizer application and storage time. Different lowercase letters indicate the difference among 'fertilizer applications' for the same storage time and coating material ($p < 0.05$). HA: humic acid, LV: Liquid vermi compost and OM: organomineral.

increased. The lowest increase was observed in coated-fruit compared to untreated fruit. Furthermore, the lowest increase was found in pectin-treated fruit in both years. Significant differences ($p < 0.05$) were observed not only among fertilizers treatments but also among coatings treatments in both years (Table 7).

3.8. Sucrose

The content of sucrose continually increased in all samples throughout storage. On the other hand, coated-fruit showed a higher trend compared with control fruit during storage. Sucrose content in fruit was significantly higher ($p < 0.05$) in coated fruit in both years. In addition, the

Table 5. Changes in fumaric acid content (mg 100 g^{-1}) during storage. Data are shown as means ± SEM.

	Storage period (d)					
Preharvest treatment	Postharvest treatment	0	4	8	12	Mean
			2020			
HA	Control	2.10 ± 0.03 z	1.95 ± 0.01 Bz	1.84 ± 0.01 Dz	1.73 ± 0.01 Dz	1.91 ± 0.04 y
	Carob	2.10 ± 0.03 z	1.99 ± 0.01 Az	1.93 ± 0.01 Bz	1.85 ± 0.01 Bz	1.97 ± 0.03 z
	Sodium alginate	2.10 ± 0.03 z	1.98 ± 0.01 Az	1.89 ± 0.01 Cz	1.79 ± 0.01 Cz	1.94 ± 0.04 z
	Pectin	2.10 ± 0.03 z	1.98 ± 0.01 Az	1.95 ± 0.01 Az	1.92 ± 0.01 Az	1.99 ± 0.02 z
LV	Control	2.37 ± 0.03 y	2.05 ± 0.01 Dy	1.98 ± 0.01 Dy	1.82 ± 0.02 Cy	2.06 ± 0.06 y
	Carob	2.37 ± 0.03 y	2.16 ± 0.01 By	2.08 ± 0.01 By	1.99 ± 0.01 Ay	2.15 ± 0.04 y
	Sodium alginate	2.37 ± 0.03 y	2.11 ± 0.01 Cy	2.02 ± 0.01 Cy	1.94 ± 0.01 By	2.11 ± 0.05 y
	Pectin	2.37 ± 0.03 y	2.20 ± 0.01 Ay	2.11 ± 0.01 Ay	2.02 ± 0.01 Ay	2.18 ± 0.04 y
OM	Control	2.97 ± 0.03 x	2.47 ± 0.01 Dx	2.39 ± 0.01 Dx	2.25 ± 0.01 Dx	2.52 ± 0.08 Bx
	Carob	2.97 ± 0.03 x	2.82 ± 0.01 Bx	2.69 ± 0.01 Bx	2.45 ± 0.02 Bx	2.73 ± 0.06 Ax
	Sodium alginate	2.97 ± 0.03 x	2.67 ± 0.01 Cx	2.47 ± 0.01 Cx	2.34 ± 0.01 Cx	2.61 ± 0.07 ABx
	Pectin	2.97 ± 0.03 x	2.85 ± 0.01 Ax	2.75 ± 0.01 Ax	2.53 ± 0.01 Ax	2.78 ± 0.05 Ax
			2021			
HA	Control	1.54 ± 0.01 y	1.36 ± 0.01 Cz	1.22 ± 0.01 Cz	1.07 ± 0.02 y	1.30 ± 0.05 y
	Carob	1.54 ± 0.01 y	1.44 ± 0.01 Az	1.33 ± 0.01 Az	1.13 ± 0.19 y	1.36 ± 0.06 y
	Sodium alginate	1.54 ± 0.01 y	1.40 ± 0.01 Bz	1.28 ± 0.01 Bz	1.12 ± 0.01 z	1.34 ± 0.05 z
	Pectin	1.54 ± 0.01 y	1.38 ± 0.01 BCz	1.24 ± 0.01 Cz	1.16 ± 0.01 z	1.33 ± 0.04 y
LV	Control	1.81 ± 0.07 x	1.54 ± 0.01 Dy	1.43 ± 0.01 Dy	1.36 ± 0.01 Dx	1.54 ± 0.05 x
	Carob	1.81 ± 0.07 x	1.68 ± 0.01 By	1.53 ± 0.01 By	1.42 ± 0.01 Bxy	1.61 ± 0.05 x
	Sodium alginate	1.81 ± 0.07 x	1.61 ± 0.01 Cy	1.48 ± 0.01 Cy	1.39 ± 0.01 Cy	1.57 ± 0.05 y
	Pectin	1.81 ± 0.07 x	1.73 ± 0.01 Ay	1.60 ± 0.01 Ay	1.49 ± 0.01 Ax	1.66 ± 0.04 x
OM	Control	1.92 ± 0.04 x	1.63 ± 0.01 Dx	1.53 ± 0.01 Dx	1.38 ± 0.01 Dx	1.61 ± 0.06 Bx
	Carob	1.92 ± 0.04 x	1.78 ± 0.01 Bx	1.65 ± 0.01 Cx	1.56 ± 0.01 Bx	1.73 ± 0.04 ABx
	Sodium alginate	1.92 ± 0.04 x	1.83 ± 0.01 Ax	1.76 ± 0.01 Ax	1.61 ± 0.01 Ax	1.78 ± 0.04 Ax
	Pectin	1.92 ± 0.04 x	1.74 ± 0.01 Cx	1.71 ± 0.01 Bx	1.46 ± 0.01 Cy	1.71 ± 0.05 ABx

Different capital letters indicate the difference among 'coating materials' for the same fertilizer application and storage time. Different lowercase letters indicate the difference among 'fertilizer applications' for the same storage time and coating material ($p < 0.05$). HA: humic acid, LV: Liquid vermi compost and OM: organomineral.

highest sucrose content was found in fruit cultivated-organomineral fertilizer. There were significant differences among fertilizer treatments in both years (Table 8).

4. Discussion

Organic acids are an important source of energy for the respiration metabolism in fresh fruit and vegetables, and are also reported to have an impact on the taste of fresh fruit and vegetables in combination with sugars (Kaynaş, 2017). Previous studies have shown to be a decrease in organic acids after harvesting due to their role in sugar synthesis, respiration and neutralization of cations (Chiabrando and Giacalone, 2016; Kaynaş, 2017). Pratt (1971) reported the presence of citric and malic acids in melon. On the other hand, Leach et al. (1989) found that citric acid was the dominant organic acid in melon fruit.

After harvesting, activities such as the respiration process and ethylene production lead to fruit and vegetables ripening. Products that are cut off from their connection to the plant or soil after harvesting cannot structurally rejuvenate, so proteins, fats, carbohydrates, and organic acids found in fruit and vegetables are used during these processes (Wills and Gording, 2016).

Tang et al. (2010) reported that citric and malic acids were the main organic acids found in the 'Xuelihong'

Table 6. Changes in fructose content (%) during storage. Data are shown as means ± SEM.

	Storage period (d)					
Preharvest treatment	Postharvest treatment	0	4	8	12	Means
			2020			
HA	Control	2.13 ± 0.02 z	2.33 ± 0.01 Az	2.45 ± 0.02 Az	2.51 ± 0.04 Az	2.35 ± 0.04 Az
	Carob	2.13 ± 0.02 z	2.18 ± 0.01 Cz	2.28 ± 0.02 BCz	2.31 ± 0.02 Cz	2.23 ± 0.02 Bz
	Sodium alginate	2.13 ± 0.02 z	2.27 ± 0.04 ABz	2.30 ± 0.03 Bz	2.40 ± 0.01 Bz	2.28 ± 0.03 ABz
	Pectin	2.13 ± 0.02 z	2.22 ± 0.01 BCz	2.22 ± 0.01 Cz	2.25 ± 0.01 Cz	2.20 ± 0.01 Bz
LV	Control	2.75 ± 0.03 x	2.93 ± 0.02 Ax	2.95 ± 0.02 Ax	3.07 ± 0.03 Ax	2.92 ± 0.04 Ax
	Carob	2.75 ± 0.03 x	2.83 ± 0.01 Bx	2.88 ± 0.01 Bx	2.93 ± 0.01 Bx	2.85 ± 0.02 ABx
	Sodium alginate	2.75 ± 0.03 x	2.86 ± 0.01 Bx	2.88 ± 0.01 Bx	2.95 ± 0.01 Bx	2.86 ± 0.02 ABx
	Pectin	2.75 ± 0.03 x	2.78 ± 0.01 Cx	2.84 ± 0.01 Bx	2.91 ± 0.01 Bx	2.82 ± 0.02 Bx
OM	Control	2.26 ± 0.03 y	2.58 ± 0.02 Ay	2.61 ± 0.01 Ay	2.71 ± 0.02 Ay	2.54 ± 0.05 Ay
	Carob	2.26 ± 0.03 y	2.34 ± 0.02 By	2.41 ± 0.01 Cy	2.51 ± 0.01 By	2.38 ± 0.03 By
	Sodium alginate	2.26 ± 0.03 y	2.39 ± 0.01 By	2.47 ± 0.01 By	2.55 ± 0.02 By	2.42 ± 0.03 By
	Pectin	2.26 ± 0.03 y	2.34 ± 0.01 By	2.36 ± 0.01 Dy	2.43 ± 0.01 Cy	2.35 ± 0.02 By
			2021			
HA	Control	2.63 ± 0.01 y	2.73 ± 0.01 Az	2.95 ± 0.02 Ay	3.02 ± 0.03 Ay	2.83 ± 0.05 Ay
	Carob	2.63 ± 0.01 y	2.68 ± 0.01 Bz	2.79 ± 0.01 By	2.82 ± 0.02 Cz	2.73 ± 0.02 By
	Sodium alginate	2.63 ± 0.01 y	2.74 ± 0.02 Ay	2.80 ± 0.03 By	2.90 ± 0.01 By	2.77 ± 0.03 ABy
	Pectin	2.63 ± 0.01 y	2.72 ± 0.01 ABy	2.75 ± 0.01 By	2.78 ± 0.01 Cy	2.72 ± 0.02 By
LV	Control	3.25 ± 0.03 x	3.43 ± 0.02 Ax	3.51 ± 0.02 Ax	3.66 ± 0.02 Ax	3.46 ± 0.05 Ax
	Carob	3.25 ± 0.03 x	3.33 ± 0.01 Bx	3.35 ± 0.01 Cx	3.43 ± 0.01 Cx	3.34 ± 0.02 Bx
	Sodium alginate	3.25 ± 0.03 x	3.36 ± 0.01 Bx	3.41 ± 0.01 Bx	3.50 ± 0.01 Bx	3.38 ± 0.03 ABx
	Pectin	3.25 ± 0.03 x	3.27 ± 0.01 Cx	3.34 ± 0.02 Cx	3.39 ± 0.01 Cx	3.31 ± 0.02 Bx
OM	Control	2.67 ± 0.02 y	2.84 ± 0.02 Ay	2.91 ± 0.01 Ay	2.94 ± 0.02 Ay	2.84 ± 0.03 Ay
	Carob	2.67 ± 0.02 y	2.76 ± 0.01 By	2.81 ± 0.01 By	2.91 ± 0.01 Ay	2.79 ± 0.03 ABy
	Sodium alginate	2.67 ± 0.02 y	2.75 ± 0.02 By	2.47 ± 0.01 Cz	2.85 ± 0.02 By	2.69 ± 0.04 BCy
	Pectin	2.67 ± 0.02 y	2.74 ± 0.01 By	2.36 ± 0.01 Dz	2.73 ± 0.01 Cz	2.63 ± 0.05 Cz

Different capital letters indicate the difference among 'coating materials' for the same fertilizer application and storage time. Different lowercase letters indicate the difference among 'fertilizer applications' for the same storage time and coating material ($p < 0.05$). HA: humic acid, LV: Liquid vermi compost and OM: organomineral.

and 'Flavor No. 3' melon cultivars, and that malic acid decreased during storage, while citric acid decreased up to 15th day of storage.

Burger et al. (2003) examined the organic acid content of 'Faqqous', 'A6' and 'F63' melon genotypes. At the end of the study, citric acid content was 1.28 mg g^{-1} in 'Faqqous' genotype, 3.91 mg g^{-1} in 'A6' genotype, and 1.53 mg g^{-1} in 'F63' genotype, while malic acid content was 3.89 mg g^{-1} in 'Faqqous' genotype, 0.89 mg g^{-1} in 'A6' genotype and 0.28 mg g^{-1} in 'F63' genotype. They also recorded that malic acid content decreased during the storage period. Wu et al. (2020) determined that the malic and citric acid content of sliced 'Xizhoumi-17' melon decreased during 12 days of storage under different storage conditions.

Özdemir and Gökmen (2017) reported that the organic acid content of pomegranate fruit stored for 28 days decreased during the storage period and this decrease was less in fruit with edible coating compared to the control. As a result of our study, the highest concentration of organic acids in melon was determined as citric acid, malic acid, succinic acid, oxalic acid, and fumaric acid, respectively, and organic acid content decreased in all treatments during the storage period. This decrease in organic acids was relatively prevented by edible coating applications. It

Table 7. Changes in glucose content (%) during storage. Data are shown as means ± SEM.

	Storage period (d)					
Preharvest treatment	Postharvest treatment	0	4	8	12	Means
		2020				
HA	Control	1.43 ± 0.01 z	1.54 ± 0.01 Az	1.61 ± 0.03 Az	1.68 ± 0.02 Az	1.57 ± 0.03 Az
	Carob	1.43 ± 0.01 z	1.48 ± 0.01 Bz	1.51 ± 0.01 Bz	1.58 ± 0.02 BCz	1.50 ± 0.02 Bz
	Sodium alginate	1.43 ± 0.01 z	1.51 ± 0.02 ABz	1.57 ± 0.01 ABz	1.60 ± 0.01 Bz	1.53 ± 0.02 ABz
	Pectin	1.43 ± 0.01 z	1.51 ± 0.01 ABz	1.53 ± 0.01 Bz	1.55 ± 0.01 Cz	1.51 ± 0.01 ABz
LV	Control	1.95 ± 0.02 x	2.21 ± 0.05 Ax	2.22 ± 0.01 Ax	2.32 ± 0.04 Ax	2.18 ± 0.04 Ax
	Carob	1.95 ± 0.02 x	2.06 ± 0.01 Bx	2.13 ± 0.01 Bx	2.21 ± 0.02 Bx	2.09 ± 0.03 ABx
	Sodium alginate	1.95 ± 0.02 x	2.11 ± 0.01 Bx	2.19 ± 0.01 Ax	2.25 ± 0.01 ABx	2.13 ± 0.03 ABx
	Pectin	1.95 ± 0.02 x	2.02 ± 0.01 Bx	2.09 ± 0.01 Bx	2.13 ± 0.01 Cx	2.05 ± 0.02 Bx
OM	Control	1.52 ± 0.01 y	1.74 ± 0.02 Ay	1.84 ± 0.02 Ay	1.92 ± 0.01 Ay	1.76 ± 0.05 Ay
	Carob	1.52 ± 0.01 y	1.61 ± 0.02 Cy	1.71 ± 0.01 Cy	1.82 ± 0.01 By	1.67 ± 0.03 ABy
	Sodium alginate	1.52 ± 0.01 y	1.69 ± 0.01 By	1.77 ± 0.01 By	1.85 ± 0.02 By	1.71 ± 0.04 ABy
	Pectin	1.52 ± 0.01 y	1.63 ± 0.01 Cy	1.66 ± 0.01 Dy	1.73 ± 0.01 Cy	1.64 ± 0.02 By
		2021				
HA	Control	1.85 ± 0.01 y	1.94 ± 0.02 Az	2.07 ± 0.01 Az	2.14 ± 0.01 Az	2.00 ± 0.03 Ay
	Carob	1.85 ± 0.01 y	1.88 ± 0.01 Bz	1.90 ± 0.01 Cz	1.93 ± 0.01 Bz	1.89 ± 0.01 Bz
	Sodium alginate	1.85 ± 0.01 y	1.94 ± 0.02 Az	1.97 ± 0.01 Bz	2.08 ± 0.04 Az	1.96 ± 0.03 ABz
	Pectin	1.85 ± 0.01 y	1.91 ± 0.01 ABz	1.95 ± 0.01 Bz	1.98 ± 0.01 Bz	1.92 ± 0.01 Bz
LV	Control	2.38 ± 0.06 x	2.65 ± 0.02 Ax	2.71 ± 0.02 Ax	2.82 ± 0.01 Ax	2.64 ± 0.05 Ax
	Carob	2.38 ± 0.06 x	2.53 ± 0.02 Bx	2.58 ± 0.01 BCx	2.64 ± 0.01 Cx	2.53 ± 0.02 ABx
	Sodium alginate	2.38 ± 0.06 x	2.56 ± 0.01 Bx	2.61 ± 0.01 Bx	2.70 ± 0.01 Bx	2.56 ± 0.04 ABx
	Pectin	2.38 ± 0.06 x	2.47 ± 0.01 Cx	2.54 ± 0.02 Cx	2.61 ± 0.01 Dx	2.50 ± 0.03 Bx
OM	Control	1.91 ± 0.01 y	2.12 ± 0.01 Ay	2.18 ± 0.01 Ay	2.21 ± 0.01 Ay	2.10 ± 0.04 Ay
	Carob	1.91 ± 0.01 y	2.02 ± 0.01 Cy	2.08 ± 0.01 Cy	2.12 ± 0.01 Cy	2.03 ± 0.02 ABy
	Sodium alginate	1.91 ± 0.01 y	2.06 ± 0.01 By	2.14 ± 0.01 By	2.18 ± 0.01 By	2.07 ± 0.03 ABy
	Pectin	1.91 ± 0.01 y	1.99 ± 0.01 Dy	2.04 ± 0.01 Dy	2.07 ± 0.01 Dy	2.00 ± 0.02 By

Different capital letters indicate the difference among 'coating materials' for the same fertilizer application and storage time. Different lowercase letters indicate the difference among 'fertilizer applications' for the same storage time and coating material ($p < 0.05$). HA: humic acid, LV: Liquid vermi compost and OM: organomineral.

could be stated that our study was in parallel with previous studies in this respect.

Sugars in fruit are one of the most important factors affecting flavor formation. Sugar, which is involved in many metabolic activities in fruit, increases with ripening.

Organic acids constitute an important energy source of respiration metabolism in fresh vegetables and fruit and have been reported to be effective on the taste of fresh vegetables and fruit together with sugars (Kaynaş, 2017). As fruit and vegetables ripen, the starch in them undergoes degradation. This degradation in fruit and vegetables is very important because the degradation of starch leads to an increase in sugar content and the formation of a sweet aroma. This metabolic event occurs before and after harvest in climacteric fruit. On the other hand, it has been reported that increases in ethylene and respiration rate in

Table 8. Changes in sucrose content (%) during storage. Data are shown as means ± SEM.

	Storage period (d)					
Preharvest treatment	Postharvest treatment	0	4	8	12	Means
			2020			
HA	Control	3.33 ± 0.01 x	3.06 ± 0.01 Dx	2.89 ± 0.02 Dy	2.84 ± 0.01 Cy	3.03 ± 0.06 B
	Carob	3.33 ± 0.01 x	3.16 ± 0.01 Bx	3.08 ± 0.01 Bx	3.00 ± 0.02 Ax	3.14 ± 0.04 ABx
	Sodium alginate	3.33 ± 0.01 x	3.11 ± 0.01 Cx	3.01 ± 0.01 Cx	2.91 ± 0.01 Bx	3.09 ± 0.05 AB
	Pectin	3.33 ± 0.01 x	3.23 ± 0.01 Ax	3.12 ± 0.01 Ax	3.02 ± 0.01 Ax	3.18 ± 0.04 Ax
LV	Control	3.14 ± 0.02 z	2.96 ± 0.01 By	2.86 ± 0.01 Dy	2.81 ± 0.01 Cy	2.94 ± 0.04
	Carob	3.14 ± 0.02 z	3.05 ± 0.02 Ay	2.98 ± 0.01 Bz	2.93 ± 0.01 Ay	3.03 ± 0.02 y
	Sodium alginate	3.14 ± 0.02 z	2.99 ± 0.01 Bz	2.94 ± 0.01 Cy	2.86 ± 0.01 By	2.99 ± 0.03
	Pectin	3.14 ± 0.02 z	3.06 ± 0.01 Az	3.02 ± 0.01 Ay	2.91 ± 0.01 Az	3.03 ± 0.03 y
OM	Control	3.24 ± 0.01 y	3.05 ± 0.01 Bx	2.95 ± 0.01 Bx	2.90 ± 0.01 Bx	3.03 ± 0.04
	Carob	3.24 ± 0.01 y	3.09 ± 0.01 Ay	3.02 ± 0.01 Ay	2.93 ± 0.01 Ay	3.07 ± 0.03 xy
	Sodium alginate	3.24 ± 0.01 y	3.04 ± 0.01 By	2.97 ± 0.01 By	2.92 ± 0.01 Ax	3.04 ± 0.04
	Pectin	3.24 ± 0.01 y	3.11 ± 0.01 Ay	3.03 ± 0.01 Ay	2.95 ± 0.01 Ay	3.08 ± 0.03 y
			2021			
HA	Control	3.12 ± 0.02 x	2.98 ± 0.01 Cx	2.89 ± 0.01 Bx	2.80 ± 0.01 Cx	2.95 ± 0.04 x
	Carob	3.12 ± 0.02 x	3.07 ± 0.01 Ax	2.94 ± 0.01 Ax	2.85 ± 0.01 Ax	3.00 ± 0.03 x
	Sodium alginate	3.12 ± 0.02 x	3.03 ± 0.01 Bx	2.93 ± 0.01 Ax	2.83 ± 0.01 Bx	2.98 ± 0.03 x
	Pectin	3.12 ± 0.02 x	3.07 ± 0.01 Ax	2.96 ± 0.01 Ax	2.87 ± 0.01 Ax	3.00 ± 0.03 x
LV	Control	2.95 ± 0.01 z	2.83 ± 0.01 Cy	2.72 ± 0.01 Cz	2.67 ± 0.01 Cz	2.79 ± 0.03 y
	Carob	2.95 ± 0.01 z	2.87 ± 0.01 Bz	2.84 ± 0.01 Ay	2.72 ± 0.01 Bz	2.84 ± 0.02 y
	Sodium alginate	2.95 ± 0.01 z	2.85 ± 0.01 Bz	2.81 ± 0.01 By	2.71 ± 0.01 Bz	2.83 ± 0.03 y
	Pectin	2.95 ± 0.01 z	2.90 ± 0.01 Az	2.84 ± 0.01 Ay	2.76 ± 0.01 Az	2.86 ± 0.02 y
OM	Control	3.03 ± 0.01 y	2.85 ± 0.01 Dy	2.78 ± 0.01 Cy	2.73 ± 0.01 By	2.85 ± 0.03 y
	Carob	3.03 ± 0.01 y	2.93 ± 0.01 By	2.85 ± 0.01 Ay	2.78 ± 0.01 Ay	2.90 ± 0.03 y
	Sodium alginate	3.03 ± 0.01 y	2.90 ± 0.01 Cy	2.81 ± 0.01 By	2.75 ± 0.01 By	2.88 ± 0.03 y
	Pectin	3.03 ± 0.01 y	2.97 ± 0.01 Ay	2.84 ± 0.01 Ay	2.78 ± 0.01 Ay	2.91 ± 0.03 y

Different capital letters indicate the difference among 'coating materials' for the same fertilizer application and storage time. Different lowercase letters indicate the difference among 'fertilizer applications' for the same storage time and coating material ($p < 0.05$). HA: humic acid, LV: Liquid vermi compost and OM: organomineral.

climacteric fruit after harvest may cause both starch and sugar loss. This is because fruit and vegetables convert glucose to CO_2 during the respiration process, resulting in the release of CO_2 from the tissues. These changes vary depending on factors such as temperature, the gas composition of storage conditions, and respiration rate (Yahia et al., 2018).

Sugars are water-soluble and small molecular weight carbohydrates that are most commonly used in plant metabolism. Fructose and glucose are reducing sugars, but sucrose is a nonreducing sugar form. During the ripening period, while the accumulation of reducing sugars is stable, there is an unstable accumulation of nonreducing sugars. After harvesting, carbohydrates in fruit and vegetables are lost at different rates depending on the species and cultivars because they are the energy source of metabolic activities. The total amount of sugar increases with ripening (Kaynaş, 2017). It was reported in studies where the amount of glucose in fresh melon was 1.8%–2.6%, sucrose was 2.4%–4.8%, and fructose was 1.9%–2.2% (Kaynaş et al., 1995; Halloran et al., 1997). Wu et al. (2020) stored fresh-cut melons at 5 °C for 12 days, and at the end of storage, they found that the amount of glucose and fructose increased, while the amount of sucrose decreased. Lester (2008) determined that glucose, sucrose, and fructose content in melon fruit flesh was 1.94%, 3.73%, and 2.35%, respectively. Cemeroğlu (2004) stated that there may be a decrease in the fruit acid rate at the end of storage due to the fact that fruit consumes organic acids and sugars in respiration during the storage period.

5. Conclusion

Preharvest organomineral fertilizer was found to be effective on the accumulation of organic acids, whereas liquid worm fertilizer was found to be effective on sugars. During the storage period, both organic acid content and sugar content were better preserved, especially in pectin-treated fruit. Although total sugar content increased during storage, pectin treatment kept this increase under control among all treatments. This is due to the fact that pectin coating slows down ripening by limiting respiration rate and ethylene release. The results obtained are supported by previous studies.

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