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Postharvest salicylic acid and chitosan Effects to the improved shelf life of “Bada” sweet cherry

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ABSTRACT

Researchers are looking for non-chemical (organic) biological materials, like chitosan and salicylic acid, that can safely be consumed by consumers while maintaining the storage properties of perishable fruit crops. Therefore, the effects of salicylic acid (SA) at concentrations of 0, 1, and 2 mmol L^{-1} on the shelf life and quality of "Bada" cherry fruit during storage were investigated. Total phenolics (TP), total antioxidant activity (TAA), ascorbic acid content (AAC), fungal decay incidence (FDI), total titratable acidity (TTA), pH, firmness, and surface color were all measured after 14 and 28 days of storage at 2.5±0.5 °C and 85–95% relative humidity. SA had a substantial effect on fruit quality at all concentrations. SA in a single concentration

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1- Introduction

The Rosaceae family includes the sweet cherry (*Prunus avium* L.), which is a significant fruit crop for the economy. It has a strong flavor, appealing color, firmness, antioxidants, and a wealth of nutrients [1]. Turkey and the USA are the world's two biggest producers of sweet cherries, according to FAO Statistics [2]. Iran produces roughly 354000 metric tons of sweet cherries annually, making it one of the most important producers of sweet cherries worldwide [3]. 'Siyah-e-Mashhad' and 'Takdane,' two popular cultivars, make up over 70% of Iran's cherry orchards [4]. In addition, a number of late- and mid-ripening sweet cherry cultivars, such as "Adli," "Shandiz," "Toos," and "Zoshk," have lately been released [5]. Furthermore, due to its sweet taste and plump roundness, the "Bada" sweet cherry has become the most well-liked variety in Iran lately. It has a short window of time before going bad. As a result, it should be used right away after being taken out of the refrigerator for home consumption. Hence, further research will help to achieve high-quality “Bada” sweet cherries that meet consumer expectations. The main postharvest factors that cause sweet cherry deterioration are weight loss, color changes, softening, surface pitting, stem browning, loss of acidity, and slight increases in TSS. To preserve fruit quality during handling and storage, it is thus essential to create postharvest technologies that are dependable and efficient as well as to employ eco-friendly practices. To enhance the quality, firmness, color, and size of sweet cherry fruits, various postharvest treatments are implemented [6]; [7]. Thin layers of packaging materials made of edible products are known as edible coatings [8]. By creating a semi-permeable barrier to water, oxygen, and carbon dioxide between the products and the surrounding atmosphere, these coatings improve the shelf life, quality, health, and stability of the physical properties of the products [7]. To stop the crop from respiring anaerobically, the appropriate coating needs to allow a specific volume of gases to pass through. SA shows great promise in reducing fruit firmness losses, discoloration, and decay incidence of sweet cherry crops as a safe and natural phenolic compound [9]; [10].

Chitosan, which is separated from crustaceans' outer shells, has lately been regarded as a postharvest sweet cherry [11, 12]. The purpose of this study was to look into how they affected the quality characteristics and postharvest life of "Bada" sweet cherry fruit while it was kept cold.

2- Materials and Methods

2-1- Plant material and treatments

In Urmia, in the West Azerbaijan province of Iran, we collected sweet cherry fruits (Prunus avium L., cv. 'Bada') from a commercial orchard. The healthy, uniform, and fully matured fruits were hand-selected from the fruit and sent straight to the laboratory that same day for additional analysis after being cleaned under running tap water. 60 sweet cherries (so, 120 fruits total) were submerged in the treatment solutions for three minutes for each replication of the edible coating treatments. The chosen fruits were uncontaminated and in good condition, with no surface damage.

2-2- Salicylic acid preparation

To achieve a uniform solution treatment, salicylic acid powder (Applichem, GmbH., Ottoweg, Germany) was dissolved in distilled water and 0.1 NaOH in the appropriate volume (0, 1, and 2 mmol L^{-1}). The mixture was then vigorously stirred with an electric stirrer for 15 minutes at 25°C.

2-3- Chitosan preparation

Poly (D-glucosamine) chitosan is made by dissolving 1% of it in 1% glacial acetic acid (v/v) and filtering through coarse filter paper (Sigma–Aldrich, St. Louis, USA) [13]. 1N NaOH was used to adjust the pH to 5.6. By diluting the stock solution with sterile distilled water, the solution was autoclaved and brought to the proper concentrations..

2-4- Fungal decay index (FDI)

Group 1 (normal), 2 = trace (up to 5%), 3 = slight (5–20%), 4 = moderate (20–50%), and 5 = severe (>50%) of fruit surface decayed were the five categories used to express the amount of fungal decay [14].

2-5- Overall quality

A set of ten trained panelists evaluated the overall quality indices using a range of 1 to 5 scales: 1 denoted improper (>50% surface deterioration), 2 bad

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(20–50% surface deterioration), 3 acceptable (5–20% surface deterioration), 4 good (up to 5% surface deterioration), and excellent (< 5 no decay, shrinkage, or other adverse effects on fruit surface were observed) [14].

2-6- Chemical analysis

Following purification, 10 g of ground sweet cherry were suspended in 100 mL of distilled water. We used a pH meter (Model No. CP-411) to measure the samples' pH and titrable acidity (TA), which we then expressed as grams of malic acid per 100 g of sweet cherry weight. The TSS was measured in the juice of the ground sweet cherry using an Atago–500 manual refractometer (Atago Co.Ltd., Tokyo, Japan) at 20°C. The percentage of TSS was expressed.

2-7- Ascorbic acid

Sweet cherry fruit's ascorbic acid content (AAC) was ascertained using the 2, 6-dichlorophenolindophenol method [15]. In a 50 mL volumetric flask, an aliquot of 10 mL sweet cherry fruit juice extract was diluted to 50 mL with 3% metaphosphoric acid.

2-8- Determination of total phenolics content

Singleton and Rossi, 1965] described the Folin–Ciocalteu method for evaluating total phenolics (TP). About 0.2–0.4 g of each sample was weighed in a 10 mL flask and filled with distilled water. For five minutes, the extract was centrifuged at 5000 rpm. The 200 µL sample solution was combined with 1 mL of Folin reagent and 800 µL of sodium carbonate solution.

2-9- Total antioxidant activity

Overall antioxidant activity (TAA) was measured using a ferric reducing antioxidant power Ferric Reducing Antioxidant Power (FRAP) assay [17]. At low pH, ferric tripyridyl triazine (Fe III TPTZ) complex reduction to ferrous form (which has a strong blue color) can be tracked by measuring the change in absorption at 593nm.

2-10- Cherry firmness

The single-column materials Texture Analyzer (Model No. TA–XTPlus, England) interfaced to a personal computer running Nexygen® software was used to determine the texture. Using a 500 N load cell, the Magness-Taylor probe pierced the fruit at a rate of 300 mm/min, reaching a depth of 23 mm. Data were presented as the highest force possible (N).

2-11- Surface color measurement

Using a colorimeter (450; Hunter Assoc) that produced CIE L*, a*, and b* values, the surface color of 20 fruits from each replicate was measured. Higher positive a* values denote red, and negative a* values denote green. Greater yellow tones and blue tones in the skin are indicated by higher positive b* values. The hue degree (h^o= arctangent [b*/a*]), where 0^o= red-purple, 90^o= yellow, 180^o= bluish-green, and 270^o= blue, and chroma (C*= [a*2 + b*2]1/2), which denotes the intensity or color saturation, were then computed using these values [18]. The standard white reflective plate served as the calibrator for the analyzer.

2-12- Statistical analysis

A completely randomized design (CRD) comprising three variables (SA concentration), three variables (chitosan concentration), and two variables (storage time) was used to set up the experiment. There were seven replicates of each treatment, each containing fifteen fruits. Duncan's multiple range test (DMRT) and SAS software were used to subject the data to Analysis of Variance (ANOVA) in order to test the differences among treatments. Duncan's multiple range tests were used to perform mean separations ($P \leq 0.05$).

3- Results

3-1-Fungal decay index

After 28 days of cold storage, fungal decay was successfully stopped by one mmol L^{-1} SA (fig. 1). SA and chitosan both reduced the incidence of decay at two mmol L^{-1} and 1%, respectively, with no discernible differences (fig. 2A, table 1).

3-2- Overall quality

At the conclusion of cold storage, overall quality declined. SA, however, had a major impact on the overall quality of the fruit. During short-term storage, the fruit's overall quality was preserved with two

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mmol L^{-1} SA plus 1% chitosan. Fruit with a high overall quality was produced during long-term storage when SA was added at a concentration of one mmol L^{-1} (fig. 2B, table 1).

3-3- pH, TA and TSS

After 28 days of cold storage, the pH of the fruit juice and the total titratable acidity content of the control sweet cherry increased and decreased, respectively (table 1, fig. 2C, and fig. 3A). Fruit pH was maintained during short-term storage by SA at concentrations of 1 and 2 mmol L^{-1}, 1 mmol L^{-1} SA + 0.5% chitosan, and 2 mmol L^{-1} SA + 0.5% chitosan. Fruit pH was substantially preserved during long-term storage by two mmol L^{-1} SA (table 1, fig. 2C). One and two mmol L^{-1} SA and two mmol L^{-1} + 0.5% chitosan effectively retained total titrable acidity (table 1, fig. 3A). At the conclusion of cold storage, total soluble solids rose. But fruit TSS was effectively maintained by two mmol L^{-1} SA (table 1, fig. 2D).

3-4- Total Antioxidant Activity

Table (2) indicates a decrease in total antioxidant activity over the course of storage. Higher chitosan concentrations preserved overall antioxidant activity, but this decrease was more pronounced in fruit treated with 0.5% chitosan. In short-term storage, 2 mmol L^{-1} SA successfully preserved total antioxidant activity (fig. 3C).

3-5- Ascorbic Acid content

Table (2) shows that during storage, the ascorbic acid content of the control sweet cherries dropped. While ascorbic acid content was effectively retained in all treatments, ascorbic acid content in fruit treated with 1% chitosan and two mmol L^{-1} SA was significantly higher than in fruit treated with control ($P \leq 0.05$).

3-6- Fruit firmness

Both SA and chitosan were effective in retaining firmness; one mmol L^{-1} SA plus 1% chitosan significantly increased firmness compared to the control (table 2, fig. 3D). The firmness of uncoated fruits (control) decreased with increasing storage period.

3-7- Fruit color

The surface color of sweet cherry fruit did not significantly change while it was being stored (table 3). The fruit color of sweet cherries treated with varying concentrations of chitosan and SA did not differ significantly.

3-8- Total Phenolics content

As shown in table 2, fruit phenolics content significantly decreased from day 1 to day 14 of storage, then significantly increased continuously during storage until day 28. The highest total phenolics content was found in fruit treated with two mmol L^{-1} SA.

4- Discussion

Sweet cherries should keep their best flavor and appearance as a fresh crop until they are consumed [19]. In many production areas, postharvest decay is a serious issue, particularly in the Iranian province of West Azerbaijan. The two most prevalent postharvest diseases of sweet cherries that are widely distributed in the environment are brown rot and gray mold, which are brought on by Monilinia laxa and Botrytis cinerea, respectively [14]. Several authors have also reported on the inhibitory effect of chitosan and SA [20]; [21]. The most important consideration when determining a fruit's marketability is overall quality. Chitosan has improved fruit's overall quality in certain areas, like weight loss [1]. By blocking the actions of the enzymes polyphenol oxidase (PPO) and peroxidase (POD), chitosan was applied to sweet cherry fruit, preventing flesh browning and extending its shelf life [11]. Strawberry fruits responded similarly to chitosan application [22]. Chitosan coating the fruit's surface reduces total phenolics and anthocyanins during storage in pomegranates [24], while also preserving the fruit's color and lengthening its shelf life [23, 24]. Chitosan coatings mainly prevent water transfer, shield fruit skin from mechanical damage, seal small wounds, and postpone dehydration, which all contribute to the fruit's ability to retain quality [25]. By triggering defense mechanisms like locally acquired resistance (LAR) and systemic acquired resistance (SAR), plants defend themselves against pathogen attacks. Increased SA levels are linked to the start of SAR;

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these levels are present locally at the infection site and frequently systemically in other tissues. Hydrogen peroxide (H2O2) levels in plant tissues can build up as a result of SA, and this serves as a signal that triggers systemic acquired resistance (SAR) [20]. Treatment with salicylic acid prevented fungal fruit decay and reduced ethylene production, which resulted in no fruit decay and a discernible drop in metabolic activity, including respiration. Any factor that raises the amount of one will also increase the amount of the other because the relationship between ethylene production and the rise in respiration is two-way [14] ; [26]. By reducing ethylene production and respiration rate, preventing fruit softening and color change, preserving sugars, organic acids, and aroma, preventing chilling injury, fostering pathogen resistance, and triggering the antioxidant system, SA applications enhance the quality of fruit storage [27]. By reducing the synthesis and activity of ACC oxidase, salicylic acid inhibits the conversion of aminocyclopropane-1-carboxylic acid (ACC) to ethylene [20]. A number of quality characteristics, including softening and discoloration, a drop in total acidity and ascorbic acid content, an increase in TSS and pH, and a decrease in total antioxidant activity, all change as fruit ripens and senescence. Our study's findings showed that, when SA was present at the ideal concentration, total acidity was maintained and a sharp rise in TSS content was avoided, which prevented a rise in pH. These outcomes might be the result of SA delaying the ripening and senescence of sweet cherry fruit. According to Srivastava and Dwivedi [28], SA has reportedly prevented banana fruit from ripening, most likely by inhibiting ethylene biosynthesis or action. Salicylic acid reduces the synthesis of ethylene by inhibiting the activities of aminocyclopropane-1-carboxylic acid oxidase (ACO) and acetyl-CoA synthetase (ACS). According to Zhang et al. [29], kiwifruit treated with SA after harvest showed reduced ethylene production in the early phases of fruit ripening along with a decrease in ACO and ACS activity. SA's negative effects on ACC, ACO, polygalacturonase (PG), pectin methylesterase (PME), cellulase, and antioxidant enzymes result in decreased ethylene production and action, which is the main cause of its effect on respiration rate reduction. The preceding study's findings attest to the positive relationship that exists in fruit tissue between the activity of lipoxygenase (LOX), the generation of free radicals, and the biosynthesis of ethylene [30]. Results indicated an additive or synergistic effect between SA and chitosan on retaining firmness in sweet cherries; these are based on previous reports showing that the chitosan-treated fruit was firmer at the end of storage [32]; [33]. The softening process in sweet cherries depended on cell wall degrading-enzymes activities like polygalacturonase, β-galactosidase, and PME, resulting in a loss in fruit quality [31]. Apples, bananas, kiwifruits, and pears have all been shown to retain their firmness after being exposed to SA[28]; [34]; [35]; [36]. Fruit firmness is attributed to the uptake of exogenous SA and chitosan, which preserve cell-to-cell adhesion and the stability of the cell wall. By preventing ethylene biosynthesis or action, SA and chitosan can both lower the rate of respiration and, in general, postpone the production of free radicals, which keeps ascorbic acid levels stable [28]. Because chitosan can form a semi-permeable film, it alters the internal environment, reducing the rate of respiration and the production of free radicals. This preserves vitamin C, phenolics, and antioxidant activity [37]. Our results on the function of SA in preserving ascorbic acid are consistent with those of Asghari [38] for strawberries and Rohi [39] for kiwis. The most important factor in maintaining overall antioxidant activity in the present investigation was two mmol L^{-1} SA. But according to earlier reports, chitosan and SA together have raised it [40, 41]. Because SA is a precursor in the shikimic acid pathway, its exogenous application increases phenolic compounds [9]. Cherry color is primarily caused by anthocyanin, a phenolic compound that is crucial to consumer perception. Salicylic acid is an operator for this process. L* and b* color index were enhanced during cold storage. Throughout storage, the uncoated (control) fruit remained darker than the coated fruit. At the end of storage, fruit treated with one mmol L^{-1} SA had skin that was a darker shade of yellow than the control.

5- Conclusions

Using SA, no outward indications of fungal contamination were seen in the sweet cherries. According to this study, SA is a safe and natural compound that can help sweet cherry fruit resist deterioration during storage. The findings

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demonstrated that SA causes resistance reactions in host tissues and lowers the fungal decay index. Total soluble solids, total titrable acidity, and decay incidence were all significantly retained by SA treatments. At the end of storage, fruit treated with chitosan and SA was firmer. Fruit firmness factors, marketability, pH, antioxidant activity, TA, AA, and fruit firmness decreased while total soluble solids and decay increased in control fruits stored. At the end of storage, fruit treated with SA alone was brighter and had more yellow skin than control. In order to preserve the quality characteristics of recently harvested sweet cherry fruit, CV "Bada," SA and chitosan can be advised.

5- Acknowledgements

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6- Conflict of Interest

The authors indicate no conflict of interest for this work.

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Table 1 Effects of salicylic acid and chitosan on sweet cherry fruit fungal decay index, overall quality, pH, TSS: total soluble solids; TA: total acidity; after 18 and 28 days storage in 2 ± 0.5ºC.

Storage time (days)	Treatments SA (mmol L^{-1})	Chitosan (%)	Fungal decay index	Overall quality	pH	TSS (%)	TA (%)
1			1 ± 0.0	5 ± 0.0	3.77 ± 0.004	16.2 ± 0.0	0.81 ± 0.01
	0	0	1^{f} ± 0.0	3.85^{bcd} ± 0.26	4.05^{h} ± 0.009	13.35^{cdefg} ± 0.41	0.69^{ab} ± 0.03
		0.5	1.14^{ef} ± 0.14	3^{ef} ± 0.3	4.44^{b} ± 0.02	13.42^{cdefg} ± 0.41	0.54^{hi} ± 0.02
		1	1^{f} ± 0.0	4^{bcd} ± 0.3	4.43^{b} ± 0.05	13.57^{bcdef} ± 0.29	0.63^{def} ± 0.01
	1	0	1.14^{ef} ± 0.14	4.28^{abc} ± 0.28	4.03^{h} ± 0.007	13.78^{abcde} ± 0.26	0.72^{a} ± 0.004
14		0.5	1.42^{def} ± 0.20	3.57^{cde} ± 0.2	4.03^{h} ± 0.01	14.42^{abc} ± 0.22	0.66^{bcd} ± 0.01
		1	1^{f} ± 0.0	4.42^{abc} ± 0.2	4.25^{def} ± 0.01	12.78^{feg} ± 0.53	0.66^{bcd} ± 0.01
	2	0	1^{f} ± 0.0	4.28^{abc} ± 0.18	4.05^{h} ± 0.01	12.64^{fg} ± 0.35	0.69^{abc} ± 0.01
		0.5	1.42^{def} ± 0.29	3.85^{bcd} ± 0.26	4.14^{gh} ± 0.01	14.07^{abcd} ± 0.36	0.7^{ab} ± 0.01
		1	1.14^{ef} ± 0.14	5^{a} ± 0.3	4.28^{cdef} ± 0.02	12.42^{g} ± 0.36	0.64^{cde} ± 0.01
	0	0	2.14^{bc} ± 0.40	3.28^{de} ± 0.18	4.34^{bcd} ± 0.02	13.85^{abcde} ± 0.14	0.52^{i} ± 0.01
		0.5	2.71^{ab} ± 0.18	2.28^{f} ± 0.18	4.42^{b} ± 0.09	14.85^{a} ± 0.28	0.43^{j} ± 0.02
		1	1.85^{cd} ± 0.26	3.85^{bcd} ± 0.26	4.63^{a} ± 0.02	13.07^{defg} ± 0.41	0.52^{i} ± 0.01
28	1	0	1.28^{def} ± 0.18	4.57^{ab} ± 0.2	4.35^{bcd} ± 0.03	13.5^{cdefg} ± 0.28	0.59^{efg} ± 0.005
		0.5	3.14^{a} ± 0.26	1.42^{g} ± 0.2	4.34^{bcd} ± 0.02	14.64^{ab} ± 0.28	0.45^{j} ± 0.01
		1	2.71^{ab} ± 0.18	3^{ef} ± 0.37	4.22^{efg} ± 0.01	13.42^{cdefg} ± 0.29	0.57^{ghi} ± 0.01
	2	0	1.85^{cd} ± 0.26	3.71^{bcde} ±0.35	4.18^{fg} ± 0.01	12.64^{fg} ± 0.23	0.58^{fgh} ± 0.004
		0.5	2.57^{ab} ± 0.20	2.28^{f} ± 0.28	4.37^{bc} ± 0.02	13.28^{defg} ± 0.35	0.56^{ghi} ± 0.02
		1	1.71^{cde} ± 0.18	4.28^{abc} ± 0.28	4.29^{cde} ± 0.01	14.14^{abcd} ± 0.21	0.54^{hi} ± 0.01
			$P \leq 0.01$.	$P \leq 0.01$.	$P \leq 0.01$.	$P \leq 0.01$.	$P \leq 0.01$.

Means followed by different letters within a group are significantly different at the 1 % level.
Values are mean ± standard deviation of seven replicates.

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Table 2 Effects of salicylic acid and Chitosan on sweet cherry fruit ascorbic acid content, total antioxidant activity, fruit firmness and total phenolics compound after 18 and 28 days storage in 2 ± 0.5ºC.

Storage time (days)	Treatments SA (mmol L^{-1})	Chitosan (%)	Ascorbic acid (mg/100gr)	Total antioxidant activity (mmol Fe+2/100grFW)	Firmness (Kg/mm^2)	Total phenolics (mgGAE/100gFW)
1			11.04 ± 0.1	3.21 ± 0.01	286.8 ± 12.4	748.64 ± 16.45
	0	0	7.19bcdefg ± 0.3	2.4ab ± 0.03	265.5bcd ± 6.95	405.5de ± 36.82
		0.5	7.94abc ± 0.4	1.93cde ± 0.06	233.8cde ± 17.15	317.3e ± 3.49
		1	8.50a ± 0.2	1.81de ± 0.15	165.1g ± 11.77	370e ± 7.34
	1	0	6.26efgh ± 0.3	2.14bc ± 0.15	166.2g ± 11.05	413de ± 20.61
14		0.5	6.54defg ± 0.2	1.98cde ± 0.14	260.9bcd ± 24.27	370.5e ± 19.31
		1	7.85abcd ± 0.2	2.11bcd ± 0.05	264.7bcd ± 10.11	388e ± 53.07
	2	0	8.32ab ± 0.3	2.47a ± 0.02	175.8fg ± 17.4	348e ± 20.81
		0.5	6.16fghi ± 0.3	2.09bcd ± 0.2	224.0def ± 23.5	400.5e ± 20.96
		1	6.63cdefg ± 0.5	2.12bcd ± 0.03	318.0ab ± 25.82	368e ± 30.82
	0	0	4.94i ± 0.5	1.70ef ± 0.01	254.2cd ± 20.38	620.5b ± 37.05
		0.5	5.97ghi ± 0.5	1.37g ± 0.08	180.1efg ± 2.34	610.5bc ± 63.42
		1	7.20bcdefg ± 0.2	1.97cde ± 0.11	260.8bcd ± 13.09	520.5bc ± 60.32
28	1	0	6.16fghi ± 0.2	1.67ef± 0.06	321.6ab ± 5.98	620.5b ± 37.05
		0.5	7.58abcde ± 0.5	1.67ef ± 0.07	293.0abc ± 26.84	603bc ± 8.66
		1	6.44efgh ± 0.5	1.77e± 0.08	328.1a ± 18.99	370.5e ± 44.41
	2	0	7.43abcdef ± 0.7	1.73ef ± 0.04	234.4cde ± 24.25	718a ± 48.30
		0.5	7.10bcdefg ± 0.3	1.45fg ± 0.06	282.8abcd ± 25.21	600.5bc ± 43.85
		1	5.23hi ± 0.4	1.78e ± 0.08	283.7abcd ± 20.95	505.5cd ± 34.73
			P ≤ 0.01.	*P ≤ 0.01.*	*P ≤ 0.01.*	*P ≤ 0.01.*

Means followed by different letters within a group are significantly different at the 1 % level.
Values are mean ± standard deviation of seven replicates.

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Table 3 Effects of salicylic acid and Chitosan on sweet cherry fruit color indices after 18 and 28 days storage in 2

.

Storage time (days)	Treatments SA (mmol L^{-1})	Chitosan (%)	*L**	*a**	*b**	Hue angle	Chroma value
1			63.64 ± 1.85	1.54 ± 0.36	24.95 ± 0.71	86.51 ± 1.12	24.99 ± 0.87
	0	0	64.24^{a} ± 2.1	1.23^{a} ± 0.55	24.22^{a} ± 0.93	86.92^{a} ± 1.5	24.27^{a} ± 0.88
		0.5	61.56^{a} ± 2.37	2.82^{a} ± 0.45	24.65^{a} ± 1.67	83.44^{a} ± 0.92	24.82^{a} ± 1.69
		1	68.06^{a} ± 1.22	0.93^{a} ± 0.31	26.43^{a} ± 0.67	88.01^{a} ± 0.6	26.45^{a} ± 0.68
	1	0	60.23^{a} ± 2.56	1.39^{a} ± 0.33	23.34^{a} ± 0.76	86.57^{a} ± 0.82	23.38^{a} ± 0.76
14		0.5	64.99^{a} ± 1.07	2.04^{a} ± 0.36	25.72^{a} ± 0.63	85.47^{a} ± 0.71	25.64^{a} ± 0.67
		1	65.99^{a} ± 1.22	0.90^{a} ± 0.15	25.86^{a} ± 0.57	88.00^{a} ± 0.33	25.87^{a} ± 0.57
	2	0	68.14^{a}± 1.2	-0.18^{a} ± 0.22	25.17^{a} ± 0.93	0.47^{a} ± 51.48	25.17^{a} ± 0.93
		0.5	67.85^{a} ± 1.84	0.63^{a} ± 0.62	25.44^{a} ± 0.57	43.60^{a} ± 44.03	25.47^{a} ± 0.56
		1	63.02^{a} ±2.14	0.63^{a} ± 0.2	23.51^{a} ± 0.69	88.41^{a} ± 0.54	23.52^{a} ± 0.68
	0	0	63.95^{a} ± 1.45	1.41^{a} ± 0.68	23.49^{a} ± 0.96	41.59^{a} ± 43.76	23.51^{a} ± 0.99
		0.5	46.37^{a} ± 11.97	1.75^{a} ± 0.79	17.83^{a} ± 4.55	83.80^{a} ± 1.95	17.94^{a} ± 4.58
		1	49.56^{a} ± 13.33	2.65^{a} ± 0.78	19.79^{a} ± 5.21	81.03^{a} ± 2.14	19.99^{a} ± 5.23
	1	0	67.80^{a} ± 0.63	0.28^{a} ± 0.33	24.70^{a} ± 0.24	44.37^{a} ± 44.47	24.37^{a} ± 0.41
28		0.5	58.27^{a} ± 3.25	2.22^{a} ± 0.42	22.30^{a} ± 0.85	84.12^{a} ± 1.34	22.42^{a} ± 0.8
		1	59.79^{a} ± 1.53	2.04^{a} ± 0.28	23.63^{a} ± 0.74	85.09^{a} ± 0.52	23.72^{a} ± 0.76
	2	0	61.96^{a} ± 2.61	3.41^{a} ± 1.06	24.47^{a} ± 0.21	82.04^{a} ± 2.5	24.78^{a} ± 0.93
		0.5	58.95^{a} ± 2.13	3.42^{a} ± 0.81	22.69^{a} ± 0.85	81.28^{a} ± 2.26	22.99^{a} ± 0.76
		1	59.43^{a} ± 1.67	2.72^{a} ± 0.77	24.41^{a} ± 0.65	83.67^{a} ± 1.72	24.59^{a} ± 0.68
			P ≤ 0.01	*P ≤ 0.01*	*P ≤ 0.01*	*P ≤ 0.01*	*P ≤ 0.01*

Values are mean ± standard deviation of seven replicates.

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Fig 1 Sweet cherry fruit treated with 1 mmol L^{-1} SA and control fruit respectively, after 28 days of cold storage.

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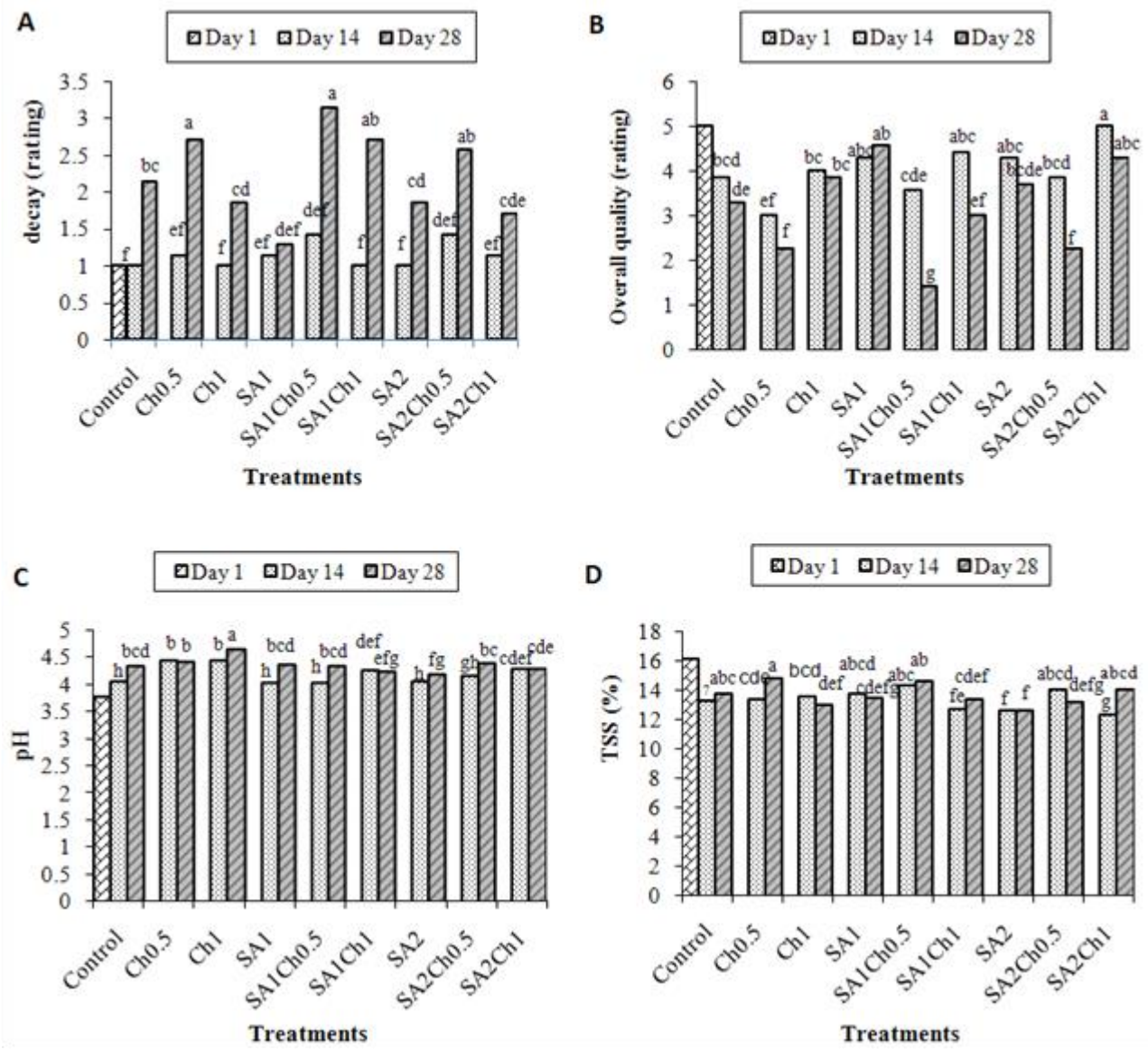

Fig 2 Effects of SA and chitosan on decay (A), overall quality (B), pH (C) and TSS: total soluble solids (D) of "Bada" sweet cherry fruit after 1, 14 and 28 days of cold storage.

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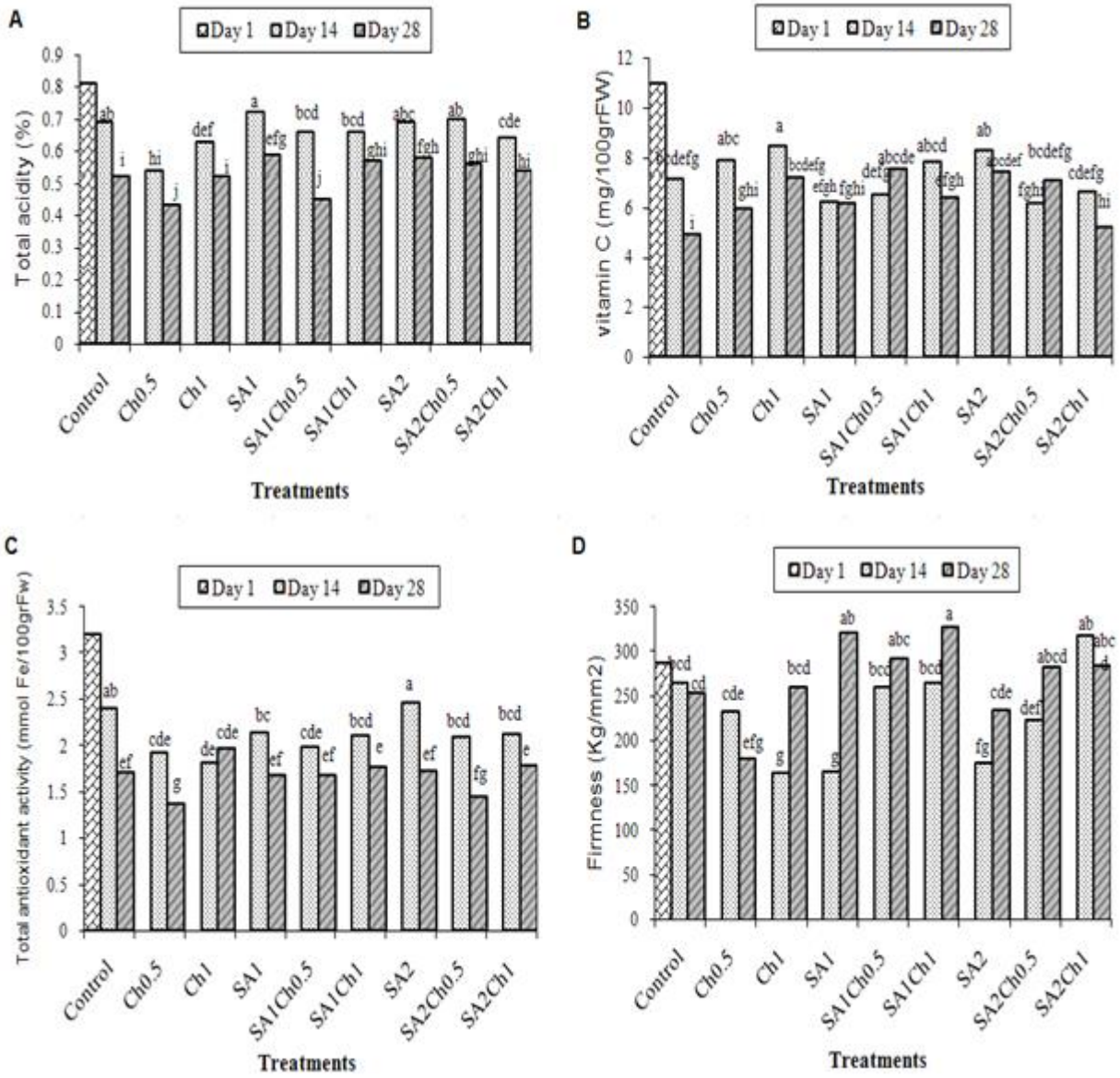

Fig 3 Effects of SA and chitosan on total acidity (A), vitamin C (B), total antioxidant activity (C) and firmness (D) of "Bada" sweet cherry fruit after 1, 14 and 28 days of cold storage.

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مقاله علمی_پژوهشی

اثرات پس از برداشت اسیدسالیسیلیک و کیتوسان در بهبود ماندگاری گیلاس رقم « بادا»

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چکیده

یافتن ترکیبات بیولوژیکی غیرشیمیایی (ارگانیک) مانند اسیدسالیسیلیک و کیتوسان که برای مصرف کننده بی ضرر بوده و در عین حال به حفظ خواص نگهداری محصولات میوه فاسد شدنی کمک نماید، مورد توجه است. بنابراین، اثرات اسید سالیسیلیک (**SA**) (صفر، یک و ۲ میلی‌مول‌در لیتر) بر ماندگاری و کیفیت میوه گیلاس "بادا" در طول نگهداری بررسی شد. فنول کل (**TP**)، فعالیت آنتی اکسیدانی کل (**TAA**)، محتوای اسیدآسکوربیک (**AAC**) و بروز پوسیدگی قارچی (**FDI**)، اسیدیته قابل تیتراسیون کل (**TTA**)، (**pH**) و سفتی و سطح رنگ در طول نگهداری برای ۱۴ و ۲۸ روز در دمای ۰/۵ ± ۲/ ۵ درجه سانتی‌گراد و رطوبت نسبی ۸۵ تا ۹۵ درصد بررسی گردید. اسیدسالیسیلیک در تمام غلظت‌ها به‌طور قابل توجهی بر کیفیت میوه تاثیر گذاشت. اسیدسالیسیلیک در یک میلی‌مول‌درلیتر در ترکیب با کیتوسان ۱ درصد به‌طور قابل توجهی باعث کاهش بروز **FDI** و حفظ بازارپسندی و سفتی میوه شد. شاخص های رنگ L^* و b^* به‌طور معنی‌داری افزایش یافت و اسیدسالیسیلیک یک میلی‌مول‌در لیتر میزان رنگ پوست مایل به زرد و رنگ روشن تر را تحریک نمود. از نتایج این تحقیق می‌توان برای مصارف مختلف گیلاس اعم از مصرف تازه‌خوری یا فرآوری شده استفاده نمود.

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