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Effects of salicylic acid and sweet basil mucilage on some postharvest quality indices of okra (*Abelmoschus esculentus* L.)

Sasan Dinarvand[1], Mohammadreza Zare-Bavani[2*]

1- Master's graduate. Department of Horticultural Science, Faculty of Agriculture, Agricultural Sciences and Natural Resources University of Khuzestan, Mollasani, Iran.

2- Assistant professor, Department of Horticultural Science, Faculty of Agriculture, Agricultural Sciences and Natural Resources University of Khuzestan, Mollasani, Iran.

ABSTRACT

The use of edible coatings to preserve fruits and vegetables during storage has attracted increasing attention. Also, salicylic acid has been used as an anti-ethylene and antimicrobial compound to improve the postharvest life of some crops. In this study, the effects of different concentrations of salicylic acid (0, 1, 2, and 4 mM) and sweet basil mucilage (0, 0.1, 0.2, and 0.3 percent) on the postharvest quality of okra during storage at 10 °C were evaluated. The results showed that increasing the storage time decreased the quality characteristics of okra. Sweet basil mucilage and salicylic acid treatments were significantly effective on maintaining the quality characteristics of okra. The highest levels of fruit firmness, soluble solids, titratable acidity, ascorbic acid, visual appearance, and the lowest weight loss were obtained in the 0.3% sweet basil mucilage and 4 mM salicylic acid treatments. Okra without coating and salicylic acid treatment completely lost its appearance quality during 16 days of storage but okra treated with high concentrations of salicylic acid and mucilage had good quality and required marketability. As a result, sweet basil mucilage and salicylic acid can be used as effective treatments to maintain the quality aspects of okra for a more extended period.

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*Corresponding Author E-Mail:
mzarebavani@asnrukh.ac.ir

1. Introduction

okra (*Abelmoschus esculentus* (L.) Moench) from the family of cheese, is a warm season vegetable that is cultivated in tropical and subtropical regions or in regions with hot seasons in the world, and today it has a good spread all over the world [1]. Its immature fruits, which are pods with tender and unripe seeds, have a unique texture and sweet taste, and are consumed as a vegetable [2]. Okra fruit is a good source of carbohydrates, vitamins B2, B3, vitamin C, protein, fat, calcium and iron [3]. Okra seeds are dried, roasted and ground and used as a food additive or boiled as a drink [4] Also, its medicinal effects in reducing inflammation, gastric irritation and colon cancer have been reported [5]. Immature pods of okra have a high respiration rate and a short lifespan, and under normal conditions, they do not last more than two days. The quality of okra is mainly evaluated by its light green color and the softness of the fruit tip (when pressed firmly between thumb and fingers) and its medium and small size. Loss of quality is detected by yellowing of color, softness and loss of freshness, hardening or non-rupture of the pod tissue when twisting it with fingers [2, 6]. The major changes that occur during the aging of okra fruit include the loss of tissue firmness and turgorescence, chlorophyll degradation and yellowness, loss of nutrients, blackening of the tip and around the fruit, increase of rots and bad smell [2].

Salicylic acid is a natural phenolic compound and plant hormone, whose use in controlling post-harvest losses of horticultural crops has recently attracted the attention of researchers [7]. It is also safe for consumers in terms of health [8]. Reports show that salicylic acid is involved in growth, ripening delay and many other metabolic processes such as disease resistance, hypersensitivity response, ion absorption, enzyme activities, oxidative stress defense mechanism, permeability control and cell membrane stability [7, 9, 10 and 11]. Salicylic acid treatment has been successfully used to increase the shelf life of some fruits and vegetables such as pineapple [11], cucumber fruit [12], dill [13], pomegranate [14], avocado [15], lychee [16] and papaya [17]. has been In a research, the highest amount of soluble solids, titratable acidity, ascorbic acid and the lowest percentage of litchi fruit rot were obtained with salicylic acid treatment [16]. Researchers reported that salicylic acid treatment significantly reduced the process of physiological weight loss, soluble solids, titratable acidity and ascorbic acid of papaya fruit compared to the control treatment and preserved the appearance characteristics of the fruit better [17]. Ardakani et al. (2012) reported that the treatment of 4 mM salicylic acid slowed down the process of weight loss and reduced the firmness of the apricot fruit tissue, and was also effective in maintaining the titratable acidity and ascorbic acid of the fruits [18].

To increase the shelf life of fresh fruits and vegetables and maintain quality and reduce waste, solutions such as the use of modified atmosphere technology, edible coatings and packaging films have been proposed [2]. The increasing use of edible coatings shows that this relatively new and simple technology is very effective in preventing adverse changes in the quality of various products. Edible films and coatings are made of natural polymers and their use improves the quality and hygiene of food [19]. The mucilage of basil seeds is a common gum obtained from basil (*Ocimum basilicum* L.) is extracted and is a heteropolysaccharide consisting of two main parts: glucomannan (hydrophobic) and xylan (hydrophilic) [20]. Basil seed mucilage has several advantages such as low production cost, ease of extraction, and hydrophilic properties, etc. [20, 21]. The use of basil seed gum mucilage in apricot controlled the loss of moisture and soluble solids of the fruit and resulted in better preservation of titratable acidity, ascorbic acid and sensory quality of the fruit [21]. In another research, basil seed mucilage as an edible coating helped preserve the sensory and appearance quality of tomatoes better. It also significantly slowed down the weight loss process of tomato fruits during storage [22].

Currently, okra is mainly refrigerated and modified atmosphere packaging with preservatives is used, so scientists have focused on technical research and development to increase the shelf life of okra [23]. The review of sources shows that there is no information regarding the use of salicylic acid and basil mucilage in order to maintain the quality and increase the shelf life of okra after harvesting, so the purpose of this research is to investigate the effects of salicylic acid and basil mucilage treatments on the quantitative and qualitative characteristics after harvesting the fruit. Okra was cold during storage.

2- Materials and methods

2-1- Test materials:

This research was carried out in the laboratory and cold room of the Department of Horticultural Sciences and Engineering, Khuzestan University of Agricultural Sciences and Natural Resources, in the spring of 2019. Local okra seeds in a commercial farm in Shush city (32°11′39″N 48°14′37″E) was cultivated. The stages of planting and keeping the crop were carried out according to the technical recommendations of the Ministry of Jihad and Agriculture. All the management measures of planting and maintaining the crop, including fertilization, irrigation, weeding, pest and disease

control, were carried out regularly to increase the growth and yield of the crop according to technical recommendations. Okra fruit harvesting started 10 weeks after planting. The fruits were ready to be harvested 4 to 7 days after the flower opened. When the crop production reached the desired commercial amount, okra pods with a size of 50 to 70 mm in length and 12 to 15 mm in diameter with a uniform color (light green) and without any signs of physical damage or disease and pest symptoms with a fruit tail of about two Centimeters were chosen according to the general popularity of consumers. The fruits were harvested carefully and manually to avoid physical damage and according to the custom of the region between 7 and 9 in the morning. The harvested fruits were immediately transported to the laboratory in polystyrene boxes. The fruits were first cooled and washed 2 times with distilled water to clean them before treatment, and were dried at laboratory temperature and their moisture content was taken.

2-2- Preparation of basil mucilage

Before starting the test of regular basil seeds (*Ocimum basilicum* L.) was purchased from Pakan Seed Company in Isfahan province and after being transferred to the laboratory, it was cleaned and the waste materials and impurities were separated from the seeds. In order to extract the gum, the seeds were mixed with distilled water at a ratio of 1:20 (weight/weight) at a temperature of 50 degrees Celsius and a pH of 7 for 20 minutes. After being hydrated at the optimal point, the seeds were subjected to centrifugal force for 30 seconds in a mixer without cutting blades. After the seeds and the gum around them became a heterogeneous mixture, the resulting mixture was subjected to a centrifuge (Universal Centrifuge, Premium 20000 model, made in Iran) at a speed of 5000 rpm for 20 minutes at a temperature of 25 degrees Celsius until the gum solution was separated from the seeds. to be The isolated gum solution was kept at 65 degrees Celsius for 24 hours in a dry oven and finally milled and kept in a dry and cool place for further tests [21]. Zero, 0.1, 0.2 and 0.3% concentrations of this basil mucilage were prepared in distilled water. The solutions were kept at room temperature (25°C) for 24 hours until the gum was completely dissolved and uniform. Glycerol at a ratio of 1% (volume/volume) was used as a softener.

2-3- Preparation of salicylic acid solutions

Salicylic acid (Merck, Germany, CAS No.;69-72-7) was dissolved in distilled water at concentrations of 0, 1, 2 and 4 mM. 0.5 ml/liter Tween 20 was added as a surfactant to the solutions and the solutions were brought to the final volume. The solutions were prepared fresh on the day of the treatments.

2-4- Preparing samples and performing treatments

Okra pods were placed in the solution for 5 minutes using the immersion method and after leaving the solution, they were kept at room temperature for 30 minutes to dry the surface of the fruit. Control fruits were treated with distilled water. The treated fruits were transferred to the warehouse with a temperature of 10 degrees Celsius and a relative humidity of 95±2% for 16 days. This experiment was in the form of a completely randomized design with 3 factorial replications including: salicylic acid (0, 1, 2 and 4 mM) and basil mucilage (0, 0.1, 0.2 and 0.3%) in five times. Storage (0, 4, 8, 12 and 16 days), the desired traits were measured.

5-2- Indicators and attributes to be evaluated

2-5-1- Percentage of fruit weight loss

The weight loss of the samples during the storage period in the cold storage was measured using a digital scale with an accuracy of 0.01 grams as a percentage of the initial weight and calculated using the following formula [21].

100×(initial weight / secondary weight - initial weight) = weight loss percentage

2-5-2- tissue stiffness

The hardness of the okra tissue was measured at a point in the middle of the okra with 4 repetitions using a penetrometer test and a tissue measuring device (model FT 011, QA Supplies LLC, made in America) with a 5 mm diameter needle, and the hardness was presented in kilograms per square centimeter. became [24].

2-5-3- Measurement of chlorophyll Total and Cartonoidha

Fruit pericarp samples (0.5 g) were quickly homogenized in 2 to 3 ml of 95% ethanol. Then, 10 ml of 95% ethanol was added to each sample, and the samples were kept for 3 to 5 minutes in a glass tube that was covered from the outside with plastic wrap to prevent direct exposure to light. Then the extract was refined in a brown volume bottle and diluted with 95% ethanol to 15 ml. Absorbance values were measured at 665, 649 and 470 nm and 95% ethanol was used as a blank [25]:

2-5-4- Measurement of dissolved solids

Soluble solids using a digital refractometer (Milwaukee model MA 871, made in Romania) to

was achieved Values were expressed in Brix degrees (corrected for 20 degrees Celsius). To measure the amount of dissolved solids, homogenized fruit flesh was used [26]..

2-5-5- Titratable acidity measurement

To Measurement of Titratable Acidity 5 ml of strained fruit juice was diluted through filter paper with 45 ml of distilled water and treated with caustic soda.0.1 normal to reachpH 2/8 It was headlined. Withputting up Level Consumable profit in the formula belowtitratable acidity was calculated in grams of citric acid per 100 ml of extract. The titratable acidity was estimated by the following formula in percentage[24].

$$\text{titratable acidity (\%)} = \frac{\text{milliliter of profit} \times \text{milliequivalent of dominant acid}_{\text{Normality of consumer interest}} \times 0.1 \times 100}{\text{Milliliter volume of sample extract}}$$

2-5-6- Ascorbic acid (vitamin C) assay

Five grams of okra samples were extracted with 50 ml of 1% (w/v) metaphosphoric acid for 1 hour. Then the resulting extract was centrifuged using a refrigerated centrifuge (Universal Centrifuge, Premium 20000 model, made in Iran) at 5000 g for 5 minutes. After that, one milliliter of the supernatant was mixed with 9 milliliters of dichlorophenol indophenol solution (0.05 mM), and then the absorption of the samples was measured using a spectrophotometer (UV-Vis model AE-S60-4UPC, made in England) at a wavelength of 515 nm. became. The solution blank sample did not contain extract. L-ascorbic acid was used to prepare the standard. Finally, the amount of vitamin C was calculated in terms of milligrams per 100 grams of body weight [27].

2-5-7- Appearance attractiveness

The visual appearance was evaluated based on the color change of the fruits from green to yellow and darkening. The number of evaluators was 15 (trained). Color change was evaluated using a hedonic scale of 7: excellent (bright green), 5: good (dull green), 3: acceptable (yellowing), and 1: unacceptable (dark) [28].

2-6- Information processing

This experiment was carried out as a factorial and in the form of a completely randomized design with three replications. Statistical analysis of data and average comparison (with LSD test at 5% probability level) was done using SAS V: 9.1 statistical processing system software and graphs were also done with Excel 2016 software.

3. Results and Discussion

The results of variance analysis of the data of this research showed that the main effects of basil mucilage edible coating and storage time were significant for all studied traits ($p \leq 0.01$). The main effects of salicylic acid were significant for fruit firmness ($p \leq 0.05$) and for other traits ($p \leq 0.01$) (Table 1). The double effects of salicylic acid × basil mucilage oral coating were significant only on the percentage of weight loss ($p \leq 0.05$). The double effects of salicylic acid × storage time on weight loss percentage, total chlorophyll and carotenoids, ascorbic acid, soluble solids and appearance attractiveness were significant ($p \leq 0.01$). The double effects of basil mucilage × storage time were significant only on weight loss percentage, fruit texture firmness, titratable acidity and soluble solids ($p \leq 0.01$), but the triple effects of salicylic acid × mucilage × storage time were not statistically significant in any of the traits. Table 1).

Table 1 Variance analysis of effects of sweet basil mucilage, salicylic acid and storage time on some quantitative and qualitative characteristics of okra fruit

Variable source	d.f.	Mean square (MS)			
		Weight loss	Firmness	Total chlorophyll	Carotenoids
Salicylic acid	3	5.347**	0.228*	44.724**	0.219**
Sweet basil mucilage	3	20.837**	3.963**	1.783**	0.050**
storage time	4	238.622**	34.933**	103.266**	2.819**
Salicylic acid × Sweet basil mucilage	9	0.224*	0.003ns	0.097 ns	0.008 ns
Salicylic acid × storage time	12	0.724**	0.046 ns	3.602**	0.138**
Sweet basil mucilage × storage time	12	3.077**	0.609**	0.216 ns	0.013 ns

Salicylic acid×sweet basil mucilage ×storage time	36	0.065 ns	0.001 ns	0.035 ns	0.001 ns
Experimental error	160	0.097	0.084	0.169	0.013
Coefficient of variation (%)		11.875	6.676	6.043	10.363

ns, ** and * indicate the non-significant and significant differences at the level of 1% and 5% probability, respectively.

Continued of Table 1

Variable source	d.f.	Mean square (MS)			
		Total soluble solids	Titrable acidity	Ascorbic acid	Visual appearance
Salicylic acid	3	13.533**	0.136**	74.195**	18.803**
Sweet basil mucilage	3	46.849**	0.748**	3.340**	8.986**
storage time	4	788.786**	5.000**	396.114**	79.350**
Salicylic acid × Sweet basil mucilage	9	0.498 ns	0.001 ns	0.188 ns	0.191 ns
Salicylic acid × storage time	12	1.919**	0.011 ns	7.141**	1.542**
Sweet basil mucilage × storage time	12	7.776**	0.101**	0.598 ns	0.785 ns
Salicylic acid×sweet basil mucilage ×storage time	36	0.141 ns	0.001 ns	0.078 ns	0.025 ns
Experimental error	160	0.577	0.015	0.486	0.571
Coefficient of variation (%)		6.551	4.489	6.331	13.926

ns, ** and * indicate the non-significant and significant differences at the level of 1% and 5% probability, respectively.

1-3- Percentage of fruit weight loss

All treatments and storage time showed significant effects on fruit weight loss percentage. Increasing the concentration of salicylic acid and the edible coating of basil mucilage caused a decrease and a significant increase in the storage time of the percentage of fruit weight loss (Tables 2, 3 and 4). The highest weight loss was recorded in the control treatment (3.41%), while the lowest weight loss occurred in the fruits treated with 4 mM salicylic acid and 0.3% basil muslage (1.47%) (Chart 1). A continuous increase in weight loss was observed in all treatments during the storage period, but increasing the concentration of salicylic acid or basil mucilage caused a significant decrease in weight loss at the same times (Tables 5 and 6).

Weight loss is mainly caused by transpiration (due to the water vapor pressure difference between the fresh fruit and the surrounding air), respiration and metabolic activities in the fruit [29]. This index is one of the most basic quality evaluation factors in fruits and vegetables. During the storage period, the lower the amount of moisture leaving the product, the smaller this index is, which indicates better preservation of product moisture [24]. As observed, during the storage period, the weight loss in okra treated with salicylic acid and basil mucilage was always lower than the control samples. By closing the openings on the skin of the fruit, salicylic acid reduces the rate of respiration and the percentage of weight loss due to sweating [9]. Also, salicylic acid can reduce respiration by inhibiting the biosynthesis or action of ethylene [30]. Less weight loss in edible coatings such as basil mucilage is due to the creation of a layer on the surface of the product that prevents moisture transfer and reduces gas exchange [31].

Table 2 Mean comparison of salicylic acid on some traits measured in okra fruit

Treats	Studied Indices							
Salicylic acid (mM)	Weight loss (%)	Firmness ($kgcm^{-2}$)	Total Chlorophyll ($mg\ g^{-1}FW$)	Carotenoids ($mg\ g^{-1}FW$)	Total soluble solid (^oBrix)	Titrable acidity (%)	Ascorbic acid ($mg100g^{-1}FW$)	Visual appearance

0	2.97 a	4.26 b	5.70 d	1.01 c	12.13 a	2.68 b	9.59 d	4.73 d
1	2.73 b	4.33 ab	6.56 c	1.08 b	11.79 b	2.71 b	10.67 c	5.25 c
2	2.53 c	4.37 a	7.37 b	1.14 a	11.44 c	2.76 a	11.76 b	5.69 b
4	2.26 d	4.40 a	7.61 a	1.13 a	11.02 d	2.78 a	12.02 a	6.03 a

In each column, means with the same letters are not significantly different at P>0.05.

Table 3 Mean comparison of sweet basil mucilage on some traits measured in okra fruit

Treats	Studied Indices							
Sweet basil mucilage (%)	Weight loss (%)	Firmness ($kgcm^{-2}$)	Total Chlorophyll (mg $g^{-1}FW$)	Carotenoids (mg $g^{-1}FW$)	Total soluble solid (ºBrix)	Titrable acidity (%)	Ascorbic acid (mg100$g^{-1}FW$)	Visual appearance
0	3.20 a	4.04 d	6.63 c	1.07 b	12.53 a	2.61 c	10.77 c	4.90 c
0.1	2.94 b	4.26 c	6.73 bc	1.08 b	12.01 b	2.71 b	10.90 bc	5.38 bc
0.2	2.49 c	4.39 b	6.85 b	1.09 b	11.35 c	2.73 b	11.05 b	5.66 a
0.3	1.86 d	4.66 a	7.03 a	1.13 a	10.49 d	2.88 a	11.32 a	5.77 a

In each column, means with the same letters are not significantly different at P>0.05.

Table 4 Mean comparison of storage time on some traits measured in okra fruit

Treats	Studied Indices							
Storage time (day)	Weight loss (%)	Firmness ($kgcm^{-2}$)	Total Chlorophyll (mg $g^{-1}FW$)	Carotenoids (mg $g^{-1}FW$)	Total soluble solid (ºBrix)	Titrable acidity (%)	Ascorbic acid (mg100$g^{-1}FW$)	Visual appearance
0	0.00 and	5.28 a	8.61 a	1.39 a	7.81 d	3.05 a	14.33 a	7.00 a
4	0.89 d	5.05 b	7.75 b	1.25 b	8.03 d	2.95 b	12.92 b	6.25 b
8	2.56 c	4.33 c	6.90 c	1.10 c	10.41 c	2.80 c	11.41 c	5.50 c
12	4.49 b	3.80 d	5.90 d	0.94 d	15.26 b	2.64 d	9.25 d	4.63 d
16	5.18 a	3.23 and	4.90 and	0.78 and	16.48 a	2.23 and	7.13 and	3.75 and

In each column, means with the same letters are not significantly different at P>0.05.

Table 5 Mean comparison of salicylic acid× storage time on some traits measured in okra fruit

Treats		Studied Indices					
Salicylic acid (mM)	Storage time (day)	Weight loss (%)	Total Chlorophyll (mg $g^{-1}FW$)	Carotenoids (mg $g^{-1}FW$)	Total soluble solid (ºBrix)	Ascorbic acid (mg100$g^{-1}FW$)	Visual appearance
0	0	0.00 m	8.62 a	1.53 a	7.82 i	14.34 a	7.00 a
0	4	1.04 k	6.87 if	1.22 and	8.25 i	11.94 d	5.67 cde
0	8	2.98 h	5.21 i	0.92 h	11.00 f	9.44 g	4.33 h
0	12	4.90 cd	4.34 j	0.77 i	15.98 c	7.44 i	3.67 i
0	16	5.90 a	3.48 k	0.61 j	17.59 a	4.77 k	3.00 j
1	0	0.00 m	8.59 a	1.41 b	7.81 i	14.32 a	7.00 a
1	4	0.92 at	7.64 d	1.26 cde	8.08 i	12.80 c	6.13 bc
1	8	2.65 i	6.69 f	1.10 g	10.55 fg	11.18 and	5.25 if
1	12	4.66 of	5.53 hi	0.91 h	15.56 cd	8.83 h	4.38 h
1	16	5.44 b	4.37 j	0.72 i	16.97 b	6.25 j	3.50 ij
2	0	0.00 m	8.60 a	1.33 bc	7.82 i	14.33 a	7.00 a
2	4	0.86 am	8.15 b	1.26 cde	7.98 i	13.39 b	6.46 ab
2	8	2.48 i	7.69 cd	1.19 if	10.28	12.34 cd	5.92 bcd

					gh		
2	12	4.36 f	6.71 if	1.04 g	15.02	10.20 f	5.00 fg
2	16	4.94 c	5.72 gh	0.89 h	16.11 c	8.53 h	4.08 hi
4	0	0.00 m	8.64 a	1.29 cd	7.80 i	14.33 a	7.00 a
4	4	0.73 l	8.33 ab	1.24 of	7.79 i	13.56 b	6.75 a
4	8	2.13 j	8.01 bc	1.19 fg	9.81 h	12.69 c	6.50 ab
4	12	4.03 g	7.02 and	1.04 g	14.46 and	10.53 f	5.46 def
4	16	4.43 if	6.03 g	0.89 h	15.24 d	8.97 gh	4.42 gh

In each column, means with the same letters are not significantly different at P>0.05.

Table 6 Mean comparison of sweet basil mucilage× storage time on some traits measured in okra fruit

Treats		Studied Indices			
Sweet basil mucilage (%)	Storage time (day)	Weight loss (%)	Firmness ($kgcm^{-2}$)	Total soluble solid (^oBrix)	Titrable acidity (%)
0	0	0.00 n	5.28 a	7.81 jk	3.06 a
0	4	1.13 k	4.93 c	8.37 j	2.87 cd
0	8	3.22 g	4.05 fg	11.31 h	2.65 if
0	12	5.29 c	3.41 i	16.61 c	2.45 g
0	16	6.39 a	2.54 k	18.56 a	2.02 i
0.1	0	0.00 n	5.28 a	7.81 jk	3.05 a
0.1	4	1.00 am	5.01 bc	8.15 jk	2.94 bc
0.1	8	2.88 h	4.24 if	10.77 h	2.78 d
0.1	12	5.02 d	3.70 h	15.99 d	2.63 if
0.1	16	5.80 b	3.10 j	17.35 b	2.15 h
0.2	0	0.00 n	5.28 a	7.82 jk	3.06 a
0.2	4	0.79 lm	5.06 abc	7.88 jk	2.95 bc
0.2	8	2.32 i	4.39 and	10.08 i	2.81 d
0.2	12	4.57 and	3.87 gh	15.27 and	2.67 and
0.2	16	4.76 of	3.34 i	15.71	2.17 h
0.3	0	0.00 n	5.28 a	7.81 jk	3.05 a
0.3	4	0.64 m	5.18 ab	7.70 k	3.03 ab
0.3	8	1.83 j	4.67 d	9.48 i	2.94 bc
0.3	12	3.07 gh	4.22 if	13.15 j	2.81 d
0.3	16	3.75 f	3.95 g	14.29 f	2.57 f

In each column, means with the same letters are not significantly different at P>0.05.

The positive effects of salicylic acid in reducing fruit weight during storage have been reported in grapes [32], bananas [33] and strawberries [34], as well as edible coating in okra [23], which is consistent with the results of the present study.

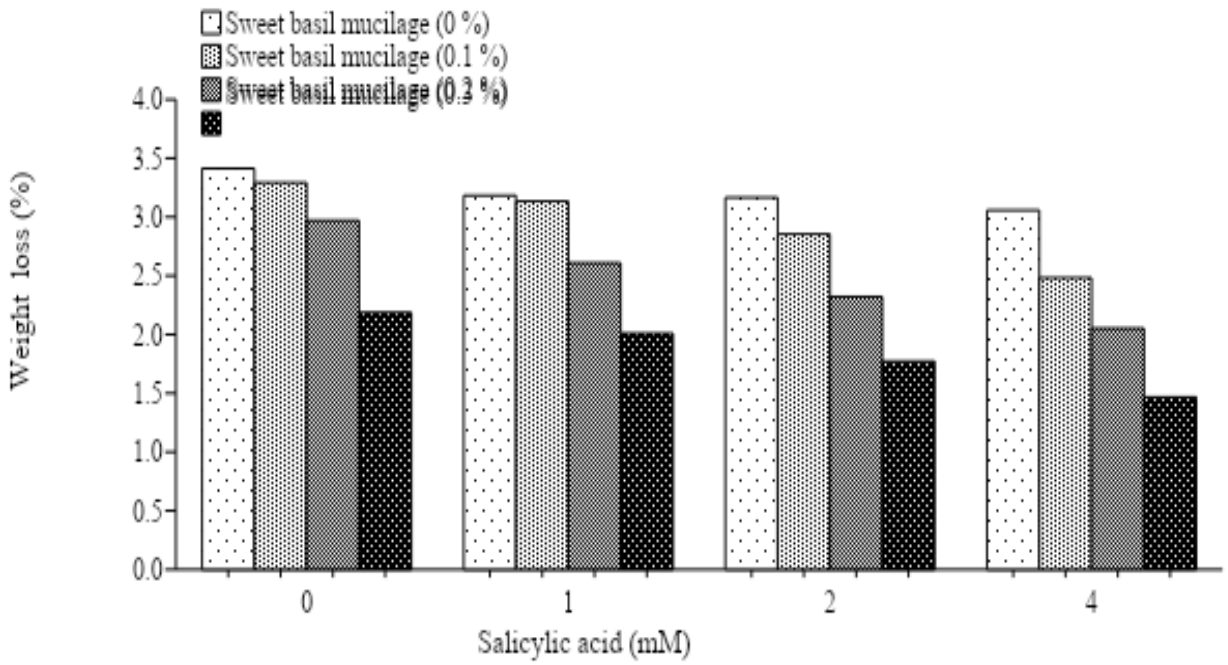

Figure 1- Interaction effects of salicylic acid and sweet basil mucilage on the weight loss of okra fruit

3-2- tissue stiffness

The highest degree of hardness of fruit tissue in the concentration of 4 mM salicylic acid ($kgcm^{-2}$4.40) it was observed that only with zero mM concentration ($kgcm^{-2}$ 26/4) showed a significant difference (Table 2). The firmness of the fruit tissue increased with the increase in the concentration of basil mucilage coating (Table 3). Increasing the storage time caused a significant decrease in the firmness of the fruit texture (Table 4). During storage at the same times, the highest amount of fruit tissue hardness was obtained in the highest concentrations of salicylic acid (Table 5) and basil mucilage (Table 6).

The freshness and firmness of the texture of fruits and vegetables is one of the most important physical characteristics and plays an important role in the marketability of fruits and vegetables. Sweating from the fruit surface and water loss reduces the firmness of the fruit, also the cell wall of the fruit softens due to the breakdown of insoluble propectin into soluble pectins, or damage to the cell membrane leads to an increase in membrane permeability and loss of turgor pressure as a result of a decrease in tissue firmness. It becomes a fruit [35]. It has been reported that salicylic acid delays the softening of the fruit tissue by reducing the production of ethylene [9] by reducing the activity of the main cell wall degrading enzymes such as cellulase, polygalactronase and xylanase [36], as well as maintaining cell adhesion [9]. . The effects of salicylic acid in maintaining the firmness and reducing the softness of the fruit texture have been reported in peach [37], apricot [38, 18] and banana [36], which is consistent with the findings of the present research.

By creating a barrier against sweating and breathing, edible coatings can preserve water and firmness of fruit tissue [31]. These results are similar to the application of chitosan coating for okra [23 and 26].

3-3- Chlorophyll Total and Cartonoidha

Increasing the concentration of salicylic acid and basil mucilage in the treatments increased and the storage time decreased the amount of total chlorophyll and okra carotenoids (Tables 2, 3 and 4). The interaction effects of salicylic acid × storage time showed that the lowest amount of total chlorophyll and carotenoids at the same time was in the treatment of 0 mM salicylic acid and the highest amount of total chlorophyll and carotenoids was in the treatment of four mM salicylic acid (Table 5).

The bright green color of okra is related to chlorophyll and carotenoids and is one of the motivating factors for the buyer to buy it. The right color leads to the creation of the desired appearance of the fruit, and therefore maintaining the color of the fruit is very important in its storage [28]. The treatments of salicylic acid and basil mucilage slowed down the process of decreasing total chlorophyll and carotenoids of okra. Oxygen and temperature have a harmful effect on chlorophyll, and okra samples become pale during storage, which indicates a significant loss of chlorophyll [2]. Chemical changes during fruit storage usually reduce the amount of pigments [39]. Decomposition of chlorophyll can be due to pH changes, oxidative systems and chlorophyllase enzyme activity, which are accelerated due to respiration and the progress of the aging process [40]. According to the findings of the current research, the researchers stated that by controlling the atmosphere around the fruit and reducing the gas exchange, the coatings lead to a better preservation of the chlorophyll and carotenoid pigments of the okra fruit [2], also salicylic acid by maintaining a greater number of chloroplasts and suppressing the activity of chlorophyllase, magnesium Declatase and pheophytinase (which play a major role in chlorophyll degradation) reduce chlorophyll degradation [41]. Salicylic acid reduces the level of oxidative stress in plants (as a resistance reaction) and improves the antioxidant capacity of plants and helps to induce the synthesis of protective compounds (such as carotenoids) [10].

3-4- Solution solids

Comparison of average data of soluble solids showed that storage time had increasing effects and salicylic acid and basil mucilage had significant decreasing effects on the increase of soluble solids of fruits (Tables 2, 3 and 4). The lowest amount of soluble solids at the same storage times was observed in the highest concentration of salicylic acid (Table 5) and basil mucilage (Table 6), while the highest amount of soluble solids was observed in fruits without salicylic acid treatment (Table 5) and without basil mucilage coating (Table 6) was registered. In general, during storage, a continuous increase in the soluble solids of fruits was observed in all treatments, but increasing the concentration of salicylic acid or basil mucilage caused a significant decrease in the increasing trend of the soluble solids of fruits (Tables 5 and 6).

The increase in the content of soluble solids in fruits during storage can be due to the breakdown of polysaccharides and pectin materials, hydrolysis of proteins and breakdown of glycosaccharides into smaller sugars, and the conversion of organic acids into sugars during the respiration process [33]. The soluble solids in the fruits treated with salicylic acid

and basil mucilage are less than the control fruits. The effect of food coating and salicylic acid in slowing down the process of increasing the amount of soluble solids in fruits can be due to the slowing down of respiration and metabolic activities such as reducing the breakdown of the cell wall, and therefore the ripening and aging process of the fruit is delayed [18]. The research of other researchers has also shown thatTThe addition of salicylic acid causes a delay in the increase of the soluble solids of fruits [2, 18, 22, 33 and 35]. Also, the effect of edible coatings in preventing the increase in the amount of soluble solids of okra has been reported [26], which is consistent with the results of the present study.

5-3- titratable acidity

The average comparison results showed that the titratable acidity of fruits decreased during the storage period (Table 4). The lowest titratable acidity of fruits was observed in treatments without salicylic acid and basil mucilage (Tables 2 and 3). Also, the highest amount of acidity during storage was recorded in fruits treated with 4 mM salicylic acid (Table 5) and 0.3% mucilage coating (Table 6). Salicylic acid and basil mucilage significantly slowed the decreasing process of titratable acidity (Tables 5 and 6). Based on the results of other researchers, the organic acids of okra fruit are consumed in the respiration process during storage and thus decrease [26]. Edible coatings reduce the rate of respiration by reducing the permeability of gases, and as a result, they prevent the consumption and reduction of organic acids (which are used as a respiratory substrate during the processing and storage of fruits) [29] and coated fruits due to the effect of edible coatings. They have higher amounts of titratable acidity to prevent weight loss and decrease breathing [24 and 29]. The use of salicylic acid had a significant effect on the amount of organic acids, which is due to the effect of salicylic acid in reducing the rate of respiration and ethylene production, thus reducing the consumption of organic acids as a respiratory substrate [38 and 42]. The results of other researchers also show the effect of salicylic acid in reducing the consumption and preservation of organic acids in fruit [18, 33, 35 and 42]. Also, the effect of edible coating in maintaining the titratable acidity of okra [25] has already been reported, which is in accordance with the findings of the present research.

3-6- Ascorbic acid (vitamin C)

The results of the mean comparison showed that increasing the concentration of salicylic acid and mucilage increased and the storage time decreased the ascorbic acid of okra fruits (Tables 2, 3 and 4). During the fruit storage period, salicylic acid significantly slowed the process of ascorbic acid reduction in fruits (Table 5).

Ascorbic acid is one of the important quality parameters that is very sensitive to degradation due to oxidation during the processing and storage process [38]. In general, the amount of ascorbic acid decreases with increasing storage period and aging of fruits [18, 43]. The reduction of vitamin C loss in foods with edible coatings can be attributed to the low oxygen exchange in these coatings. Keeping oxygen away from food delays the oxidation reaction of vitamin C [43]. The positive effect of aloe vera gel coating with basil mucilage on the retention of vitamin C in apricot [21] has already been reported. Salicylic acid plays an essential role in activating the antioxidant system in the plant, and its effect in increasing the ascorbic acid of the fruit can be due to this [18]. The role of salicylic acid in preserving vitamin C in peach [37], apricot [18] and kiwi fruit [44] has also been reported, which is consistent with the results of our research.

3-7- Appearance attractiveness

According to the obtained results, the tested treatments affected the appearance of the fruit, so that in salicylic acid and basil mucilage treatments, increasing the concentration resulted in better preservation of the fruit's appearance, although there was a statistically significant difference between the concentration of 0.3% and 2%. 0.0% basil mucilage was absent (Tables 2 and 3). Increasing the storage time decreased the appearance quality of the fruits (Table 4). During storage, the best appearance quality of the fruit in timeThe same was related to the highest concentration of salicylic acid (4 mM) (Table 5). Uncoated fruits without salicylic acid treatment completely lost their appearance quality during 16 days of storage, but the fruits treated with high concentrations of mucilage and salicylic acid had good quality and required marketability (Tables 5 and 6). Appearance quality evaluations are one of the most important marketability indicators for garden products and are used for purposes such as product acceptance from the consumer's point of view and choosing the best treatment or methods to maintain and maintain product quality. Salicylic acid has been reported to effectively reduce respiration in harvested fruits [9]. Reducing the metabolic activities of the fruit reduces the loss of juice and the amount of carbohydrates and effectively delays the aging process of the fruit [44].. Also, some food coatings have been effective in maintaining the shelf life, nutritional composition and appearance quality of many products [19].The results obtained from

this research are consistent with previous reports on apricot fruit [18].

4- General conclusion

The results of this research showed that, during 16 days of storage, the measured appearance and quality characteristics of okra had a sharp decrease, which indicates the sensitivity and shelf life of this product. Salicylic acid and basil mucilage treatments slowed down the process of weight loss, tissue firmness, titratable acidity, ascorbic acid, total chlorophyll and carotenoids and fruit appearance quality, and also significantly reduced the increase of fruit soluble solids. The appearance quality of untreated fruits decreased drastically during storage, but the treated fruits with increased concentration of basil mucilage and salicylic acid treatment got a higher score by the evaluators. So that salicylic acid treatments (4 mM) and basil mucilage oral coating (0.3%) have the most positive effect.They had an advantage in maintaining the quality and appearance of okra. Based on the obtained results, salicylic acid and basil mucilage can be used as a natural composition and edible coating commercially to increase the shelf life and maintain the quality of okra.

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6- Resources

[1] Shen, D.D., Li, X., Qin, Y.L., Li, M.T., Han, Q.H., Zhou, J., Lin, S., Zhao, L., Zhang, Q., Qin, W., and Wu, D.T. (2019). Physicochemical properties, phenolic profiles, antioxidant capacities, and inhibitory effects on digestive enzymes of okra (*Abelmoschus esculentus*) fruit at different maturation stages. *Journal of Food Science and Technology*, 56 (3):1275- 1286.

[2] Rai, D.R., and Balasubramanian, S. (2009). Qualitative and Textural Changes in Fresh Okra Pods (*Edible hibiscus* L.) under Modified Atmosphere Packaging in Perforated Film Packages. *Food Science and Technology International*, 15 (2):131- 138.

[3] Fajinmi, A. A., and Fajinmi, O. B. (2010). Incidence of okra mosaic virus at different growth stages of okra plants [*Abelmoschus esculentus* (L.) Moench] under tropical condition. *Journal of General and Molecular Virology*, 2 (1): 028- 031.

[4] Moekchantuk, T., and Kumar, P. (2004). *Export Okra Production in Tailand*, Intercountry Programme for Vegetable IPM in South & SE Asia Phase II Food and Agriculture Organization of the United Nations, Bangkok, Tailand.

[5] Babarinde, G., and Fabunmi, O.A. (2009). Effects of packing materials and storage temperature on quality of fresh okra (*Abelmoschus esculentus* L.) fruit.*Tropical and Subtropical Agriculture*, 42. 151- 156.

[6] Finger, F., Dlla-Justina M.E., Casali V.W., and Puiatt, M. (2008). Temperature and modified atmosphere affect the quality of okra. *Agricultural Science*, 65 (1): 312- 313.

[7] Noonim, A., and Venkatachalam, K. (2022). Combination of salicylic acid and ultrasonication for alleviating chilling injury symptoms of longkong. *Food Quality and Safety*, 6: 1- 14.

[8] Mahdi, J., Al-Musayeib, N., Mahdi, E. and Pepper, C. (2013). Pharmacological importance of simple phenolic compounds on inflammation, cell proliferation and apoptosis with a special references to β-d-salicin and hydroxybenzoic acid. *European Journal of Inflammation*, 11 (2): 327- 336.

[9] Aghdam, M. S., Asghari, M., Babalar, M., and Sarcheshmeh, M. A. A. (2016). Impact of salicylic acid on postharvest physiology of fruits and vegetables. In Eco-Friendly Technology for Postharvest Produce Quality (pp. 243-268): Elsevier.

[10] Ezzat, A., Ammar, A., Szabó, Z., and Holb, I.J. (2017). Salicylic acid treatment saves quality and enhances antioxidant properties of apricot fruit. *Horticultural Science*, 44 (2):73- 81.

[11] Youryon, P., Supapvanich, S., and Wongs-Aree, C. (2019): Internal browning alleviation of Queen pineapple cv. 'Sawi' under cold storage using salicylic acid or abscisic acid peduncle infiltration. *The Journal of Horticultural Science and Biotechnology*, 94 (6): 744- 752.

[12] Zhang, W.P., Jiang, B., Lou, L.M., Lu, M.H., Yang, M., and Chen, J.F. (2011). Impact of salicylic acid on the antioxidant enzyme system and hydrogen peroxide production in *Cucumber sativa* under chilling stress. *Journal for Natural Research*, 66: 413- 422.

[13] Koyuncu, M. A., Güneyli, A., Erbaş, D., Onursal, C. E., and Seçmen, T. (2018). Combined

Effects of MAP and Postharvest Salicylic Acid Treatment on Quality Attributes of Dill (*Anethum graveolens* L.) Bunches during Storage. *Journal of Agricultural Sciences*, 24 (3): 340-348.

[14] Sayyari, M., Babalar, M., Kalantari, S., Serrano, M., and Valero, D. (2009). Effect of salicylic acid treatment on reducing chilling injury in stored pomegranates. *Postharvest Biology and Technology*, 53, 152- 154.

[15] Sanches, A., and Repolho, R. (2022). Exogenous salicylic acid preserves the quality and antioxidant metabolism of avocado 'Quintal' cultivar. *Journal of Horticulture and Postharvest Research*, 5 (1): 79- 92.

[16] Kumar, D., Mishra, D.S., Chakraborty, B., and Kumar, P. (2013). Pericarp browning and quality management of litchi fruit by antioxidants and salicylic acid during ambient storage. *Journal of Food Science and Technology*, 50 (4): 797- 802.

[17] Hanif, A., Ahmad, S., Shahzad, S., Liaquat, M., and Anwar, R. (2020). Postharvest application of salicylic acid reduced decay and enhanced storage life of papaya fruit during cold storage. *Food Measure*, 14: 3078- 3088.

[18] Ardakani, E., Davarynejad, G. H., and Azizi, M. (2013). Evaluation of salicylic acid and temperature treatments on storability, postharvest quality and antioxidant activity of apricot (*Prunus armeniaca* cv. 'Lasgerdi') Fruit. *Journal of Horticultural Science*, 27(3): 326-334.

[19] Porta, R., Rossi-Marquez, G., Mariniello, L., Sorrentino, A., Giosafatto, V., Esposito, M., and Di Pierro, P. (2013). Edible Coating as Packaging Strategy to Extend the Shelf-life of Fresh-Cut Fruits and Vegetables. *Journal of Biotechnology & Biomaterials*, 4 (3): e124.

[20] Karimi, N., and Kenari, R. E. (2015). Functionality of Coatings with Salep and Basil Seed Gum for Deep Fried Potato Strips. *Journal of the American Oil Chemists' Society*, 93 (2): 243- 250.

[21] Nourozi, F., and Sayyari, M. (2020). Enrichment of *Aloe vera* gel with basil seed mucilage preserve bioactive compounds and postharvest quality of apricot fruits, *Science of Horticulture*, 262: 109041.

[22] Tabaestani, H. S., Sedaghat, N., Pooya, E. S., and Alipour, A. (2013). Shelf life improvement and postharvest quality of cherry tomato (*Solanum tomato* L.) fruit using basil mucilage edible coating and cumin essential oil. *International Journal of Agronomy and Plant Production*, 4 (9): 2346- 2353.

[23] Jiyue, W., Denghong, Sh., Yu, B., Bochen, O., and Yan, L. (2020). Effects of chitosan treatment on the texture parameters of okra fruit (*Abelmoschus esculentus* L. (Moench)). *Quality Assurance and Safety of Crops & Foods*, 12: 66-75.

[24] Hajivand-Ghasemabadi, S., Zare-Bavani, M., and Noshad, M. (2022). The influence of gelatin, aloe gel and chitosan coatings on physicochemical characteristics of fresh-cut persian shallot during storage. *Journal of food science and technology*, 18 (119): 169- 182. (In Persian)

[25] Liu, Y., Feng, X., Zhang, Y., Zhou, F., and Zhu. P. (2021). Simultaneous changes in anthocyanin, chlorophyll, and carotenoid contents produce green variegation in pink–leaved ornamental kale. *BMC Genomics*, 22: 455.

[26] Heydarian, A., Ahmadi, E., Dashti, F., and Normohammadi, A. (2022). Evaluation of Mechanical and Chemical Parameters of Okra with Chitosan Coating in Nano Packaging Films and Atmospheric Modified Conditions. *Journal of Agricultural Machinery*, 12 (4): 600- 612. (In Persian)

[27] Klein, B. P., and Perry, A. K. (1982). Ascorbic acid and vitamin A activity in selected vegetables from different geographical areas of the United States. *Journal of Food Science*, 47(3): 941- 945.

[28] Ngure, J.W., Aguyoh, J.N. and Gaoquiong, L. (2008). Effect of storage temperatures and hot water dipping on post-harvest characteristics of Okra. *Journal of Applied Biosciences*, 6 (2): 173- 179.

[29] Hosseini, H, Akhavan, H, Balvardi, M, Bagheri, P, and Pakzad-Moghadam, M. (2019). Effect of *Aloe vera*gel coating containing green tea extract and salicylic acid on the shelf life of Mazafati date. *Journal of food science and technology*, 16 (88): 47- 60. (In Persian)

[30] Zhang, Q. (2004). Effects of polyamines and salicylic acid postharvest storage of Ponkan mandarin. *Journal of Horticulture*, 632: 317- 320.

[31] Maringgal, B., Hashim, N., Tawakkal, I.S.M.A., and Mohamed, M.T.M. (2020). Recent advance in edible coating and its effect on fresh/fresh cut fruits quality. *Trends in Food Science and Technology*, 96: 253- 267.

[32] Ranjbaran, E., Sarikhani, H., Wakana, A., and Bakhshi, D. (2011). Effect of salicylic acid on storage life and postharvest quality of grape (*Wine*

vine L. cv. Midwife Sefid).*Journal of the Faculty of Agriculture, Kyushu University*, 56 (2): 263- 269.

[33] Mahidashti, F., and kamiab, F. (2018). Interaction of Salicylic Acid and Mentha Extraction on Increasing of Postharvest Life and Decreasing of Post-harvest Rots of Banana (*Muse of the wise* cv. Dwarf Cavendish). *Research Achievements for Field and Horticulture Crops*, 7 (1): 1- 15.

[34] Shafiee, M., Taghavi, T. S., and Babalar, M. (2010). Addition of salicylic acid to nutrient solution combined with postharvest treatments (hot water, salicylic acid and calcium dipping) improved postharvest fruit quality of strawberry. *Science of Horticulture*, 124: 40- 45.

[35] Shah, S. T., Basit, A., Ullah, I., Sajid, M., Ahmad, I.; Ahmad, I., Areeb, M., Sanaullah, K., Ullah, I., and Muhammad, B. (2020). Influence of edible coatings and storage duration on post-harvest performance of plum. *Pure and Applied Biology*, 10 (1): 81- 96.

[36] Srivastava, M. K., and Dwivedi, U. N. (2000). Delayed ripening of banana fruit by salicylic acid. *Plant Science*, 158: 87- 96.

[37] Tareen, M., Abbasi, N., and Hafiz, I. (2012). Effect of salicylic acid treatment on storage life of peach fruits CV'. *Flordaking. Pakistan Journal of Botany*, 44: 119- 124.

[38] El-Abbasy, U. K., El-Khalek, A. F. A., and Mohamed, M. I., (2018). Postharvest applications of 1-methylcyclopropene and salicylic acid for maintaining quality and enhancing antioxidant enzyme activity of apricot fruits cv. "caninoa" during cold storage. *Acta Horticulture*, 880: 525-532. [39] Modares, B., Ramin, A. A., and Ghobadi, C. (2014). Effect of 1-MCP on storage and shelflife of strawberry fruits (*Fragaria xananassa*Cv. Camarossa). *Journal of Crop Production and Processing*, 4 (11): 253- 268

[40] Koca, N., Karadeniz, F., and Burdurlu, H. S. (2007). Effect of pH on chlorophyll degradation and colour loss in blanched green peas. *Food Chemistry*, 100 (2): 609-615.

[41] Yadav, N., Singh, A.K., Emran, T.B., Chaudhary, R.G., Sharma, R., Sharma, S., and Barman, K. (2022). Salicylic acid treatment reduces lipid peroxidation and chlorophyll degradation and preserves quality attributes of pointed gourd fruit. *Journal of Food Quality*, 2022: 1-7.

[42] Dorostkar, M., Moradinezhad, F., and Ansarifar, E. (2019). Effect of postharvest application of salicylic acid, oxalic acid and nitric oxide on improving qualitative properties and extending the shelf life of fresh apricot fruit cv. 'Sharoudi'. *Journal of Food Science and Technology*, 16 (92): 177- 189 (In Persian).

[43] Ayranci, E., and Tunc, S. (2004). The effect of edible coatings on water and vitamin C loss of apricots (*Common Armenian* Lam.) and green peppers (*Potatoes* L.). *Food Chemistry*, 87 (3): 339- 342.

[44] Zhang, Y., Kunsong, C.H., Zhang, S., and Ferguson, I. (2003).The role of salicylic acid in postharvest ripening of kiwifruit. *Postharvest Biology and Technology*, 28: 67- 74.

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اثرات اسید سالیسیلیک و موسیلاژ ریحان بر برخی شاخص‌های کیفی پس از برداشت بامیه (*Abelmoschus esculentus* L.)

ساسان دیناروند [۱]، محمدرضا زارع بوانی [۲*]

۱- دانش‌آموخته کارشناسی ارشد، گروه علوم و مهندسی باغبانی، دانشکده کشاورزی، دانشگاه علوم کشاورزی و منابع طبیعی خوزستان، ملاثانی، ایران،

۲- استادیار، گروه علوم و مهندسی باغبانی، دانشکده کشاورزی، دانشگاه علوم کشاورزی و منابع طبیعی خوزستان، ملاثانی، ایران

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* مسئول مکاتبات:

mzarebavani@asnrukh.ac.ir

چکیده

استفاده از پوشش‌های خوراکی برای نگهداری میوه‌ها و سبزی‌ها در زمان نگهداری توجه روزافزونی را به خود جلب کرده است. همچنین اسید سالیسیلیک به‌عنوان ترکیب ضد اتیلنی و میکروبی برای افزایش عمر پس از برداشت برخی از محصولات مورداستفاده قرار گرفته است. در این مطالعه، اثرات غلظت‌های مختلف اسید سالیسیلیک (۰، ۱، ۲ و ۴ میلی‌مولار) و موسیلاژ ریحان (۰، ۰/۱، ۰/۲ و ۰/۳ درصد) بر کیفیت پس از برداشت بامیه در طی نگهداری در دمای ۱۰ درجه سلسیوس مورد ارزیابی قرار گرفت. نتایج نشان داد که افزایش زمان انبارمانی موجب کاهش خصوصیات کیفی بامیه گردید. تیمارهای اسید سالیسیلیک و موسیلاژ ریحان به‌طور معنی‌دار در حفظ خصوصیات کیفی بامیه مؤثر بودند. بیشترین میزان سفتی بافت میوه، مواد جامد محلول، اسیدیته قابل تیتر، اسید آسکوربیک و جذابیت ظاهری و کمترین کاهش وزن در تیمارهای اسید سالیسیلیک ۴ میلی‌مولار و موسیلاژ ریحان ۰/۳ درصد به دست آمد. بامیه‌های فاقد پوشش و بدون تیمار اسید سالیسیلیک در طی ۱۶ روز نگهداری کاملاً کیفیت ظاهری خود را از دست دادند اما بامیه‌های تیمار شده با غلظت‌های بالای اسید سالیسیلیک و موسیلاژ از کیفیت خوب و بازارپسندی لازم برخوردار بودند. درنتیجه، اسید سالیسیلیک و موسیلاژ ریحان می‌توانند به‌عنوان تیمارهای مؤثری برای حفظ جنبه‌های کیفی میوه بامیه برای مدت طولانی‌تر مورداستفاده قرار گیرند.