

Application salicylic acid and aloevera gel as edible coating layer to preserving fresh-cut melon slices in cold storage

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Article history

Received: 11 September 2016

Received in revised form:

31 October 2016

Accepted: 1 November 2016

Abstract

The change in packaged fresh-cut grapes quality that prepared by two different storage methods and treated by Salicylic acid and aloe vera was evaluated. Each melon fresh-cut slice, were prepared to treated with treatment. Thereafter, melon fresh-cut were treated by salicylic acid 0.5, 1 % and aloe vera gel 20, 30% that diluted with water. After drying, the samples put in rigid trays and stored at cold storage with 0°C and refrigerator with 4°C for 7 days. General melon fresh-cut quality (Test panel and acceptability), weight loss, total soluble solids (TSS), titratable acidity (TA), TSS/TA, pH and vitamin C were evaluated periodically with 3 days intervals. The results showed that there no significant effected between treatment and control but between treatment differences was significant ($P < 0.05$). Salicylic acid and aloe vera gel treatments induced significantly during both of storage times. Melon fresh-cut weight loss didn't significantly affect.

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Keywords

Fresh Cut
Weight Loss
Fruit quality
Vitamin C

Introduction

Fresh-cut products because of the ease of use and a high nutritional value have a high marketability (Jeong *et al.*, 2008). Due to the characteristics and benefits of fresh-cut, ready to use and the role of fruit and vegetables as the basic ingredients for human health, the importance of these products (Martin, 2007). Melon is one of the main tropical products that are sensitive to frost. This physiological disorder, especially was occurred when the fruit is placed in low temperature storage. Changes in membrane structure damaging as the first result due to placed in cold storage and then Secondary reactions of ethylene production, respiration increase or accumulation of toxic compounds such as ethanol and acetaldehyde was occurred (Valdenegro *et al.*, 2004). Preparation of fresh-cut products is accompanied with the injury as a wound mechanical leads to stress when the fruit is cutting (Watada *et al.*, 1996). Edible coatings are commercially to reduce the loss of moisture, prevent physical damage, improve the morphological characteristics of the product and increase the fruits of compounds as anti-browning, color, nutrients, flavors and ingredients antimicrobials are used (Martin Belloso *et al.*, 2005). Aloe vera gel is a polysaccharide component with an elastic coating, which can be easily dissolved in water and in the equally to cover product. The gel acts as a protection

layer on the product and the underlying cells to be protected against mechanical damage and prevents water loss. Aloe vera gel is transparent, odorless and has high absorption ability. The gel is completely safe and compatible with the environment, which can an alternative cover in various post-harvest fruit (Choi and Chung, 2003).

Salicylic acid is a phenolic compound is playing a main role at various stress stimuli induced resistance in plants against pathogens. In addition this compound encourage to induce resistance, in many other cases, such as increasing the amount of antioxidants in the product, reduced ethylene production in harvested crops and fungicide effects is important directly on spoilage fungi (Asghari *et al.*, 2007). Salicylic Acid by changing the activities of ripening enzymes, enzymes responsible for cell wall degrading and other antioxidant enzymes in the cell system, significantly affected on ripening and aging the fruits (Agarwal *et al.*, 2005). Increase the importance keeping fresh-cut melon fruit after harvest and use of substances that are less harmful to human health. With this approach, the use of salicylic acid and aloe vera gel as an edible coating in melon fresh-cut of the main purposes of this research.

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Material and Methods

Plant Material and experimental design

Melon (*Cucumis melo* L.) was harvested from a commercial farm in urmia, Iran, in 2014. At the laboratory, melons were selected to obtain homogeneous batches based on color, size and absence of injuries and healthy. Melons were cut to obtain from samples ranging from 200 to 300 g as fresh-cut fruits. The melons slices were treated with salicylic acid at concentrations 0, 0.5 and 1 mmol/L and also 33% and 20% concentrations of *Aloe Vera* L. gel. Treatment was performed by immersion during 3 min with a solution of 0,1 and 2 mmolL⁻¹ salicylic acid and *A. Vera* diluted (1: 3=30%) and (1:5=20%) with distilled water. After treatment the samples were stored at two places, one place in refrigerator and other cold storage. Samples were placed in 4°C temperature in refrigerator and other samples were stored in cold storage in 0±0.5°C temperature and 95%RH. Samples are evaluation in two time 3 and 7 days. The control fruits were immersed in distilled water and served as control for two times.

Weight loss

Melon fresh-cut samples were weighed at the beginning of the experiment just after treatment, and after 3 and 7 days during the storage time. Weight loss was expressed as the percentage loss of the initial total weight.

Total soluble solids (TSS), pH, Titratable acidity (TA), and TSS/TA, vitamin C

The pH was determined by pH meter (JENWAY – 3505), and titratable acidity (TA) (expressed as tartaric acid) was determined by titration of 25 ml filtrated juice by 0.1 N sodium hydroxide (NaOH) up to pH of 8.3. Total soluble solid (TSS) contents were determined by extracting and mixing one drop of juice from each fruit into a refractometer (CETI-Belgium). Vitamin C content of the samples was measured using 2, 6- dichlorophenol indophenols (Sigma Company) method as described by (A.O.A.C., 2000).

Statistical analysis

The experiment was conducted using a completely randomized design with 4 replications. Data were analyzed as a 2-factor linear model using the PROC GLM procedure (SAS software ver. 9.1) with treatment and storage time as the factors. Differences of least squared means were considered to be significant at P<0.05.

Results and Discussion

Melon quality

The change in grape fresh cuts quality including test panel and storage acceptability was summarized in table 1 and 2. It can be observed that decreasing quality at melon storage 7 days was more than 3 days storage. Melon fresh-cut slice treated with aloe vera and salicylic acid could not improved quality and reduces acceptability and test panel during 7 days refrigerator. In general melon fresh-cut that treated with aloe vera and salicylic acid together was improved melon quality more than each of the treatments alone. It seems use combined treatment was more affected on melon fresh-cut quality. Aloe vera gel coating decrease respiration in melon fresh-cut and in other hand salicylic acid encourage to induce resistance and changing the activities of ripening enzymes (Asghari et al., 2007).

Weight loss

The changes in the weight loss were shown in table 1 and 2. There were no significant differences between treatments. Melon fresh-cut treated with aloe vera gel and salicylic acid could not reduce weight loss significantly in all of treatments. Weight loss is mainly regulated by respiration, transpiration and metabolic activities in fruits. Zheng and Zhang (2004) reported that salicylic acid close the stomata which suppressed respiration rate and decrease weight loss of fruits. Thus, the results of this study suggest that salicylic acid might have reduced respiration and transpiration which delayed senescence. Weight loss mainly occurs due to water loss by transpiration and loss of carbon reserves due to respiration (Vogler and Ernst, 1999). The rate at which water is lost depends on the water pressure gradient between the fruit tissue and the surrounding atmosphere. Aloe gel is coating act as cover, thereby restricting water transfer and protecting fruit skin from mechanical injuries.

TSS, pH, TA and TSS/TA

The changes of pH, titratable acidity (TA), total soluble solids (TSS) and TSS/TA in melon fresh-cuts was summarized at table 1 and 2. In two storage methods, aloe vera gel and salicylic acid and also combined two treatments was significantly affected on pH. In all of treatment in two storage methods, pH content was decreased significantly (p≤0.05) during storage time. But there are no significant differences between control and treatment during storage time. There was no significant difference between both of treatments and control in TSS melon fresh-cut slices, at the 3 and 7 storage times in both refrigerator and

Table 1. Influence Aloe Vera gel and Salicylic acid treatment and storage time on melon fresh-cut during refrigerator at 4°C

Treatment	Storage Time (days)								
		pH	TSS	TA	TSS/TA	Vit. C(mg/100 g.FW)	Acceptability	Test Panel	W. loss
Control	3	5.75 ^{ab}	8.12 ^{abcd}	0.26 ^{ab}	32 ^{cd}	20.72 ^{cd}	2.4 ^d	1 ^d	2.4 ^{ab}
	7	5.53 ^{cd}	7.75 ^{abcd}	0.17 ^d	45.75 ^{ab}	27.7 ^{abcde}	1.5 ^{de}	1 ^d	3.6 ^{ab}
salicylic 0.5%	3	5.88 ^a	7.75 ^{abcd}	0.22 ^{abcd}	34b ^{cd}	21.37 ^{cd}	6 ^a	1 ^d	1.7 ^{ab}
	7	5.54 ^{cd}	7.75 ^{abcd}	0.16 ^d	47.5 ^a	24.52 ^{bcde}	4.75 ^{ab}	1 ^d	1.35 ^a
Salicylic acid 1%	3	5.55 ^{cd}	7.5 ^{abcd}	0.26 ^{ab}	28.7 ^{de}	23.25 ^{bcde}	5a ^b	1 ^d	0.1 ^b
	7	5.4 ^{ef}	7.5 ^{abcd}	0.18 ^{cd}	42.25 ^{ab}	23.25 ^{bcde}	4.5 ^{bc}	1 ^d	2.9 ^{ab}
Aloe vera 30%	3	5.56 ^{cd}	6.75 ^d	0.22 ^{abcd}	30.25 ^{cd}	24.55 ^{bcde}	5 ^{ab}	4 ^a	1 ^{ab}
	7	5.18 ^a	7 ^{cd}	0.17 ^d	40 ^{abcd}	33.95 ^{ab}	3.25 ^c	0 ^a	0.9 ^b
Aloe vera 20%	3	5.6 ^c	7.5 ^{abcd}	0.25 ^{abc}	29.25 ^{cd}	22 ^{cd}	6 ^a	4 ^a	2 ^{ab}
	7	4.9 ^h	7.2 ^{bcd}	0.25 ^{abc}	30 ^{cd}	37.12 ^a	1.25 ^d	0 ^e	0.77 ^b
Salicylic 0.5%+ Aloe vera 30%	3	5.74 ^d	8.5 ^{abc}	0.29 ^a	29.75 ^{cd}	16.97 ^a	6 ^a	1 ^d	0.1 ^b
	7	5.43 ^{def}	7.75 ^{abcd}	0.23 ^{abcd}	33.25 ^{bc}	33.32 ^{ab}	5.25 ^{ab}	1 ^d	1.47 ^a
salicylic 0.5% + Aloe vera 20%	3	5.75 ^{ab}	9 ^a	0.29 ^a	30.25 ^{cd}	19.47 ^{de}	6 ^a	3 ^b	0.9 ^b
	7	5.43 ^{def}	8.75 ^{ab}	0.21 ^{bcd}	41 ^{abcd}	24.07 ^{bcde}	4.5 ^{bc}	2 ^c	1.57 ^a
Salicylic acid 1% + Aloe vera 30%	3	5.75 ^{ab}	8.25 ^{abcd}	0.23 ^{abcd}	35 ^{abcde}	20.1 ^{cd}	6 ^a	1 ^d	0.1 ^b
	7	5.47 ^{ef}	9 ^a	0.28 ^{ab}	32.25 ^{cd}	28.95 ^{abcd}	4.5 ^{bc}	2 ^c	1.27 ^a
Salicylic acid 1% + Aloe vera 2%	3	5.78 ^{ab}	7.25 ^{bcd}	0.28 ^{ab}	25.5 ^a	21.37 ^{cd}	6 ^a	3 ^b	1.9 ^{ab}
	7	5.34 ^f	8.5 ^{abc}	0.23 ^{abcd}	36.5 ^{abcd}	30.82 ^{abc}	4.5 ^{bc}	3 ^b	1.7 ^{ab}

Means of three replicates followed by the same letters were not statistically significant different (P<0.05).

cold storage methods. In TA There are no significant differences between treatments in refrigerator storage but in cold storage method treatment significantly ($p \leq 0.05$) affected on TA. Melon fresh-cuts that were stored in cold storage, treatment significantly decrease the TA during storage time. TSS/TA ratio gradually increased during refrigerator storage but no significant differences observed between control and treatments. In cold storage method, treatment significantly ($p \leq 0.05$) affected on TSS/TA during storage time and shown a significant increase ($p \leq 0.05$). Generally, there was a gradual increase in TSS throughout storage that resulted to increasing TSS/TA ratio that can be accompanied by the development of off-flavors due to formation of ethanol in the fruits (Rapisarda *et al.*, 1998). It may be possible that with increasing water loss TSS content increased into fruits. Increase TSS can be attributed to the role of salicylic acid to improve membrane permeability, absorption and utilization of mineral nutrients. Some researches indicated that salicylic acid increased membrane permeability would facilitate absorption and utilization of mineral nutrients and transport of assimilates (javaheri *et al.* 2012).

Vitamin C

According to Table 1 and 2, there are no significant differences between control and treatments. Vitamin C content was increased during storage time in two storage methods. The highest vitamin C in refrigerator storage method was observed in aloe vera 30% treatment with 7 days and also the highest vitamin C content was obtain in Salicylic acid 1%+ Aloe vera 20% treatment at 7 days in cold storage method. In both storage methods treatment increased the vitamin C content. Javaheri *et al.* (2012) reported that vitamin C content in tomato treated with salicylic acid was higher compared to control plants. It is possible salicylic acid enhanced the activation some enzyme such as ascorbate peroxidase and also fresh-cut fruit that coated with aloe vera gel preserving vitamin C degradation.

Conclusion

Melon fresh-cut slice that stored in cold storage 0°C maintained quality better than refrigerator storage. Salicylic acid concentration and aloe vera gel that used in our study had no significant effects on quality of fruits and weight loss, TSS, pH, TA and

Table 2. Influence Aloe Vera gel and Salicylic acid treatment and storage time on melon fresh-cut during cold storage at 0°C

Treatment	Storage Time	Vit.							
		pH	TSS	TA	TSS/TA	C(mg/100 g .FW)	Acceptability	Test panel	W. loss
Control	3	5.92 ^a	8 ^a	0.2 ^b	38.75 ^{cd}	21.35 ^{cd}	3 ^a	1 ^a	2.4 ^b
	7	5.63 ^b	8.25 ^a	0.14 ^c	59.5 ^a	31.45 ^a	3 ^b	2 ^c	3.6 ^b
Salicylic 0.5% +Aloe vera 30%	3	5.70 ^b	8.25 ^a	0.28 ^a	28.75 ^{de}	19.47 ^d	6 ^a	3 ^b	0.85 ^{ab}
	7	5.39 ^c	8 ^a	0.21 ^b	38.25 ^{cd} _e	27.7 ^{abc}	4.25 ^c	3 ^b	0.6 ^b
Salicylic 0.5% +Aloe vera 20%	3	5.64 ^b	8.25 ^a	0.27 ^a	30.75 ^{cd} _e	21.35 ^{cd}	6 ^a	3 ^b	1.9 ^{ab}
	7	5.39 ^c	8.25 ^a	0.2 ^b	41.25 ^{bc}	25.82 ^{abcd}	5 ^b	0 ^e	1.7 ^{ab}
Salicylic acid 1% +Aloe vera 30%	3	5.73 ^b	8.25 ^a	0.27 ^a	30.75 ^{cd} _e	21.35 ^{cd}	6 ^a	3 ^b	1.9 ^{ab}
	7	5.43 ^c	8.25 ^a	0.2 ^b	41.25 ^{bc}	25.82 ^{abcd}	5 ^b	0 ^e	1.7 ^{ab}
Salicylic acid 1%+ Aloe vera 20%	3	5.7 ^b	7.25 ^a	0.26 ^a	27.25 ^a	23.27 ^{bcd}	5.75 ^a	4 ^a	0 ^b
	7	5.45 ^c	8.25 ^a	0.17 ^{bc}	51 ^{ab}	30.8 ^{ab}	5 ^b	0 ^e	1.52 ^a

Means of three replicates followed by the same letters were not statistically significant different ($P \leq 0.05$).

TSS/TA. In all treatment no significant differences was observed but salicylic acid and aloe vera gel treatment increased the TSS during both of storage methods and Also this treatments increased pH, TSS/TA and TA during storage times. Treatments had no significant effects on weight loss.

References

- Agarwal, A. and Prabakaran, S. A. 2005. Mechanism, measurement, and prevention of oxidative stress in male reproductive physiology. *Indian Journal of Experimental Biology* 43: 963–974.
- Aghdam, M. S., Mostofi, Y., Motallebiazar, A., Ghasemneghad, M. and Fattahi-Moghaddam, J. 2009. Effects of MeSA vapor treatment on the postharvest quality of Hayward kiwifruit. P.254. International Postharvest Conference. Antalya, Turkey.
- Choi, S. and Chung, M. H. 2003. A review on the relationship between *Aloe vera* components and their biologic effects. 1, p. 53. Proceeding of the Integrative Medicine Conference,
- Jeong, H. L., Jin, W. J., Kwang D.M. and Kee J.P. 2008. Effects of anti-browning agents on polyphenoloxidase activity and total phenolics as related to browning of fresh-cut 'Fuji apple, *Asean Food Journal* 15: 79-87.
- Javaheri, M., Mashayekhi, K., Dadkhah, A. and Tavallaee F. Z. 2012. Effects of salicylic acid on yield and quality characters of tomato fruit (*Lycopersicum esculentum* Mill.). *International Journal of Agriculture and Crop Science* 4(16):1184-1187.
- Martin, O. 2007. Pros and cons of minimally processed foods. *Trends Food Science Technology* 18(11): 582-583.
- Martin-Belloso, O., Bendicho, S., Elez-Martinez, P., Barbosa-Canovas, G. V., Tapia, M. S. and Cano, M. P. 2005. Does High Intensity Pulsed Electric Fields Induce Changes in Enzymatic Activity, Protein Conformation and Vitamin and Flavor Stability? p. 87-104. Marcel Dekker/CRC Press, Boca Raton, FL, USA.
- Rapisarda, P., Carollo, G., Fallico, B., Tomaselli, F. and Maccarone, E. 1998. Hydroxycinnamic acids as markers of Italian blood orange juices. *Journal of Agriculture Food Chemistry* 46: 464–470.
- Valdenegro, M., Flores, F. B., Romojaro, F., Ramirez, M. and Martinez-Madrid, M. C. 2004. Susceptibility of Spanish melon fruits to chilling injury during cold storage. *Acta Horticulturae* 682: 1219–1225.
- Vogler, B. K. and Ernst, E. 1999. Aloe vera L.: a systematic review of its clinical effectiveness", *British Journal of General Practice* 49(447): 82-90.
- Watada, A. E., Ko, N.P. and Minott, D.A. 1996. Factors affecting quality of fresh-cut horticultural products. *Postharvest Biology and Technology* 9: 115–125.
- Zheng, Y. and Zhang, Q. 2004. Effects of polyamines and salicylic acid postharvest storage of 'Ponkan' mandarin. *Acta Horticulturae* 632(1): 317-320.