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Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

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Physical Quality Observation of Edible Coating Made from Aloe Vera on Cantaloupe (*Cucumismelo* L.) Minimally Processed

R. Yulianingsih, D.M. Maharani, L.C. Hawa and L. Sholikhah
Department of Agricultural Engineering, Faculty of Agricultural Technology,
University of Brawijaya, Malang, Indonesia

Abstract: Minimally processed fruits, which provide fresh and edible product, are facing some difficulties on damages such as progressive deterioration due to desiccation, microbial growth and bio chemical processes. To overcome these problems the application of edible coating from aloe vera suggests a proper assistance. An edible coating from aloe vera was developed and tested on minimally processed cantaloupe fruit for the extension of shelf-life. A coating from aloe vera with 0.02% ascorbic acid, 1% Glycerol and 1.5% CMC (*Carboxymethyl Cellulose*) was applied on minimally processed cantaloupe. Cantaloupes coated with the aloe vera were stored at 5, 10, 15, 20 and 27°C for 24, 48, 76 and 96 hours. Weight loss, hardness and color of cantaloupes were measured to determine the ability of aloe vera in protecting the cantaloupes from deterioration after storing at the various conditions. The applications of coating from aloe vera on cantaloupe were shown reducing weight loss and color changes and effective in retaining the firmness of the minimally processed cantaloupe.

Key words: Edible coating, aloe vera, cantaloupe, minimally processed

INTRODUCTION

Minimally processed fruit is a popular product because of its potential health benefits and a trend towards consumer desires for “fresh” foods. The increasing demand of fresh-cut product presents a challenge for researchers and processors to make more stable and safe products from microbiological standpoint. Edible coating is an alternative solution for those problems. Edible coating is defined as a thin layer of material which can be eaten and provides a barrier to moisture, oxygen and solute movement for the food (Guilbert, 1986). Application of edible coating on fruits have the same effect as modified atmosphere packaging (MAP) in modifying the internal gas composition (Park, 1999). Edible coating has a good additional protection for minimally processed fruit. The appropriate edible coating formulation may reduce gas exchange rates and water loss as well as represent an excellent way of incorporating additives to control reactions that are detrimental to quality (Baldwin, Nisperos-Carriedo and Barker, 1995). Edible coating can be developed from proteins, polysaccharides, lipids or from a blend of these groups of material (Kester and Fennema, 1988). In this case, one material that can be used as a coating material is aloe vera.

Aloe vera contains active ingredients such as essential oils, amino acids, minerals, vitamins, enzymes and glycoproteins. The sheets of aloe vera gel provide a barrier to oxygen and water movement and have no effect to the taste (Bernstein, 2005). It also has anti-microbial activity for fighting against several microbes such as *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Trichophyton mentagraphytes*, *T. schoeleinii*, *Microsporium canis* and *Candida albicans*. The use of Aloe Vera for star fruit coating has been investigated by Mardiana *et al.* (2008), while Koswara *et al.* (2002) explore the edible coating composition made of CMC and glycerol. The aim of this work is to investigate the ability of edible coating from aloe vera to protect the minimally processed cantaloupe from deterioration.

MATERIALS AND METHODS

Cantaloupes and aloe vera: Cantaloupe was cut crosswise into 2 parts, then each piece was cut vertically into eight pieces. Hence the totals are 16 pieces.

Preparation of aloe vera gel: Aloe vera we washed and the leave skins were peeled. The pulps were separated and crushed in a blender to turn it into mush. Filter the pulps of aloe vera by using textile filter until it remained viscous liquid. It was then deposited.

Process of making edible coating: Edible coating was made by adding 0.02% ascorbic acid; glycerol 1 and 1.5% CMC in 250 mL of distilled water, stirred until distributed evenly, then pour it to 600 mL Aloe vera gel.

Corresponding Author: R. Yulianingsih, Department of Agricultural Engineering, Faculty of Agricultural Technology, University of Brawijaya, Malang, Indonesia

Then the Aloe vera gel solution was heated at a temperature of 100°C for 5 min. The gel Solution was then cooled at a temperature of 20-35°C. The gel solution was used for coating 20 pieces of Cantaloupe.

Cantaloupe coating process: The gel solution of aloe vera was prepared in the bowl. The aloe vera gel soaked in slices of cantaloupe for 5 min and submerged evenly. Then, the coated cantaloupes were drain and dried by airing it for 30 min. The dried fruits were divided in two groups, i.e., the cantaloupes that were packaged by plastic wrap and the cantaloupes that were not packaged. Finally the trays containing coated cantaloupes with wrapping, unwrapping coated cantaloupes and non-coated cantaloupes were stored at 5, 10, 15, 20 and 27°C.

Physical analysis: Weight loss, hardness and color of cantaloupes were measured to determine the ability of aloe vera in protecting the cantaloupes from deterioration after storing at various conditions. The determination of hardness was done by using a penetrometer Electric BI-235 with the following conditions: test speed (5.0 mm/s) and penetration distance (8 mm). The resistance of penetration was measured as the strength necessary for a cylindrical probe of 4 mm of diameter. The color was determined by using color reader and recorded through three readings, i.e., L (Lightness), a (green chromaticity) and b (yellow chromaticity). Whiteness index (WI) and Chroma (C) was calculated through the following equation:

$$100-[(100-L)^2+(\alpha)^2+(b)^2]^{\frac{1}{2}}$$

and:

$$C=[(\alpha)^2+(b)^2]^{\frac{1}{2}}$$

respectively.

Sensory evaluation: One hundred twenty pieces of fresh-cut cantaloupes were divided into three groups, i.e., 40 pieces for non-coated, 40 pieces for unwrapping coated and 40 pieces for wrapping coated were used to carry out a sensory analysis. Each groups were divided into two. There were evaluated for sensory test in the same day (t = 0) and after being stored at 5°C for four days (t = 4) by twenty volunteers. Each volunter evaluated 6 samples (3 prepared at t = 0 days and 3 stored for four days). The attributes of taste, odour, firmness and color were evaluated by the panelists. The tests was done by using a hedonic scale test consists of 7 values with seven statements, ranging from extremely dislike to very like.

RESULTS AND DISCUSSION

Weight loss: The weight loss of fruits was due to respiratory process, transference of humidity and oxidation process that occurred during the storage (Ayranci and Tunc, 2003). Figure 1 showed that the weight loss increased according to the storage time. Temperature greatly affects the amount of water loss. According to the Arrhenius rule, every increase of 10°C will twicely increase the weight loss rate. The influence of temperature can be avoided by giving the insulator (heat barrier) on the package (Syarif *et al*., 1989). The result indicates that aloe vera coating significantly reduces the weight loss of cantaloupe that was stored in the low temperature (5°C). The condition was much more better if the cantaloupes were store in low temperature and were packaged by plastic wrapping.

The weight loss rate constant was affected by the storage temperature and coating treatments. In general, cantaloupes, coating by aloe vera, have the smaller weight loss rate constant than control. Another factor that affects the increasing of the weight loss was the transpiration of watering loss in the living tissues. As a result, the commodity becomes shriveled and wrinkled. The weight loss rate of vegetables and fruits are not the same even if they are stored in the same conditions. The larger the surface areas are, the higher rates of the weight loss are. The transpiration and evaporation commodities will occur when the difference in vapor pressure of the atmosphere on the product and the surrounding vapor pressure are presence. The Internal Relative Humidity of atmosphere in fresh fruits and vegetables is at least 99%, while the surrounding atmosphere is usually lower. If the commodity is placed in an atmosphere with RH less than 99%, then the moisture will move out from the surrounding (Winarno, 1990).

Firmness: The loss of firmness is one of the main factors limiting the quality and post-harvest of the shelf-life of fruits and vegetables. The changes in the firmness between the control and treated fruits

Table 1: Rate of weight loss constant

Temperature (°C)	Coating+ Wrapping	Coating	Control
5	0.0562	0.1172	0.3338
10	0.1333	0.3491	0.3325
15	0.3078	0.3495	0.4729
20	0.4747	0.7695	0.7389
27	0.7493	1.0015	0.6328

Table 2: Rate of firmness-decreased constant of cantaloupe

Temperature (°C)	Coating+ Wrapping	Coating	Control
T5	0.0542	0.1357	0.1930
T10	0.104	0.0870	0.1101
T15	0.1157	0.1222	0.1184
T20	0.2388	0.2284	0.2588
T27	0.3804	0.5884	0.8252

Value of rate constant of the firmness change tends to increase according to the higher storage's temperature. Additionally, coating cantaloupes have little value than the control

Table 3: Changes in whiteness index of fresh-cut cantaloupes pieces with aloe vera coating and stored for seven days

	Whiteness Index						
Treatment	1	2	3	4	5	6	7
Coating+wrapping							
T 5°C	38.88	38.54	38.17	37.78	37.75	37.70	37.64
T 10°C	38.20	38.01	37.82	37.60	38.71	39.62	
T 15°C	37.90	37.39	36.85	36.27	36.29		
T 20°C	37.35	37.07	36.78	37.00			
T 27°C	35.21	35.92	34.46				
Coating							
T 5°C	36.63	36.55	36.47	36.37	36.30	36.27	
T 10°C	34.67	34.59	34.51	34.42	34.48	34.21	34.28
T 15°C	34.21	34.13	34.04	33.85			
T 20°C	32.24	32.30	32.51				
T 27°C	36.23	39.25	43.38				
Non-coated							
T 5°C	34.53	34.48	34.33	34.24	34.09		
T 10°C	37.61	37.01	36.38	36.07	35.68		
T 15°C	35.37	34.74	34.05	33.06			
T 20°C	36.57	36.39	35.67				
T 27°C	37.35	41.40					

Table 4: Changes in chroma of fresh-cut cantaloupes pieces with aloe vera coating and stored for seven days

	Chroma						
Treatment	1	2	3	4	5	6	7
Coating+wrapping							
T 5°C	37.92	38.93	39.96	41.00	41.69	42.38	43.07
T 10°C	35.67	36.52	37.36	38.21	39.24	40.27	41.09
T 15°C	33.49	35.02	36.55	38.08	41.06		
T 20°C	36.47	37.28	38.08	39.76			
T 27°C	38.83	41.99	46.84				
Coating							
T 5°C	35.20	35.84	36.49	37.13	39.80	41.69	
T 10°C	37.58	37.94	38.30	38.67	40.01	40.58	40.66
T 15°C	36.85	37.41	37.97	39.53			
T 20°C	37.55	38.43	40.58				
T 27°C	38.11	41.21	46.01				
Control							
T 5°C	38.30	40.02	41.77	43.34	44.92		
T 10°C	35.02	36.33	37.67	39.65	41.63		
T 15°C	34.15	35.83	37.52	40.28			
T 20°C	36.18	37.52	39.26				
T 27°C	38.96	40.77					

during the storage are shown in Fig. 2. The firmness of fresh-cut cantaloupe decreased significantly throughout the storage. He firmness reduced from 1043 g on day 0 to 747 g on day 5th. This shows that the reduction of the firmness was an important factor affecting the quality of fresh-cut Honeydew cantaloupe fruit during the storage. The decreasing firmness on the coating and control cantaloupe were larger than coating and wrapping cantaloupe. This suggests that treatment of wrapping and coating cantaloupe provides protection against firmness. The moisture of cantaloupe decreased due to respiration and transpiration which in turn leads to the discoloration accompanied by a reduced firmness on the cantaloupe (Desrosier, 1988). Firmness-decreased rate constant was analyzed by using the order 1 and showed at Table 2.

Color development: Table 3 and 4 shows the effects of edible coatings on the color attributes. Those are whiteness index and chroma of cantaloupes slices at 5°C which were calculated through the Eq. 1 and 2. The flesh color in cantaloupe is orange. The intensity of the orange was correlated with beta-carotene content (Burger *et al*., 2006). During the storage at 5-20°C, there were no significant changes, but when the storage was at 27°C, especially for coating and non-coated, the color of cantaloupes changed rapidly and the flesh color of cantaloupe was lighter. The chroma of cantaloupes

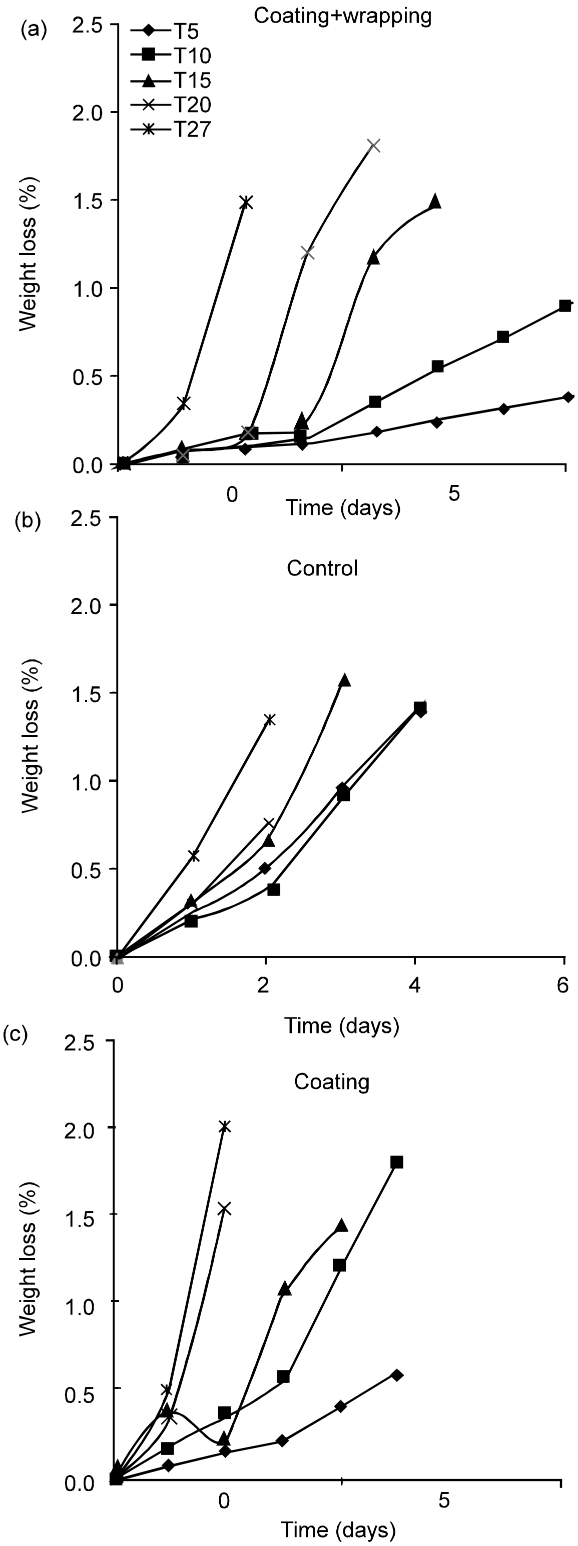

Fig. 1(a-c): Effect of coating studies on the weight loss of cantaloupe. The storage temperature significantly affected the weight loss of cantaloupe (Cantalopue were stored at 5°C (T5), 10°C (T10), 15°C (T15), 20°C (T20) and 27°C (T27)

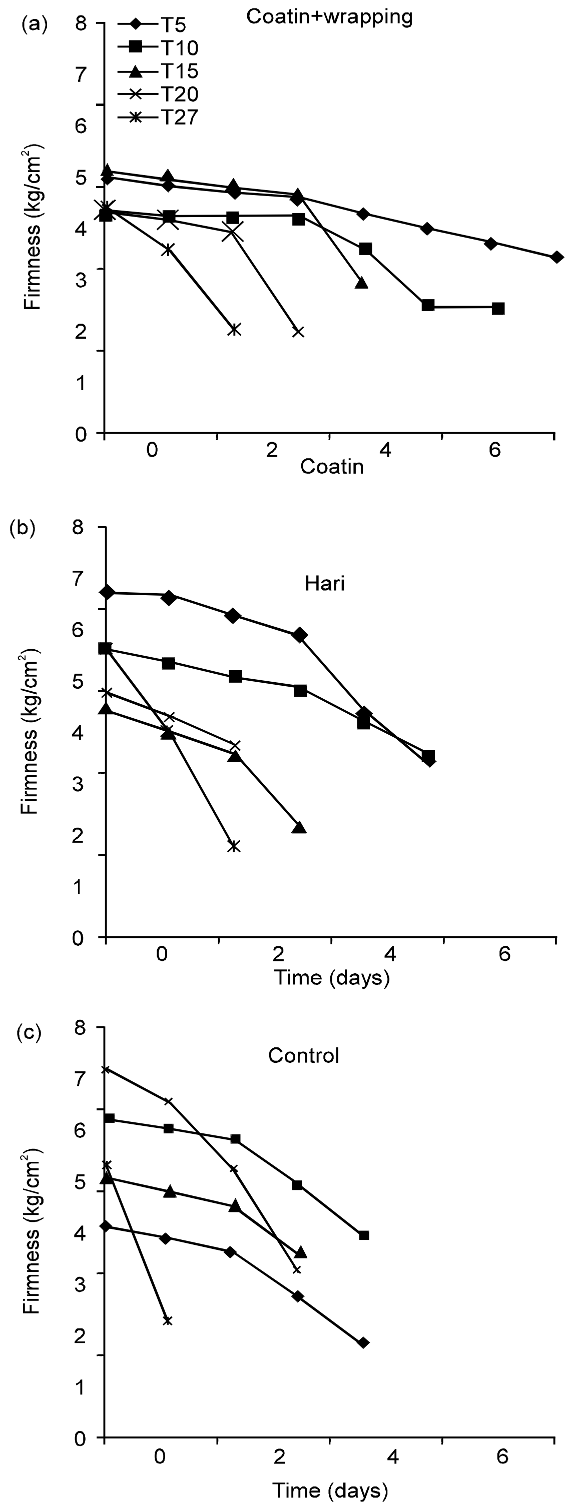

Fig. 2(a-c): Effect of coating studies on the firmness of cantaloupe. The storage temperature were significantly affected firmness of cantaloupe (Cantalopue were stored at 5°C (T5), 10°C (T10), 15°C (T15), 20°C (T20) and 27°C (T27)

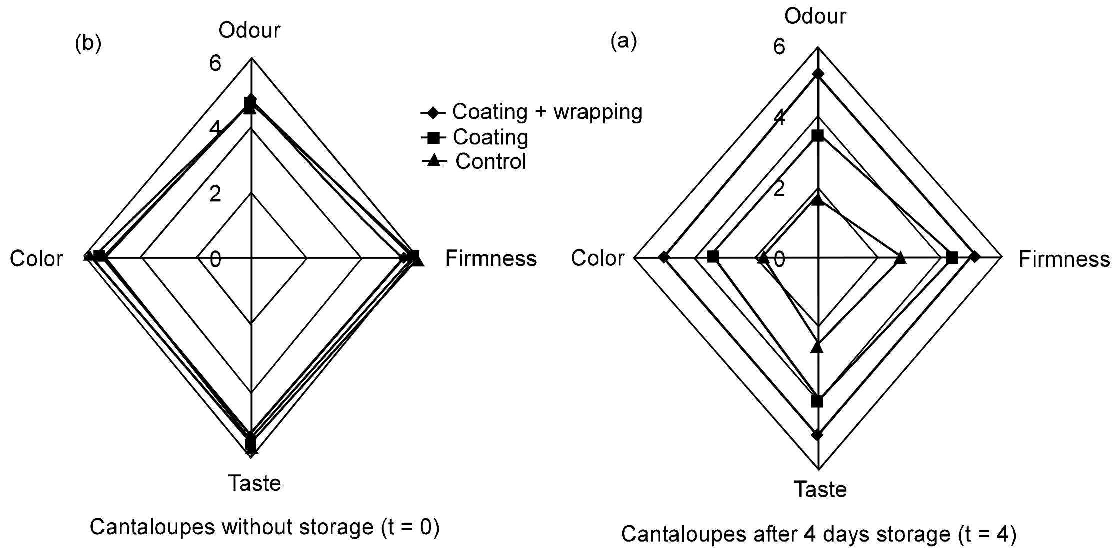

Fig. 3(a-b): Influence of storage time on sensory characteristics of fresh-cut cantaloupe pieces. Tests was done by using a hedonic scale test consists of seven values with seven statements, ranging from 1 = extremely dislike, 2 = dislike, 3 = somewhat dislike, 4 = neutral/normal, 5 = somewhat like, 6 = like and 7 = very like

began to increase just after the storage, respectively, when storage was at 27°C. But for the colder temperature storage, there were slightly chroma changes both on coating and control. It shows that during the storage, the flesh color was not the important factor limiting the quality of cantaloupe cut. Portela and Cantwell (2001) and Ergun *et al.* (2007) suggest that the development of translucent or water-soaking symptom will have effects on the values of L and chroma of minimally processed musk cantaloupe fruit. However, the result in that study shows no development on translucent and water-soaking symptom over the storage.

Sensory evaluation of the fresh-cut cantaloupes: The changes in sensory parameters are including taste, odor, firmness and color of coated and uncoated fresh cut cantaloupe during four days of the storage are shown in Fig. 3. Consumer testing was limited for four days storage for eligibility for the consumer in terms of physical reason, especially for only coated and non-coated.

The storage time did not show an important effect on the evaluated sensory characteristics (i.e., odor, color, firmness and taste) for cantaloupes with coating and wrapping and the changes throughout the storage time did not appear to be perceived by the panelists. But for coated and non-coated cantaloupe, there were significant effects on the evaluated sensory characteristics; fewer changes were on coating only cantaloupe than non-coated cantaloupe. Debeaufort *et al.* (1998) indicated that the using of edible coatings can reduce the loss of volatile compounds from the food to avoid the partial or total loss of food flavors.

Conclusion: The applications of coating from aloe vera on cantaloupe were shown to be beneficial in retarding the senescence process. This coating reduced the weight loss and color changes and was effective in retaining the firmness of the minimally processed cantaloupe. The combination coating and wrapping give the best result.

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