

## Influence of Some Natural Edible Coatings Post-Harvest Treatments on "Maamoura" Guava Fruit Quality and Storability

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**Abstract:** Guava is tropical and subtropical climacteric fruit. Guava fruit has a limited postharvest life due to highly perishable, susceptible to chilling injury, abrupt softening, fast ripening, fungal growth and mechanical damage. So, this experiment was aimed to extend guava fruit quality and storability via natural edible coating. This experiment was carried out during two seasons (2019-2020) on "Maamoura" guava cv. at the laboratory of Horticultural Crop Technology Department, NRC, Egypt. Guava fruit treated with gelatin, cactus pear extract, henna leaf extract, moringa leaf extract and control (tap water) then stored under cold storage conditions (8±1 °C). The results indicated that all treatments extending storage period till three weeks with a significant reduction in weight loss percent and decay percent content compared to the control which stored for only two weeks under cold storage conditions. Moreover, gelatin recorded the significant lowest fruit weight loss percent and decay percent followed by cactus pear extract. In addition gelatin edible coating maintaining high fruit freshness (delaying ripening) through preserve high amount of titratable acidity and Vitamin C content with low TSS content compared to the control. This study showed the light on using safety natural extracts to extend storability of guava fruit during cold storage.

**Key words:** Gelatin • Cactus pear • Henna • Moringa • Storage

### INTRODUCTION

Guava (*Psidium guajava* L.) is one of the most promising fruit grown in tropical and subtropical regions worldwide. It known as "Poor man's apple" or "Apple of tropics" for low fruit prices and prolific bearing nature [1]. It belongs to Myrtaceae family and considered one of remunerative crop and the exquisite nutritionally valuable [2]. Due to tolerant to high temperature, high nutritional value, high return, the potential for processing, there exists a great interest for large-scale guava cultivation. Guava is the richest fruit of vitamin C and consider a good source for pectin. Guava fruits has a great demand for fresh and processing purposes in domestic and international markets [3].

One of the serious problems faces of guava world trade is short postharvest life. Led to a significant loss of

guava production during harvest, handling and transportation to the far markets [4]. At ambient condition the fruit cannot be stored more than 3 days [5]. Fruits rapidly perish with higher weight loss, fungal decay due to its sharp ripening nature, soft skin, high respiration and high ethylene production, which limits its marketability. So, guava fruit ripening control is a must and necessary to increase their storability and marketability [6].

Cold storage-maintained quality of fruit due for reducing ripening, transpiration, respiration rate, ethylene production, disease incidence, enzymatic reactions subsequently extend fruit shelf life [7]. Using edible coatings create modified atmosphere which modulate moisture loss, fruit metabolism and extend the shelf life. Likewise, edible coating application on the fruit, Moringa in guava, Avocad, Tomato as gelatin use as edible coating application in Strawberry, sweet cherry [8-12].

The most preferable postharvest treatments according to consumer preference that are environmentally friendly which mean natural, safety, free from chemicals and biodegradability. For that it can be consider as an alternative preservative coating for vegetables and fruits [9]. Moreover, the demand for production safety food increases with increasing the importance of food security concern, people awareness and organic farming [13]. Searching for an alternative method to reduce the use of synthetic fungicides, fertilizers, ... etc., is a must [13, 14].

In this context, leaf extract of moringa is draw attention as low-cost bio stimulant for being similar or more effective than synthetic fungicides for postharvest technology beside preserving the soil and the farmers' health [15-17]. It is composed of bioactive compounds, such as vitamin (A, B, C, E) carotenoids, flavonoids and phenolic acids [18]. It had relatively high inhibitory potential against fungal pathogens in different concentrations from 30% till 10% maintained papaya fruit quality [19]. In addition, it preserved textural quality and volatile compounds beside reduction of microbial growth and suppress respiration [20].

Gelatin is a natural water-soluble biopolymer protein obtained by collagen hydrolysis [21]. Gelatin as edible coating was barrier effective against respiration gases as modified atmosphere, beside suppressing the softening enzymes activity such as pectin methyl esterase, polygalacturonase,  $\beta$ -galactosidase and cellulase [22, 23]. Aguilar-Mendez *et al.* [24] found that gelatin coatings decreased weight loss and extended avocado postharvest shelf life.

Henna (*Lawsonia inermis*) extract has a high antimicrobial, antifungal and antioxidant activity similar to prickly pear (*Opuntia ficus-indica*) [25-29].

There is little or no information available about the effect of moringa leaf extract, cactus pear leaf extract and gelatin as edible coatings on extending the storability of guava fruits. Therefore, the objective of our study was to evaluate the potential previous natural extracts coatings on maintaining postharvest quality of "Maamoura" guava fruit

## MATERIALS AND METHODS

The present study was carried out during two seasons (2019-2020) at the laboratory of Department of Horticultural Crops Technology, National Research center, Giza, Egypt. Fine-quality guava fruits of the "Maamoura" cultivar at full green color, uniform size, firm stage, free from blemishes and mechanical damage were

harvested. The experiment aimed to study the effect of some natural extracts Cactus pear, moringa, Henna and gelatin as edible coating on the postharvest quality of "Maamoura" guava cv. during cold storage.

**Preparation of Plant Extracts:** Cactus pear stems were peeled and cubed. Samples were cooked with water in the ratio of 1:5 in autoclave at 160 c fir 1 h. the cooked pulp was filtered and left to cool. The slurry was centrifuged for 10 min and the supertant obtained was used as coating material (cactus pear mucilage). The filtrate (pulping liquor) was also used as coating solution. Polyethylene glycol of molecular weight 2000 as plasticizer was added to coating solution 5% w/v. ph. value of this solution was adjusted at 7 using few drops of ammonia solution.

Moringa leaf extract was prepared by soaking 100 g of air-dried moringa leaf in one liter of distilled water for 24 hrs. [30]. Then diluted after filtered with water to prepare 20% concentrations by dissolving 20ml of filtered solution plus 3ml glycerol in 100ml distilled water in a beaker.

Gelatin 8% was prepared directly through adding 8 g gelatin powder plus 3ml glycerol in 100ml distilled water in a beaker. For Henna 2% it prepared as the moringa leaf extract by soaking 100 g of air-dried henna leaves in one liter of distilled water for 24 hrs. Then diluted after filtered with distilled water to prepare 2% concentrations by dissolving 2ml of filtered solution plus 3ml glycerol in 100ml distilled water in a beaker. Finally, control treatment preparing by adding 3ml glycerol in 100ml distilled water.

**Treatments:** A total of five treatments (20% cactus pear extract, 20% moringa leaf extract, 8% gelatin, 2% henna leaf extract and control (tap water) were used in this experiment. Fruits were treated in three replicates, each replicate consists of 10 fruits. Fruits were dipped for 5 min. in the previous prepared solutions, then keep to dry at room temperature, packed in perforated carton boxes and stored up to 21 days at  $8 \pm 1^\circ \text{C}$  and 90% relative humidity for visual observations. The following physical and chemical fruit properties were determined weekly during cold storage.

**Fruit Physical Properties:** Weight loss of guava fruit was determined using a digital balance by the following formula:  $\text{weight loss \%} = (\text{Initial weight} - \text{weight in the specific time of storage}) / \text{initial weight} \times 100$  [31].

The decay percentage was evaluated visually and calculated by the following formula

Fruit decay % = (the number of rotten fruit / the total number of fruit) × 100. Rotten fruit were classified as having at least one visible rotten spot on the surface [31].

**Fruit Chemical Properties:** In the extracted juices, total titratable acidity expressed as percentage of citric acid by titration with 0.1 N sodium hydroxide using phenolphthalein as indicator [32]. Ascorbic acid (V.C) was expressed in milligrams ascorbic acid per 100 ml of fruit juice using 2, 6 dichlorophenolindophenol titrimetric method [32]. Digital hand refractometer (PR32, Atago Paleta ATago CO .LTD. Japan) used to TSS determination and expressed as °Brix [33].

**Statistical Analysis:** The complete randomized block design was followed for arrange treatments with three replicates for each treatment. Differences significances between treatments were analyzed using MSTAT-C statistical package [34]. LSD values were calculated at 0.05 [35].

## RESULTS AND DISCUSSION

**Fruit Weight Loss (%):** The results about the effect of henna, moringa leaf extract, cactus pear extracts and gelatin as edible coating on fruit weight loss of guava during cold storage are shown in Table (1). All treatments success in extending storage period of guava for three weeks except for the control treatments, which stored only for two weeks, in both seasons. Moreover, gelatin recorded the significant lowest values of weight loss percentage through three weeks. Cactus pear extracts during the first and the second week of cold storage recorded lowest weight loss compared to Henna and moringa leaf extracts with a significant value in the first week during cold storage in both seasons.

**Fruit Decay (%):** The results about the effect of gelatin and extracts of henna, moringa leaf extract and cactus pear on decay percent of guava during cold storage are shown in Table (3). Data showed that, all treatments significantly decreased decay percent compared to the control. Moreover, gelatin edible coating treatment decreased decay percent significantly during the second and third weeks of guava during cold storage compared to the all-other treatments in the both seasons.

**Fruit TSS (%):** The results about fruit TSS percent as affected by gelatin and extracts of henna, moringa leaf

extract, cactus pear as edible coating on TSS content of guava during cold storage are shown in Table (3). It can be noticed that, gelatin edible coating followed by cactus pear extract treatment decreased TSS content significantly during the first and second week of cold storage compared to the control treatment in the first season. While during the second season, at the third week of cold storage, moringa leaf extract significantly decreased TSS of guava compared to the other treatments. Decreasing TSS content beside high acidity is an indicator to that, fruit is still freshness in ripening stage.

**Fruit Acidity (%):** Table (4) show the effect of gelatin and extracts of henna, moringa leaf extract, cactus pear as edible coating on acidity content of guava fruit during cold storage. The results clear that, gelatin edible coating treatment maintain significantly high acidity content during the second week of guava during cold storage compared to the control treatment in both seasons. Moreover, moringa leaf extract and cactus pear extract maintained significant high acidity content compared to henna extract and control in the second seasons, during cold storage. Maintaining low TSS content beside high acidity are an indicator to that, fruit is still freshness in ripening stage.

**Fruit Vitamin C (%):** The results about the effect of gelatin and extracts of henna, moringa leaf extract and cactus pear as edible coating on vitamin C percent of guava during cold storage are shown in Table (5). Data observed that, all treatments success in preserving vitamin C percent significantly higher than control during cold storage compared to the control treatments, in the second seasons. Moreover, gelatin recorded the significant highest vitamin C percentage through the first and second weeks of cold storage compared to the control. Preserving high amount of vitamin C is consider as indicator for the freshness of fruit.

The effect of gelatin on decreasing weight loss and decay percent during cold storage was previous observed by Gol and Rao, [23] as they found that, beneficial impact of gelatin coatings in delaying weight loss, titratable acidity, TSS and sugar content beside total carotenoids of mango fruit. Moreover, gelatin coatings led to the highest retention of ascorbic acid and phenolic content. Similary, gelatin coatings success in delaying mango fruit ripening via suppressing softening enzymes activity like pectin methyl esterase, polygalacturonase and β-galactosidase and cellulase. In addition, 10% gelatin coating-maintained

Table 1: Effect of some natural edible coating on fruit weight loss % of "Maamoura" guava during cold storage

Treatments	Storage period (weeks)			
	0	1	2	3
First season				
8% Gelatin	0	2.0 c	3.5 d	8.6 b
2% Henna extract	0	5.5 a	7.0 b	11.0 a
20% Moringa extract	0	5.3 a	4.6 bc	11.0 a
20% Cactus pear extract	0	3.3 b	5.7 c	10.6 a
Control	0	5.5 a	9.8 a	-
Second season				
8% Gelatin	0	1.8 d	3.3 c	8.4 b
2% Henna extract	0	3.6 b	6.1 b	9.6 a
20% Moringa extract	0	3.5 b	4.1 bc	9.6 a
20% Cactus pear extract	0	2.3 c	5.1 bc	9.9 a
Control	0	4.5 a	9.9 a	-

Values have the same letter (s) are not significantly different at 5% level

Table 2: Effect of some natural edible coating on decay percent of "Maamoura" guava during cold storage

Treatments	Storage period (weeks)			
	0	1	2	3
First season				
8% Gelatin	0	4.4 b	17.7 c	43.9 b
2% Henna extract	0	10.6 b	30.4 b	53.1 a
20% Moringa extract	0	9.3 b	33.2 b	50.4 a
20% Cactus pear extract	0	7.4 b	29.6 b	50.7 a
Control	0	37.7 a	53.4 a	-
Second season				
8% Gelatin	0	3.1 b	22.6 c	45.8 c
2% Henna extract	0	9.3 b	33.0 b	50.8 b
20% Moringa extract	0	8.2 b	30.7 bc	55.8 a
20% Cactus pear extract	0	7.1 b	30.7 bc	52.9 a
Control	0	29.9 a	46.0 a	-

Values have the same letter (s) are not significantly different at 5% level

Table 3: Effect of some natural edible coating on TSS of "Maamoura" guava during cold storage.

Treatments	Storage period (weeks)			
	0	1	2	3
First season				
8% Gelatin	6.4 a	7.2 d	7.4 c	8.1 b
2% Henna extract	6.4 a	7.8 a	8.4 a	8.6 a
20% Moringa extract	6.4 a	7.7 b	8.6 a	8.5 a
20% Cactus pear extract	6.4 a	7.6 c	8.0 b	8.5 a
Control	6.4 a	7.8 a	8.4 a	-
Second season				
8% Gelatin	7.1 a	7.5 a	7.8 a	8.4 ab
2% Henna extract	7.1 a	7.4 a	7.8 a	8.2 b
20% Moringa extract	7.1 a	7.3 a	7.8 a	8.1 c
20% Cactus pear extract	7.1 a	7.6 a	7.8 a	8.6 a
Control	7.1 a	7.6 a	8.2 a	-

Values have the same letter (s) are not significantly different at 5% level

Table 4: Effect of some natural edible coating on fruit acidity of "Maamoura" guava during cold storage

Treatments	Storage period (weeks)			
	0	1	2	3
First season				
8% Gelatin	0.175 a	0.159 a	0.155 a	0.150 a
2% Henna extract	0.175 a	0.158 a	0.151 b	0.145 b
20% Moringa extract	0.175 a	0.161 a	0.150 b	0.146 b
20% Cactus pear extract	0.175 a	0.160 a	0.150 b	0.146 b
Control	0.175 a	0.154 b	0.149 c	-
Second season				
8% Gelatin	0.170 a	0.166 a	0.165 a	0.157 a
2% Henna extract	0.170 a	0.162 a	0.149 c	0.150 a
20% Moringa extract	0.170 a	0.164 a	0.161 b	0.154 a
20% Cactus pear extract	0.170 a	0.163 a	0.163 ab	0.154 a
Control	0.170 a	0.158 a	0.149 c	-

Values have the same letter (s) are not significantly different at 5% level

Table 5: Effect of Extracts of some natural edible coating on Vitamin C percent of "Maamoura" guava during cold storage

Treatments	Storage period (weeks)			
	0	1	2	3
First season				
8% Gelatin	54.6 a	50.4 a	48.5 a	47.1 a
2% Henna extract	54.6 a	50.0 ab	47.4 b	47.1 a
20% Moringa extract	54.6 a	50.0 ab	47.3 b	47.0 a
20% Cactus pear extract	54.6 a	50.0 ab	47.3 b	47.0a
Control	54.6 a	49.4 b	46.9 b	-
Second season				
8% Gelatin	57.0 a	53.1 a	49.2 a	49.0 a
2% Henna extract	57.0 a	51.3 b	48.0 b	47.2 b
20% Moringa extract	57.1 a	51.2 b	48.0 b	47.3 b
20% Cactus pear extract	57.1	51.3 b	48.4 ab	57.5 b
Control	57.0 a	50.0 c	46.3 c	-

Values have the same letter (s) are not significantly different at 5% level

production of defense-related peroxidase enzymes at high level followed by 5% gelatin. The role of gelatin coating was observed in many fruit such as avocado and strawberry [24, 11]. Furthermore, the other benefit from gelatin coating is their inhibition effect for total flora, molds and yeasts [11]. Which reflect the effect of gelatin coating in extending fruit shelf life.

This is the first report on using cactus pear extract and henna leaf extract in postharvest technology. Our results indicate the superior results of cactus pear extract and henna extract in extending storage of guava fruits till three weeks after harvest compare to only two weeks for control. Cactus pear extracts and henna leaf extract during significantly decreased weight loss compared to the control during cold storage in both seasons. Promising effect of henna leaf extract in delaying

fruit weight loss and decay percent come from the antimicrobial and antifungal effects beside antioxidant activity [25-27]. Also, prickly pear has an antimicrobial effect and antioxidant activity [28, 29]. For the effect of moringa extract on extending storage ability of guava fruits our results indicated that, moringa leaf extract success in delaying weight loss and decay percent beside high fruit acidity compared to the control. Which maintain fruit freshness during ripening stage. These results go in line with Shehabudheen *et al.* [8] as they find that moringa gum coating was successful in delaying guava fruit weight loss and maintaining high quality. The previous results are in line with Liamngee *et al.* [10] as they found that treating tomatoes fruits with moringa extracts extended their shelf life by four days compared to the control. The effects of moringa in improving postharvest quality and storability have been reported on many fruit species such as guava, papaya, avocado, tomato and plum [8, 19, 9, 20, 13, 31]. The effects of moringa may be attributes to their composition of bioactive compounds, such as vitamins (A, B1, B2, B3, C, E) beside carotenoids, phenolic acids and flavonoids [18]. Furthermore, moringa extracts improved fruit textural quality through decreasing reduce microbial growth ad respiration [20].

It could be concluded that, Gelatin at 8% was superior in maintaining high guava fruit quality during cold storage. Through decreasing fruit weight loss, decay percent and delaying ripening (low TSS and high vitamin C and titratable acidity).

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