

## Effects of different postharvest treatments on the physicochemical properties and shelf life of fresh-cut Mango and Guava

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### ABSTRACT

Fresh-cut fruits are susceptible to postharvest storage due to their rapid physiological, biochemical and microbial alterations. This study was carried out to evaluate the commercial and nutritional aspect of fresh-cut mango and guava at 0, 3, 6, and 9 days intervals at 4 °C with various treatments. The specimens were collected from the horticulture department of Bangladesh Agricultural Research Institute (BARI), Gazipur and analyzed for acidity, total soluble solids, vitamin-C, moisture, ash, microbial status and their overall storage stability. The baseline results indicated that the proximate composition of fresh mango was 85% moisture, 1.46% ash, 1.55% acidity, 8.5 °Brix total soluble solids (TSS), 0.93% fat, 0.59% protein and 27mg/100g vitamin-C while the guava had 91% moisture, 0.25% ash, 0.29% acidity, 7.5 °Brix TSS and 41.5 mg/100g vitamin-C. Under different storage conditions, moisture, acidity, and vitamin-C exhibited a considerable reduction, whereas TSS and microbial load markedly increased over time. Among different treatments, 40% sugar solution and 1.67% CMC solution showed high significance by increasing shelf life, conserving higher acidity and limiting microbial accumulation up to 6 days compared to the control. The findings suggest that sugar and CMC solution can be a potential method for preserving fresh-cut mango and guava fruits for short-term storage.

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## INTRODUCTION

The global demand for fresh-cut fruits have been significantly increased in recent decades, mainly driven by consumer convenience, accessibility, sensory appeals and changing dietary pattern. However, their perishable nature is considered to be one of the major challenges for postharvest managements, long term storage and retaining optimum nutritional status. Fresh-cut fruits undergo through a wide range of physiological and biochemical changes which accelerates the moisture loss, microbial growth, enzymatic disorder, lipid peroxidation, cell disruption and nutritional degradation, shortening their shelf life, limiting their availability and restrict their potential for large scale commercialization, particularly in tropical and subtropical regions (Iturralde *et al.*, 2022).

Bangladesh, blessed with fertile lands and convenient climatic conditions, has become a hotspot for diverse tropical and subtropical fruits that plays a significant role in nutritional security, livelihood development and strengthening the national economy. Among different fruits, mango and guava are two of the most popular fruits due to their tasty flavor and nutritional values. Mango (*Mangifera indica* L.) belongs to Anacardiaceae family and is termed as “king of fruits”, which is famous for its sensory appeals, great sources of Vitamin A, C and K, folate, choline, calories and antioxidants (Hussain *et al.*, 2021). On the other hand, guava is often referred as “poor man apple” because of its year-round availability, affordability and exceptional nutritional status including high percentage of Vitamin-C, dietary fiber, antioxidant, flavonoids, polyphenols, lycopene, anticancer properties with lower glycaemic index. In recent decades, Bangladesh has become a pioneer of world mango and guava production, ranking 8<sup>th</sup> in mango and 9<sup>th</sup> in guava production, cultivating almost 139,100 hectares of land in 2022 (WPR, 2025). Even though they have enormous potentials for food and nutritional security, postharvest losses are being considered to be the main limitations contributing to 20-44% losses in fruits and vegetables in every

year in Bangladesh, causing \$2.4 billion loss annually (Saha *et al.* 2025). This is largely caused by improper harvesting, inadequate handling, poor storage facilities and limited option of value addition.

Growing consumer demand for fresh-cut fruit highlights the need for consistent postharvest management practices that prolong marketability and reduce quality loss. However, there are substantial gaps in scientific knowledge on the dynamics of chemicals and shelf life, such as storage temperature, humidity, total soluble solids (TSS), ascorbic acids, and titratable acidity-all of which are reliable indicators of fruits freshness, flavour balance and nutritional quality. Most of the earlier research has focused on whole fruits or individual quality attributes, postharvest physiology and ripening kinetics having limited focus on fresh-cut fruits (minimally processed) especially under different storage intervals (Hossain *et al.*, 2020; Sivakumar and Fallik., 2013). Addressing these gaps in perspective of Bangladesh where fresh-cut fruit products are gaining consumer acceptability and triggering the economic growth is essential for reshaping economies and marketing policies.

Therefore, the present study was aimed to examine the chemical characteristics and shelf-life of fresh-cut mango and guava at different days of storage interval. Specifically, this research investigates temporal trends of TSS, vitamin-C, and ascorbic acid content, with a view to establishing deterioration trends and describing relative shelf-life under the storage conditions. The results will provide insights into species-specific postharvest management practices, packaging and storage treatment patterns and will help reduce postharvest loss while preserving nutritional and sensory quality of fresh-cut tropical fruits at local and international markets.

## MATERIALS AND METHODS

### Experimental site and duration

The experiment was conducted in the laboratory of Biochemistry and Central Laboratory of Sher-e-Bangla Agricultural University, Dhaka-1207, BARI and

Bangladesh Council of Scientific and Industrial Research during the period from January to June 2016.

### Plant materials and chemicals

The fruits (fresh mango and guava) were collected from the Horticulture Department of BARI, Gazipur. Fruits were cleaned and preserved in refrigerator (0-4 °C) until used for the chemical analysis. Sugar sample, potassium Meta bi-sulphate (KMS), carboxymethyl cellulose (CMC) was collected from EH & AgroVet Ltd., Dilshaj Mansion, Shymoli, Dhaka.

### Experimental setup (mango and guava)

Six different samples of mango and guava were used for storage studies at 0 to 4 °C in refrigerator from one to nine days. The effect of storage time (3, 6, 9 days) on moisture and chemical properties such as acidity, vitamin-C, total soluble solids (TSS), ash and microbial load were studied. A total of six treatments were applied to mango and guava cubes (1 inch × 1 inch, 70 g each) to evaluate the effect of storage duration (3, 6 and 9 days at 4 °C) on physiological changes and microbial dynamics. The cut sample were treated with sugar (20%, 40%) solution, KMS (0.1%, 0.01%) solution and coated with CMC solution. The treated samples were packed with Polyethylene paper and stored at 0-4 °C temperature. The following treatments combinations were used in this study.

- i. S<sub>1</sub>: Treated with 20% sugar solution,
- ii. S<sub>2</sub>: Treated with 40% sugar solution,
- iii. S<sub>3</sub>: Treated with 0.1% KMS solution,
- iv. S<sub>4</sub>: Treated with 0.01% KMS solution,
- v. S<sub>5</sub>: Treated with 1.67% CMC solution and
- vi. S<sub>6</sub>: Not Treated

All samples were incubated at (0-4) °C for 3, 6 and-9 day's intervals.

### Chemical analysis

The raw and processed samples were analyzed for their titratable acidity, total soluble solids (TSS), vitamin-C, moisture, ash and microbial analysis. All the determinations were done three times, and the results were expressed as mean value.

### Titratable acidity determination

Titratable acidity was determined by titrating the fruit extract against standard sodium hydroxide solution (0.1 N) using phenolphthalein as an indicator (AOAC, 2006).

Finally, the acidity of the sample was determined by the following equation:

$$\% \text{ acidity} = \frac{T \times N \times E \times V_1}{V_2 \times W \times 1000} \times 100$$

Where,

T= Titer value, N= Normality of NaOH, E= Equivalent weight of acid, V<sub>1</sub>= Volume made up, V<sub>2</sub>=Volume of the sample taken for titration, W= weight of sample.

### Total soluble solids (TSS) determination

The TSS of the sample was measured with refractometer (Model: HI 96801) and the results were expressed as °brix. Prior to each measurement, the refractometer was calibrated properly. Then the prism surface of the refractometer was wiped with soft tissue paper and few drops of sample juice were poured on the prism surface.

### Vitamin-C (ascorbic acid) Determination

Vitamin-C was measured by the reduction of 2-6 dichlorophenol indophenols dye titration method (AOAC, 2006). The results were expressed in mg ascorbic acid per 100 g fresh weight and calculated using the following formula:

$$\text{Vitamin - C (mg)} = \frac{T \times F \times V}{A \times W} \times 100$$

Where,

T = volume of titrate (ml), F = Dye factor (5), D = Total volume of extract (ml), A= Aliquot volume of extract (ml), W= Weight of sample (g)

### Determination of ash

Ranganna's approach (Ranganna, 1986) was used to gravimetrically measure the ash content of fruit samples. A specified amount of fruit material was boiled in a muffle furnace for a few hours at 300°C,

subsequently for an overnight period at 420 °C or for five to seven hours at 550 °C. After cooling in dryers, the material's ash was weighed. Until a steady mass was achieved, the heating, cooling, and weighing procedures were repeated. The ash content was measured as;

$$\% \text{ Ash} = \frac{W_3 - W_1}{W_2 - W_1} \times 100$$

Where,  $W_1$ = weight of crucible,  $W_2$ = weight of crucible + sample, and  $W_3$ = weight of crucible + ash

### Determination of moisture

Moisture content of fruits sample was determined by conventional method i.e., drying in an oven at 100° C for overnight. Empty aluminum moisture dish was weighted ( $w_1$ ) and 2.5 g sample was taken in a moisture dish and weighted ( $w_2$ ). The sample was spread evenly and placed without lid in oven and dried samples overnight at 100° C. The dishes were transferred to desiccators to cool. Aluminum dish was weighed after cooling ( $w_3$ ) and the % ash was calculated by following formula;

$$\% \text{ Ash} = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

Where,  $W_1$ = Weight of dish,  $W_2$ = Weight of dish + Fresh sample, and  $W_3$ = Weight of dish + dried sample

### Determination of total viable bacteria

For total viable count of microorganism present in the samples (mango, guava), standard pour plate method was followed according to the method described in "Recommended method for the microbiological examination of food" (Ali, 2008). Serial dilutions ( $10^{-1}$ - $10^{-6}$ ) was done for each sample with sterilized distilled water and placed on growth plate. After that the samples were incubated in growth chamber at 36 °C for 24 h. Colonies were counted with the aid of a magnifying glass and finally the total number of bacteria per gram of sample was calculated by the following equation:

Colony count (per ml) =Number of colonies (per plate) × Reciprocal of the dilution.

### Statistical analysis

The recorded data for each character from the experiments was analyzed statistically to find out the variation resulting from experimental treatments using MSTAT-C package program. The mean for all the treatments were calculated and analysis of variance of characters under the study was performed by F variance test. The mean differences were evaluated by Least Significance Difference test (Gomez and Gomez, 1984).

## RESULTS

### Moisture content of mango and guava

The experimental results show that moisture content of all sample decreases over the time. Moisture content of food (fruit) items is very essential for the health of human as well as for all living organisms. From the results, it was found that the moisture content of the samples was decreased over the time (Table 1).

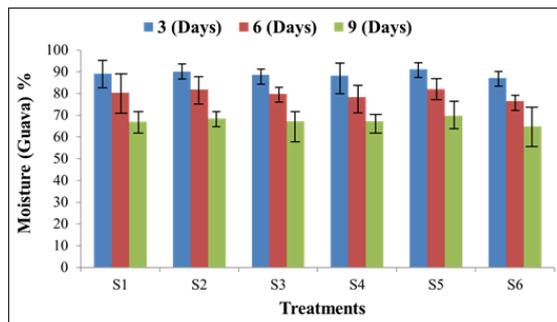
**Table 1.** Moisture content of mango at different days of interval

Sample/ Treatments	Moisture (%)		
	3 (Days)	6 (Days)	9 (Days)
$S_1$	84.10±1.54ab	75.8±1.57bc	66.00±0.93b
$S_2$	85.20±1.19a	77.9±1.93ab	67.90±1.37a
$S_3$	83.80±2.30bc	75.5±2.53c	65.20±1.24bc
$S_4$	82.70±3.91c	74.5±1.14c	63.90±3.44c
$S_5$	85.40±1.21a	78.1±1.64a	68.80±1.74a
$S_6$	80.90±2.91d	73.8±1.44c	61.20±2.11d
LSD (0.05)	1.419	2.208	1.802
CV (%)	0.81	1.51	1.42

Values with similar letter(s) are statistically identical and those having different letter(s) differ significantly at 0.05 level of significance

Moisture content (%) of mango was significantly influenced by different samples at 3, 6 and 9 days of interval. In case of mango, the lowest moisture contents (80.90, 73.8, and 61.20 %, respectively) were found for sample  $S_6$  (control sample) after 3, 6 and 9 days of interval. The highest values (81.40, 74.1, and 64.90 %, respectively) of moisture were observed for the sample  $S_5$  in 1.67% CMC solution sample after 3, 6 and 9 days of interval.

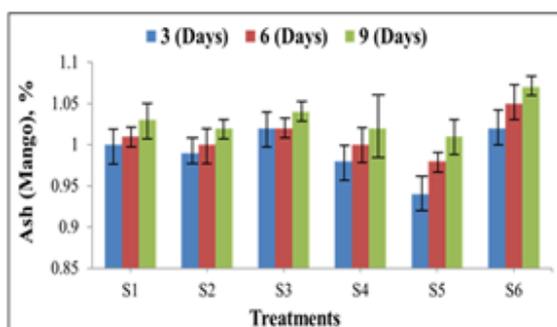
The moisture content (%) of guava was significantly influenced by different sample at 3, 6 and 9 days of interval. The lowest moisture percentages (87.10, 76.57, and 69.80 %, respectively) were found in S<sub>6</sub> sample at control treatment after 3, 6 and 9 days of interval. The highest percentage of moisture (91.10, 82.00, and 69.80 %, respectively) was observed in S<sub>5</sub> at 1.67% CMC sample solution after 3, 6 and 9 days of interval (Fig. 1).



**Fig. 1.** Moisture content of guava at different days of interval

#### Ash content of mango and guava

It was observed from our experiment that the ash content of all sample increases over the period. Ash content (%) of mango was significantly influenced in different samples after 3, 6 and 9 days of interval (Fig. 2). In case of mango, the lowest percentage of ash value (0.94, 0.98, and 1.01 %, respectively) was found in sample S<sub>5</sub> with 1.67% CMC sample solution after 3, 6 and 9 days of interval. The highest values (1.02, 1.05, and 1.07 %, respectively) of ash were observed in sample S<sub>6</sub> in control treatment after 3, 6 and 9 days interval.



**Fig. 2.** Ash content of mango at different days of interval

The ash content (%) of guava was also significantly influenced in different sample at 3, 6 and 9 days of

intervals (Table 2). In case of guava the lowest percentages (0.21, 0.23, and 0.23 %, respectively) of ash content were found in S<sub>2</sub> sample at 40% sugar solution after 3, 6 and 9 days of interval. The highest percentages of ash (0.25, 0.29, and 0.30 %, respectively) were observed in S<sub>6</sub> at control treatment after 3, 6 and 9 days of interval. These results were similar to the result of Ara *et al.* (2014) who reported that mango's ash content varies between 0.17-0.80 %, whereas in another experiment Joshi *et al.* (2018) showed ash content of guava ranges from 0.57-0.85 %. Our measured values (0.21-0.30 %) were lower, likely due to varietal differences or methodological differences.

**Table 2.** Ash content of guava at different days of interval

Sample/ Treatments	Ash (%)		
	3 (Days)	6 (Days)	9 (Days)
S <sub>1</sub>	0.22±0.05bc	0.24±0.01cd	0.25±0.01bc
S <sub>2</sub>	0.21±0.02c	0.23±0.04d	0.23±0.01c
S <sub>3</sub>	0.23±0.02abc	0.24±0.03cd	0.25±0.04bc
S <sub>4</sub>	0.24±0.01ab	0.26±0.06b	0.27±0.07ab
S <sub>5</sub>	0.22±0.04bc	0.25±0.02bc	0.25±0.09bc
S <sub>6</sub>	0.25±0.03a	0.29±0.09a	0.30±0.10a
LSD (0.05)	0.015	0.162	0.022
CV (%)	6.28	4.38	5.6

Values with similar letter(s) are statistically identical and those having different letter(s) differ significantly at 0.05 level of significance

#### Total soluble solid content of mango and guava

TSS content of fresh cut fruits depends on many factors, such as temperature, humidity, storage condition etc. It was observed that the TSS is increased over the time (Table 3). In mango, the lowest value of TSS (8.9, 10.9, and 13.5, respectively) was recorded in 0.01% KMS solution sample (S<sub>4</sub>) at 3, 6 and 9 days, whereas the highest value of TSS (10.2, 13.3, and 15.87, respectively) was recorded in 40% sugar solution sample (S<sub>2</sub>).

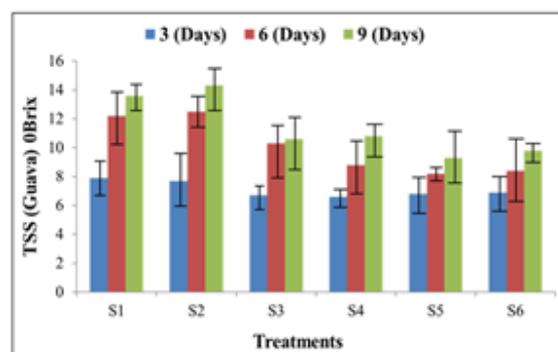
In guava the lowest value (6.6) of TSS was found in S<sub>4</sub> treatment which was statistically similar with rest of the treatment except S<sub>1</sub> and S<sub>2</sub>, whereas the highest value (7.9) of TSS was found in S<sub>1</sub> treatment which was statistically similar with S<sub>2</sub> treatment at 3 days of

interval (Fig. 3). At 6 and 9 days of interval the minimum value (8.2 and 9.3 respectively) of TSS was found in S<sub>5</sub> treatment which was statistically similar with S<sub>4</sub> and S<sub>6</sub> whereas the maximum value (12.5, and 14.3, respectively) of TSS was found in S<sub>2</sub> treatment.

**Table 3.** TSS (°Brix) content of mango at different days of interval

Sample/ Treatments	TSS °Brix		
	3 (Days)	6 (Days)	9 (Days)
S <sub>1</sub>	9.9±1.04ab	11.9±0.59bc	14.4±1.20c
S <sub>2</sub>	10.2±1.54a	13.3±0.97a	15.87±1.91a
S <sub>3</sub>	9.2±1.74bc	12.3±1.29b	14.7±1.03b
S <sub>4</sub>	8.9±0.58c	10.9±1.37d	13.5±1.20e
S <sub>5</sub>	9.0±1.54c	11.2±0.84cd	14.13±2.14d
S <sub>6</sub>	9.5±0.59abc	11.8±0.92bcd	14.2±1.34cd
LSD (0.05)	0.776	0.831	0.107
CV (%)	4.51	3.77	0.75

Values with similar letter(s) are statistically identical and those having different letter(s) differ significantly at 0.05 level of significance



**Fig. 3.** TSS (°Brix) content of guava at different days of interval.

#### Acidity content of mango and guava

The acidity (%) of mango was significantly influenced by different sample at 3 and 9 days of interval and not influenced at 6 days of interval (Table 4). In case of mango, the lowest value (1.14, 0.88, and 0.38 %, respectively) of acidity was found for sample S<sub>5</sub> in CMC solution after 3, 6 and 9 days which was statistically similar with S<sub>3</sub> (1.15, 0.88, and 0.38 %, respectively).

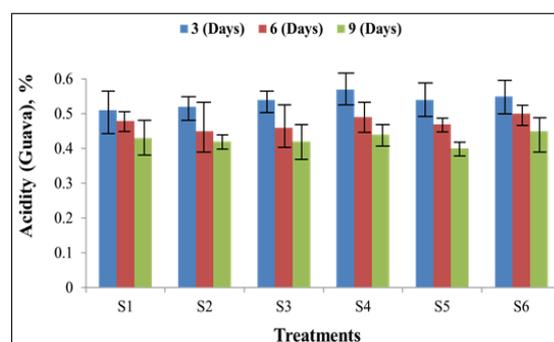
The highest value (1.18, 0.89 and 0.42 respectively) of acidity was observed at sample S<sub>6</sub> in control sample which was statistically similar with S<sub>4</sub> (1.17, 0.89, and 0.41 %, respectively) after 3, 6 and 9-days interval.

The acidity (%) of guava was not significantly influenced by different sample at 3, 6 and 9 days after treatment (Fig. 4). The lowest value (0.51 %) of acidity was found in S<sub>1</sub> at 20% sugar solution sample after 3 days, the minimum value of acidity (0.45, and 0.40 %, respectively) was found in S<sub>2</sub> and S<sub>3</sub> at after 6 and 9 days of interval respectively. The highest value (0.55, 0.50, and 0.45 %, respectively) was observed in S<sub>6</sub> at control treatment after 3, 6 and-9 days of interval.

**Table 4.** Acidity content of mango at different days of interval

Treatments	Acidity (%)		
	3 (Days)	6 (Days)	9 (Days)
S <sub>1</sub>	1.16±0.73bc	0.87±0.03b	0.40±0.03c
S <sub>2</sub>	1.16±0.33bc	0.88±0.02ab	0.39±0.01cd
S <sub>3</sub>	1.15±0.79cd	0.88±0.01ab	0.38±0.02d
S <sub>4</sub>	1.17±0.82ab	0.89±0.03a	0.41±0.03ab
S <sub>5</sub>	1.14±0.08d	0.88±0.04ab	0.38±0.03d
S <sub>6</sub>	1.18±0.57a	0.89±0.03a	0.42±0.01a
LSD (0.05)	0.161	0.125	0.118
CV (%)	6.24	7.22	6.11

Values with similar letter(s) are statistically identical and those having different letter(s) differ significantly at 0.05 level of significance

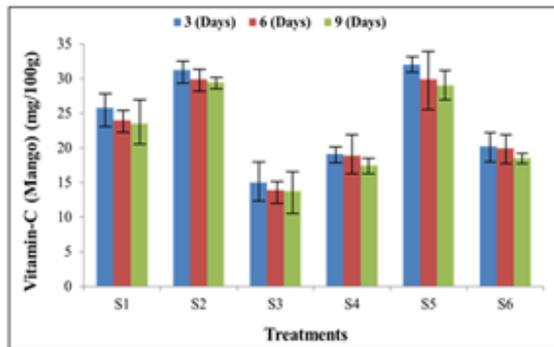


**Fig. 4.** Acidity content of guava at different days of interval

#### Vitamin-C content of mango and guava

Vitamin-C value is defined as milligrams of vitamin-C per 100 grams of sample. From the experimental results, it was seen that this content of the samples decreased over the time (Fig. 5). Vitamin-C content (mg/100g) of mango was significantly influenced by different sample after 3, 6 and 9 days of interval. In case of mango, the minimum value (15, 13.90, and 13.75 mg/100g, respectively) of vitamin-C was found

in treatment S3 in 0.1% KMS solution sample after 3, 6 and 9 days.



**Fig. 5.** Vitamin-C content of mango at different days of interval

The maximum value (32, 29.90, and 29.50 mg/100g, respectively) of vitamin-C was observed at sample S5 in 1.67% CMC solution sample which was statistically similar with S2 (31.25, 29.90, and 29.00 mg/100g, respectively) after 3, 6 and 9 days of interval.

**Table 5.** Vitamin-C content of guava at different days of interval

Treatments	Vitamin-C (mg/100g)		
	3 (Days)	6 (Days)	9 (Days)
S <sub>1</sub>	48.90±2.05a	47.40±2.61bc	46.20±3.20b
S <sub>2</sub>	49.10±4.19a	49.00±6.23a	45.80±2.84b
S <sub>3</sub>	41.80±2.35c	41.20±1.95e	40.20±3.61d
S <sub>4</sub>	45.00±3.05b	44.80±1.92d	43.50±1.57c
S <sub>5</sub>	49.10±5.01a	48.90±3.28ab	46.13±2.55b
S <sub>6</sub>	49.20±5.63a	46.10±2.79cd	47.80±4.11a
LSD <sub>(0.05)</sub>	1.853	1.605	1.276
CV (%)	3.86	3.47	3.81

Values with similar letter(s) are statistically identical and those having different letter(s) differ significantly at 0.05 level of significance

The vitamin-C content (mg/100g) of guava was significantly influenced by different sample at 3, 6 and 9 days of interval (Table 5). The lowest values (41.80, 41.20, and 40.20 mg/100g, respectively) of vitamin-C was found in S<sub>3</sub> samples at 0.1% KMS solution after 3, 6 and 9 days of interval. The highest value (49.20, and 47.80 mg/100g respectively) was observed in S<sub>6</sub> control samples after 3 and 9 days of interval and at after 3 days interval the maximum amount of vitamin-C (49.00 mg/100g) was found at S<sub>2</sub> in 40% sugar solution which is statistically similar with S<sub>5</sub>.

### Microbial load content of mango and guava

Microbial load or microbial colony formation is very harmful for the shelf-life as well as nutritional composition of food product. From the experimental results, it was observed that the microbial load content of the samples increased over the time (Table 6). Microbial load of mango was significantly influenced by different sample after 3, 6 and 9 days of interval. In mango, the lowest amount of microbial load ( $2.3 \times 10^3$ ,  $2.6 \times 10^3$ , and  $2.6 \times 10^3$  cfu/ml, respectively) was found in S<sub>3</sub> samples in 0.1% KMS solution after 3, 6 and 9 days of interval. The highest microbial loads ( $3.0 \times 10^4$ ,  $3.2 \times 10^4$ , and  $3.2 \times 10^4$  cfu/ml, respectively) were observed at sample S<sub>6</sub> in control treatment after 3, 6 and 9 days of interval.

**Table 6.** Microbial load content of mango at different days of interval

Sample/ Treatments	Microbial load (cfu/ml)		
	3 (Days)	6 (Days)	9 (Days)
S <sub>1</sub>	$2.6 \times 10^4 \pm 0.01b$	$2.7 \times 10^4 \pm 0.36b$	$3.2 \times 10^4 \pm 0.71a$
S <sub>2</sub>	$3.0 \times 10^3 \pm 0.03c$	$3.2 \times 10^3 \pm 0.37d$	$3.4 \times 10^3 \pm 0.91b$
S <sub>3</sub>	$2.3 \times 10^3 \pm 0.31d$	$2.6 \times 10^3 \pm 0.03d$	$2.6 \times 10^3 \pm 0.21c$
S <sub>4</sub>	$2.5 \times 10^4 \pm 0.53b$	$2.6 \times 10^4 \pm 0.11c$	$2.7 \times 10^4 \pm 0.41a$
S <sub>5</sub>	$2.5 \times 10^3 \pm 0.70c$	$3.2 \times 10^3 \pm 0.31d$	$3.2 \times 10^3 \pm 0.72b$
S <sub>6</sub>	$3.0 \times 10^4 \pm 0.83a$	$3.2 \times 10^4 \pm 0.23a$	$3.2 \times 10^4 \pm 0.63a$
LSD <sub>(0.05)</sub>	1606	8042	1261
CV (%)	5.13	5.14	4.57

Values with similar letter(s) are statistically identical and those having different letter(s) differ significantly at 0.05 level of significance

**Table 7.** Microbial load content of guava at different days of interval

Sample/ Treatments	Microbial load (cfu/ml)		
	3 (Days)	6 (Days)	9 (Days)
S <sub>1</sub>	$2.7 \times 10^4b$	$2.9 \times 10^4b$	$3.2 \times 10^4b$
S <sub>2</sub>	$3.4 \times 10^3c$	$3.6 \times 10^3c$	$3.6 \times 10^3cd$
S <sub>3</sub>	$2.4 \times 10^3d$	$2.8 \times 10^3d$	$3.4 \times 10^3d$
S <sub>4</sub>	$2.8 \times 10^3cd$	$3.1 \times 10^3cd$	$3.6 \times 10^3cd$
S <sub>5</sub>	$3.0 \times 10^3cd$	$3.3 \times 10^3c$	$3.8 \times 10^3c$
S <sub>6</sub>	$3.4 \times 10^4a$	$3.6 \times 10^4a$	$4.2 \times 10^4a$
LSD <sub>(0.05)</sub>	177.9	8790	1385
CV (%)	3.77	8.58	2.55

Values with similar letter(s) are statistically identical and those having different letter(s) differ significantly at 0.05 level of significance

The microbial load content of guava was significantly influenced by different sample at 3, 6 and 9 days of interval (Table 7). The lowest microbial loads in guava

( $2.4 \times 10^3$ ,  $2.8 \times 10^3$ , and  $3.4 \times 10^3$  cfu/ml, respectively) were found in sample S3 in 0.1% KMS solution after 3, 6 and 9 days of interval.

The highest microbial loads ( $3.4 \times 10^4$ ,  $3.6 \times 10^4$ , and  $4.2 \times 10^4$  cfu/ml, respectively) were observed at S6 in no treatment after 3, 6 and 9 days of interval.

## DISCUSSION

This study revealed the significance of changes of the physiological and chemical properties of fresh cut fruit mango and guava during storage. The moisture content was consistently decreased over the period, which is common phenomena in harvested produces. This can be attributed to water loss through respiration and transpiration that reduce weight, appearance, shelf-life and market availability by shriveling the fruit surface. Similar findings were reported by Wilson *et al.* (2019), who reported that when fruits are processed minimally, the tissue becomes softer and respire more water quickly leading to water and weight loss. However, the samples were treated with 1.67% CMC sample solution showed significant reduction in water loss after 3, 6 and 9 days of interval, as the CMC solution creates a semi permeable barrier interfering with vapor mechanism and delays dehydration. The efficacy of this method has also been confirmed by several previous studies in maintaining freshness of mango and guava (Marín *et al.*, 2020; Ali *et al.*, 2022).

The TSS was gradually increased during initial storage days following by downward trends. This is largely due to the breakdown of starch content into simple sugar format and enhancing sweetness. According to the observations, the initial TSS varies between 7.9-13.60 °Brix, whereas in later days measured between 6.9-9.80 °Brix. This result was similar with Baloch and Bibi (2012), who found that the TSS was increased with the ripening process reaching apex in high storage temperature, irrespective of sample/variety of the fruit. This rising can be attributed to several enzymatic activities including amylase, invertase and sucrose synthase in converting carbohydrates into simple sugars (glucose,

fructose and sucrose). This conversion is also considered to be one of the important indexes of ripening process in mango and other climacteric fruit (Doreyappy-Gowda and Huddar, 2001).

In term of Vitamin-C, there was a gradual declining trend for cut fruits with storage intervals. This is mostly due to the ascorbic acid oxidase enzyme activity, resulting the deformation of the Vitamin-C structure in unstable format dehydroascorbic acid, which further degrades quickly (Giannakourou & Taoukis, 2021). Moreover, ascorbic acid loss significantly impacted by the ambient storage temperature. This can be credited to quick responses of certain amount of acid concentrations with dissolve oxygen, enhancing respiration, acid oxidation and enzymatic reactions. Kabasakalis *et al.* (2000) reported that fruits stored in room temperature loss 29-41% of ascorbic acid within 4 months. In the current investigation, fruits treated with 1.67% CMC solution shown much less deterioration over time, while untreated guavas revealed a rapid decline in ascorbic acid content. This could be explained by the coating's capacity to restrict oxygen absorption, which lowers ascorbic acid's oxidative breakdown and helps maintain its concentration over time (Maqbool *et al.* 2011; Pham *et al.* 2023).

Microbial load is a critical factor to determine prolongs shelf life and freshness of cut fruits. The present study revealed progressive increase in microbial intensity during the storage time, mainly due to environmental exposure of cut surface and nutrients leakage, making an ideal environment for microbe's habitats. Similar findings were reported for guava by Jideani *et al.* (2017). Mango showed higher intensity of microbial growth due to presence of high sugar content, while guava phenolic compounds and ascorbic acid may have provided resistance to microbial growth and development (Rahim *et al.*, 2010). However, edible coating of fruits plays a crucial role to prevent microbial colonization, developing a protective coating surrounding the fruits. The study showed that without coating, microbial load was  $3.2 \times 10^4$  cfu/ml while 1.67% CMC

treated fruits showed  $3.2 \times 10^3$  cfu/ml and fruits treated with 0.1% KMS solution displayed  $2.6 \times 10^3$  cfu/ml at 9 days storage interval in mango. Similar findings were reported by Singh *et al.* (2005) in mango bar and Kalsi (2002) in guava pulp.

Acidity of fruits is very crucial as it regulate the taste, shelf life, microbial growth and nutritional status of fresh cut fruits. Present study showed remarkable declining in acidity percentage of fruits in different storage interval. In case of mango, a gradual decline was noticed with increasing storage duration. This reduction is mainly caused by the breakdown of organic acid into phenolic compounds and using as respiratory substrate for fruit senescence's. Also, different enzymatic activities including dehydrogenase and citrate lyase and microbial activity significantly decrease acid content in mango. These findings are closely aligned with Islam *et al.* (2013), who reported that citric and malic acid are used as respiratory substances and significantly decreased the shelf life of mango. For guava similar trends was identified although the rate was lower than mango. This is because of having high ascorbic acid and phenolic compounds in guava, which helps decrease enzymatic and microbial activity. Moreover, Hanani *et al.* (2023) and Ali *et al.* (2022) demonstrated that edible coating of fresh cut fruits significantly retained titratable acidity when stored at 4°C compared to untreated samples.

## CONCLUSION

This study reveals that the physiochemical properties of fresh mango and guava were largely controlled by the treatments. Coating with 1.67% CMC solution and immersion in 40% sugar solution were the most effective to reduce moisture loss, controlling microbial load and preserving the Vitamin-C in treated specimens. These treatments significantly maintain the acceptable quality of fruits under refrigerated condition up to 6 days, highlighting the potentialities of minimizing post-harvest losses of minimally processed fruits while maintaining qualities for consumer satisfaction. Thus, this study proposes cost-effective methods to preserve the

nutritional and sensory quality of fresh cut mango and guava increasing their shelf life and marketability.

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